

Field Production

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Hail Damage Recovery on Ornamental Trees

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Key words: *Acer rubrum* L. 'Franksred', *Pyrus calleryana* Decne. 'Cleveland Select', *Prunus cerasifera* Ehrh., *Crataegus viridis* L. 'Winter King', and *Cornus florida* L. 'Cherokee Princess'

Significance to Industry: It is not uncommon for hail to damage nursery crops in the Southeastern US. The period of time for hail wounds to heal on various woody ornamental genera is unknown. Holding trees until wounds are healed presents other problems such as preventing disease and insect pressure due to the open wounds, as well as harvesting and marketing larger plant material. Growing plants for additional years will likely produce larger stock than the market wants or larger in size than a nursery typically handles. In this test, the wounds started healing during the first growing season after the hail event; however, on most of the trunk wounds, lesions did not completely heal over until the 3rd growing season after damage occurred. At the end of the 4th growing season, obvious evidence from hail damage was still visible on the trunk and shoots of the plants. Though healing occurred on most wounds caused by the hail, these plants are still unmarketable in the nursery and landscape industry.

Nature of Work: The severity of hail damage can vary with the size of the hail, wind speed, duration of the event and the growth stage of the crop. Damage incurred early in the season can crush and kill cells and cause subsurface damage that is not easily detected. When the cambium is unharmed, wounds may close over during the same growing season or bruised tissue may split as the healing occurs. If the duration of the hail event was long with large hail, the wounds in the bark may be open and ragged-edged (4) with the wood (xylem) exposed. Compartmentalization of the hail damaged area can be visible with callous tissue, but wounds may still remain exposed for more than one growing season.

Damage from hail can result in losses ranging from minor, to reduced growth and reduced quality, to complete devastation. The open wounds and stress may invite an increased incidence of insect and disease problems (increasing pesticide costs and lowering quality). Hail damage is easily recognized immediately after it occurs, but becomes less noticeable with time. Telltale evidence of hail damage will persist on long-lived tissues for many years, and may show indications of secondary infections in the old wounds (4).

Zwolinski and Wingfield (5) reported a high incidence of insect and disease pressure on *Pinus radiata* following hail damage. The influence of hail damage on Japanese pear 'KOUSUI' trees resulted in fewer shoots that were shorter in length and ended elongation sooner than undamaged trees with inferior fruit size and a significantly longer number of flower buds per branch, compared to undamaged trees (3). Plants in the *Rosaceae* family can result in greater losses due to twig canker fungi and bacterial fireblight entry into the wounds (1). *Botryosphaeria* canker, from an opportunistic fungus, infects stressed plants through existing openings caused by winter injury, improper pruning, wind, and hail damage (2).

On 7 Apr 2006, widespread hail storms hit many areas of Warren County, TN and caused significant damage on many acres of ornamental nursery crops. Some trees suffered small lesions while trees in other areas of the county suffered numerous large wounds on the trunks and main branches. The hail often stripped the bark exposing wood on all sides of the plants. Frequently wounds from hail damage are only found on one side of the plant, however, during this event, damage was incurred on all sides of the plant. Plants were just beginning to leaf out and most buds were unfurled.

At the time of this hail event, there were approximately 16 insurance companies capable of issuing crop insurance policies that were underwritten by the USDA Risk Management Agency (RMA). Very few crop adjustors had knowledge of woody ornamental plants or were familiar with nursery production. Because the nursery crops were not killed by hail, the insurance companies and RMA determined the crops could be rehabilitated with one to two years of additional time in the field. Suggestions were made by RMA if nursery crops could not be sold in traditional markets due to scars that remained after the wounds healed then producers should find markets such as for firewood, thus rendering plants marketable.

The objective of this research was to monitor recovery from hail damage on shoots and trunks of select ornamental trees. Three trees each of *Acer rubrum* L. 'Franksred', *Pyrus calleryana* Decne. 'Cleveland Select', *Prunus cerasifera* Ehrh., *Crataegus viridis* L. 'Winter King', and *Cornus florida* L. 'Cherokee Princess' were obtained as B&B from a Warren County nursery soon after the April, 2006 hail storm occurred, and were planted in a single row 10 ft apart, in a field plot with Waynesboro silt loam soil at the Nursery Research Center in McMinnville, TN.

On 1 May 2006, hail damage lesions were counted on each plant and 3 lesions (mainly on the trunk) were numbered with a paint marker to ensure identification of the same lesion throughout the test. All plants had greater than 15 lesions, with lesions averaging about 0.5-inch at the widest point and 1.2-inch at the longest point. Monthly photographs were made during 2006, 2007, 2008 and 2009 to show a visual progression of bark healing from the damage area. No destructive analyses of the hail damage lesions were made.

Plants were irrigated as needed with drip irrigation during the duration of the 4-year test. Weed control was maintained with biannual applications of pre- and postemergence herbicides. Plot fertility applications made in spring of 2007, 2008, and 2009 were based on results from annual soil tests. Tree height and trunk diameter (measured 6-inch above the soil line) was measured at planting and on 1 Nov 2006, 5 Dec 2007, 7 Nov 2008, and 9 Nov 2009. The experimental design was a random planting with three single plant replications of each species.

Results and Discussion: Lesions incurred from the hail storm healed slowly on all genera (Figs. 1, 2, 3, 4 and 5). Some lesions on the main trunks had exposed wood immediately after the hail storm, but during the first growing season callous tissue formed around the wound perimeters. One of the 'Franksred' maples was attacked by flatheaded appletree borer during the first growing season (2006). The tree did not die, but after 4 years, bark disfigurement is evident on the trunk.

All three 'Cleveland Select' pears suffered from fireblight infection, and during the second growing season, one had major dieback of the terminal. Most canopy branches exhibit rough bark indicative of cankers formed from fireblight infection.

In light of the stress induced with the excessive number of hail lesions, height and trunk diameter growth (Table 1) during the 4-year period was considered somewhat normal for transplanted B&B nursery stock. The authors have observed that the growth of many genera of ornamental trees and fast growing trees (such as maple and pear) average about 0.7-inch trunk diameter and 2-3 feet of height growth annually. Moderate growing trees such as hawthorn and ornamental plums average about 0.5-inch trunk diameter with 1.5-2 feet height growth annually. Slower growing trees like dogwood generally increase trunk diameter about 0.3-inch annually with 1-1.5 feet of height growth. The field plot was maintained to reduce soil moisture stress and nutrition was adequate.

Regardless of the transplantability and growth of the trees after the hail storm, it remains questionable whether these trees should or can be marketed by the industry. The hail damaged areas have wound closure but obvious scar tissue is present on the trunk and branches. Though destructive measurements were not made to determine the extent of the hail damage into the cambium area, these trees may have weakened tissue as a result of the slow wound closure.

Producers must determine the extent of damage, in terms of leaf loss or physical damage to the trunk and branches. Hail damage is easily recognized immediately after it occurs and evidence may persist for many years. If hail damage is minimal and growth conditions are favorable following a hail event, wound closure and scarring may be miniscule; however, damage can result in increased disease incidence or insect

pressure and a reduction in leaf area. Telltale evidence of hail damage persisted on trunks and main branches for at least four years in this test and still shows indications of secondary infections in the old wounds and trunk scars from borer attack. Though healing as occurred on most wounds caused by the hail, these plants are considered unmarketable in the nursery and landscape industry.

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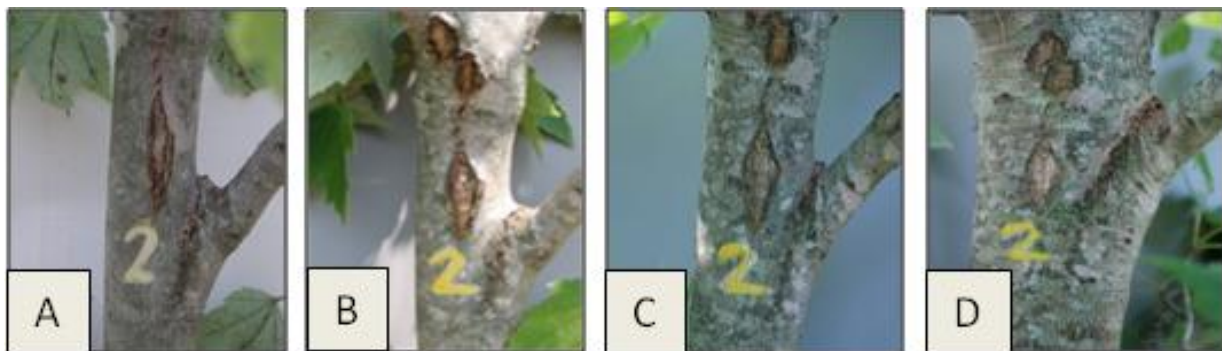


Fig. 1. Hail damage wounds on *Acer rubrum* 'Franksred' photographed A. one month after hail storm, May 06; B. one year after hail storm, Jun 07; C. two years after hail storm, Jun 08; D. three years after hail storm, Aug 09.

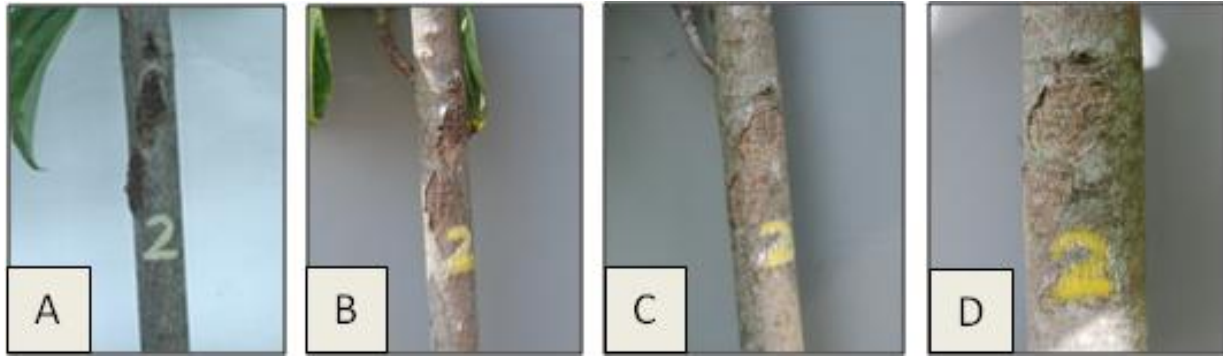


Fig. 2. Hail damage wounds on *Cornus florida* 'Cherokee Princess'. A. one month after hail storm, May 06; B. one year after hail storm, Jun 07; C. two years after hail storm, Jun 08; D. three years after hail storm, Aug 09.



Fig. 3. Hail damage wounds on *Crataegus viridis* L. 'Winter King' photographed A. one month after hail storm, May 06; B. one year after hail storm, Jun 07; C. two years after hail storm, Jun 08; D. three years after hail storm, Aug 09.



Fig. 4. Hail damage wounds on *Prunus cerasifera* photographed A. one month after hail storm, May 06; B. one year after hail storm, Jun 07; C. two years after hail storm, Jun 08; D. three years after hail storm, Aug 09.

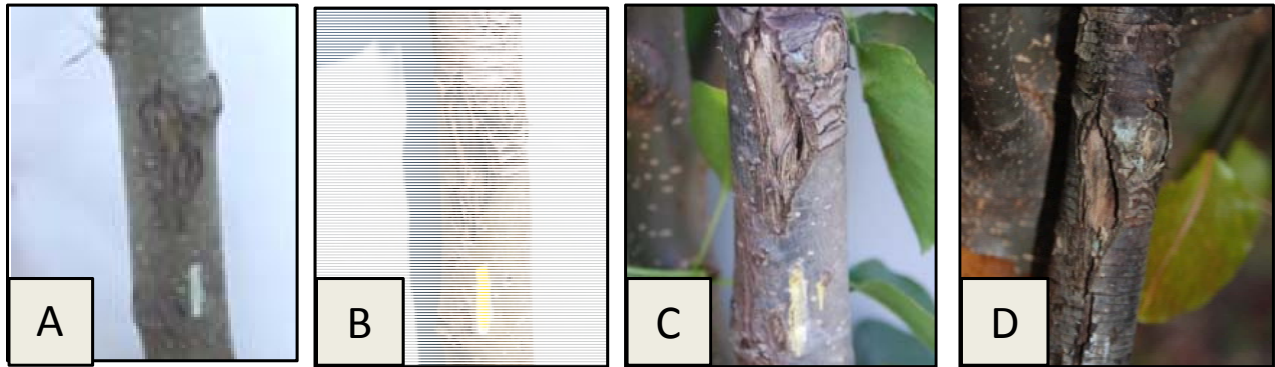


Fig. 5. Hail damage wounds on *Pyrus calleryana* 'Cleveland Select' photographed A. one month after hail storm, May 06; B. one year after hail storm, Jun 07; C. two years after hail storm, Jun 08; D. three years after hail storm, Aug 09.

Table 1. Initial size measurements and mean growth increase in height and trunk diameter during a 4-year evaluation of hail damaged trees.

Ornamental tree	Initial height, cm ^Z	Initial trunk diameter, mm ^Z	Annual Height Growth, cm ^Y				Annual Trunk Diameter Growth, mm ^Y			
			2006	2007	2008	2009	2006	2007	2008	2009
'Franksred' maple	326	40.1	18	64	100	120	3.6	8.7	23.9	12.1
'Cleveland Select' pear	261	34.3	36	10	128	130	5.6	11.9	20.6	19.8
Purple leaf plum	245	30.7	40	73	73	78	6.3	10.6	16.2	13.4
'Winter King' hawthorn	312	34.2	1	10	55	89	5.2	9.9	12.7	17.6
'Cherokee Princess' dogwood	217	34.3	10	24	85	29	3.3	4.9	12.4	12.1

^ZInitial height and trunk diameter at planting, May 2006.

^Y Height and trunk diameter were measured on 15 Nov 2006, 19 Oct 2007, 10 Nov 2008 and 1 Nov 2009. The annual height and trunk diameter growth for 2006, 2007, 2008, and 2009 was the difference between Dec 2007 and Nov 2006, Dec 2007 and Nov 2008, and Nov 2009 and Nov 2008, respectively.