MATERIALS FOR POTENTIAL USE IN SUNSCALD PREVENTION[1,2]

by Margaret Litzow and Harold Pellett

Abstract. Sunscald is a major problem on many shade trees during winters when wide daily temperature fluctuations occur. Various protective materials were tested to determine their effectiveness in preventing rapid temperature changes under alternating sunny and shady conditions. Foylon 7018 and Ross TreeGards were significantly better than the control in preventing a drop in cambial temperature 15-19 minutes after shading.

Sunscald is a major problem on many shade trees grown in Northern areas. It has been reported on maples, basswood, boxelder, black walnut (10), birch, balsam fir, Douglas fir, Eastern white pine, and spruce as well as many fruit trees (15). Damage usually occurs on the south or southwest sides of thin-barked trees and is characterized by dead bark that sloughs off exposing areas of dead sapwood.

Although the exact causes of sunscald are not well defined, winters where there are rapid and wide temperature fluctuations often produce considerable damage (3, 8, 24). Baier and Bohlmann (2) suggested that the overheating of the bark by the sun and repeated freezing of the cambium and wood causes sunscald. Huberman (15), after monitoring cambial temperatures of Eastern white pine (*Pinus strobus* L.), concluded that rapid freezing of tissues after they have been unseasonably warmed by the sun causes sunscald. Injury on black walnut was reported after temperatures for two days in January reached 16°C followed by several days with temperatures as low as -14°C and in February when several weeks with temperatures as high as 27°C was followed by -11°C (5).

Savage (22) compared rates of temperature drop in peach bark originally heated to 35°C. A temperature rate drop of 9.5°C per hour lowered to -8.3°C caused much more severe injury than the slower rate of 2.8 - 3.4°C per hour lowered to -14°C. Harvey (12) measured cambial temperatures on an Antonovka apple tree and concluded that killing from sunscald was often seen on surfaces that are exposed at right angles to the sun's rays and that the cambium showed a small temperature lag when exposed to different temperatures. Clouds that obscure the sun for a few minutes will cause the bark to freeze if the air temperature is sufficiently low. As the cloud passes, the cambium will warm up and in one case Harvey (12) reported the cambial temperature of a black plum limb rose 10°C within three minutes. He also found that the cambium in trees with thick bark shows a greater temperature lag than those with thin bark. Eggert (7) monitored the cambial temperature variations on the north and south sides of 16.4 cm diameter peach and 28.9 diameter apple trees from December to March. The highest temperature recorded on the south side of a peach tree was 30°C at which time the air temperature was just below freezing. Peach cambial temperatures of 16°C or higher were recorded on 18 of the 90 days. Cambial temperature differences between the north and south sides were as high as 28 to 31°C in the peach tree trunks and 17 to 20°C in the apple tree trunks.

Other factors reported to affect occurrence and degree of sunscald injury include: cultivar (6, 21), size and age of the tree (5, 6, 8, 12, 15, 20, 21, 22), drought (20, 23), high N rates, root frost damage and/or application of greasy substances or plastic wrappings for protection against rodents

[1]Scientific Journal Series Paper No. 12297 of the Minnesota Agricultural Experiment Station, St. Paul, MN. Mention of a trademark, proprietary product, or vendor does not constitute a guarantee or warranty by the University of Minnesota and does not imply approval of it to the exclusion of other products or vendors that may be suitable.

[2]The authors acknowledge assistance from General Bandages, Inc., 8300 Lehigh Avenue, Morton Grove, Il 60053 for supplying Guard-Tex; Ross Daniels, Inc., P.O. Box 430, West Des Moines, IA 50265 for supplying Ross TreeGard; Poly Growers, Inc., Box 359, Muncy, PA 17756 for supplying Foylon 7018; A.M. Leonard, Inc, for supplying "Foam Shields" tree protectors, and Jim Bossert for constructing our wooden tree wrap frames. This research was supported by grants from the Minnesota State Department of Agriculture Shade Tree Program and the Horticultural Research Institute.

(23), as well as trees trained in a vase shape, those with big scaffold limbs and trees with declining vigor (20).

Bacterial and fungal diseases are often associated with sunscald (10, 16, 22, 25) as secondary organisms. Invasion by these organisms will eventually weaken and kill the tree.

Various methods of preventing sunscald have been recommended. These include use of Kraft paper (24), whitewash (2, 4), board shields (4), a white water-base paint (13, 14, 24), a whitewash slurry of lime, casein and a sticker (18), slaked lime (9) and aluminum foil (1). Savage (22) found that materials that combined a reflective material and one with insulative properties provided the best trunk protection. Both aluminum foil-backed fiberglass and polyurethane stabilized trunk temperatures. White paint and white-wash prevented temperature rises of more than 5.6 °C. White and aluminum paint, however, injured trees. Kesner and Hansen (17) compared various materials (shredded newspaper mixed with a glue [Comfort Coat], aluminum foil, light gauge aluminum pipe, urethane foam, white latex exterior paint, fiberglass insulation and heating cables covered with fiberglass insulation) for their ability to minimize day-night and across the trunk temperature fluctuations between the N and S sides of sour and sweet cherry. They concluded that although all materials were useful in preventing sunscald, a good quality outdoor white latex paint applied to the S and SW sides of tree trunks was the most practical. Painted trunks maintained, from noon to 3 p.m. on bright, sunny winter days, an 8-16.7 °C cooler temperature on the south side than the unpainted check trees. Some latex paints, however, caused injury on Norway, silver and sugar maples (14, 19) which, in some cases, led to Cytospora canker infections (19). In addition, paint mixtures are unsightly and remain on the trees for several years.

Since rapid changes in temperature appear to cause sunscald, materials that prevent rapid changes in temperature under alternating periods of shade to sun and vice versa should have the greatest potential for preventing sunscald. This study was devised to determine the effectiveness of various protective materials in preventing rapid temperature fluctuations under alternating sunny and shady conditions. Products identified could then be field tested.

Procedure and Results

Two wooden frames each 2.4 m long were constructed to hold 37.5 cm lengths of 2″ x 2″ stakes or 2.5 cm diameter sections of white ash (*Fraxinus americana* L.) (Figure 1). The temperature on the south side of samples under a variety of test materials was monitored with thermocouples and a recording potentiometer. Tests were run during late January and early February (1980). The thermocouples were placed under the wraps or held in place by cellophane tape with the 2 x 2's and embedded in the cambium of the white ash. The experiments were run on sunny days with shading controlled by placing and removing a wooden shade in front of the samples.

The wrap materials tested were wrapped around the 2 x 2's and white ash in a spiral arrangement. The first group of materials tested was on the 2 x 2's and consisted of:

1. Ross TreeGard
2. Guard — Tex
3. No treatment — control
4. White latex paint
5. Kraft paper tree wrap
6. Kraft paper tree wrap painted white
7. Water-Mat capillary mat
8. Two layers of Water-Mat capillary mat
9. Weed-chek Landscape Mat
10. Aluminum foil
11. AirCap Barrier Coated Bubbles
12. Same as #11 but painted white
13. Same as #11 but under a layer of aluminum foil
14. Same as #11 but under Kraft paper tree wrap
15. Same as #11 but under Water-Mat capillary mat
16. Microfoam

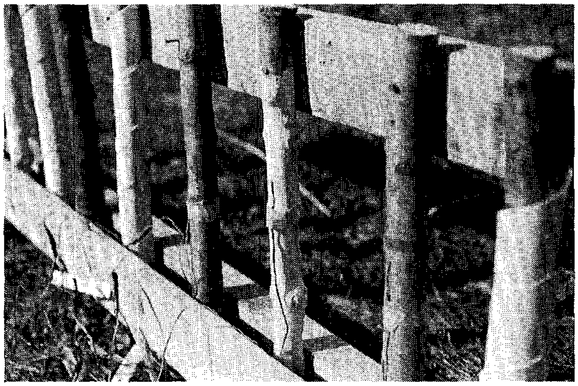

Figure 1. White ash sections on frame showing thermocouple placement and various materials tested.

Temperatures under these treatment materials were monitored on three cold, sunny days in January. Based on preliminary results the following materials were further evaluated on 37.5 cm lengths of 2.5 cm diameter white ash (3 reps per treatment):

1. Control
2. Foylon 7018
3. Kraft paper tree wrap
4. Water-Mat capillary mat
5. Aluminum foil
6. Ross TreeGard
7. Aluminum foil over AirCap Barrier Coated Bubbles
8. White latex paint

Temperatures were monitored for one day in January and three days in February. The shade was alternately placed in front of the samples and then removed.

The Kraft paper tree wrap treatment consistently showed a faster rate of temperature change than the control suggesting that materials commonly used for sunscald prevention may not be providing the expected protection. The Water-Mat capillary mat and white paint treatments also had rapid rates of temperature change. The three reflective materials used, foil, foil over AirCap Barrier Coated Bubbles and Foylon 7018 resulted in the slowest rate of temperature change (Figure 2). Foylon 7018 was the easiest to apply and would have the greatest durability of the three materials. The Ross TreeGard had an intermediate rate of temperature change.

In late January and early February (1981) we repeated our evaluations of the various wrap materials using the wooden frames; however, we used 37.5 cm lengths of 2.5 cm diameter silver maple (*Acer saccharinum* L.). The remainder of the procedure was the same as the previous year's. In this study we compared the following wraps:

1. Control
2. Foylon 7018
3. Kraft paper tree wrap
4. Kraft paper tree wrap as a loose fitting cylinder
5. Faded Kraft paper tree wrap
6. Ross TreeGard
7. White latex paint

Different combinations of these treatments were compared (6-8 replications). The only treatments that were consistently significantly better than the control in preventing a fall or rise in cambial temperature 13 minutes after the shade was added or removed were the Foylon 7018 and Ross TreeGard (Table 1).

During the winter of 1982 we retested Foylon 7018, Kraft paper tree wrap and Kraft paper tree wrap as a loose fitting cylinder and in addition tested Foylon 7018 and "Foam Shield" tree protectors as loose fitting cylinders. Foylon 7018 as a wrap or cylinder was consistently significantly better than the control and the Kraft cylinder and "Foam Shields" were on some days significantly better than the controls.

In the fall of 1979, 1980 and 1981, we wrapped various sizes of several shade tree species with our experimental materials. Due to

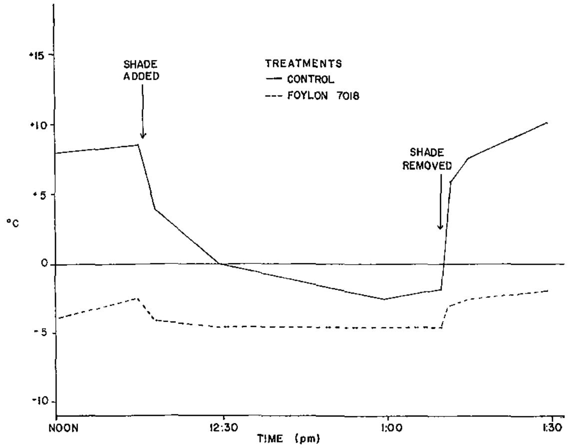

Figure 2. Average temperatures in cambial layer of 2.5 cm diameter white ash comparing Foylon 7018 to no treatment. Data were recorded on February 6, 1980. Air temperature was −3°C.

Table 1. Average temperature change in cambial layer of 2.5 cm diameter silver maple with various trunk protectants. Data were recorded in the early afternoon on January 29, 1982. Air temperature was −2°C.

Treatment	*Temperature change in °C 13 min. after shading*	*Temperature change in °C 13 min. after removing shade*
Control	−6.1	+7.3
Foylon 7018	−0.4	+0.9
Kraft tree wrap (new)	−7.4	+7.3
Kraft tree wrap (faded)	−5.0	+5.2
Kraft tree wrap cylinder	−2.9	+3.5
TreeGard	−2.0	+2.6
White latex paint	−3.6	+5.4

the mild winters there was not damage to the controls or any of the treatments; however, it was noted that trunks that had been wrapped with the AirCap, Kraft paper tree wrap and Ross TreeGard were wet and if not removed in the spring might encourage the growth of fungi and bacteria especially if the trunk was damaged. Hart and Dennis (11) found that cracks under tree wraps oozed a dark slimy material (possibly microorganisms) while cracked unwrapped trees did not. In addition, the Guard-tex was shredded making it unsightly and unusable for another season. The Ross TreeGard and Foylon 7018 left an imprint on the bark when removed in late June due to growth expansion. Thus spring removal would be imperative especially on fast-growing trees.

Further testing in the field under sunscald producing conditions are needed before any recommendations can be made. It appears, however, that reflective materials hold promise as protective wrap materials for sunscald prevention.

Literature Cited

I. Anonymous. 1950. *Foil protects trees.* Am. Nurseryman 92: 22-23.
2. Baier, W. and T.E. Bohlmann. 1964. *Stem temperature and sunscald damage to tree.* Tegniese Mededeling, Landbounavorsingsinstituut van die Hoeveldstreek Potchefstroom 19: ii + 16.
3. Bradford, F.C. 1937. *Three distinct types of winter injury in trunks of fruit trees.* Quart. Bull. Mich. Agric. Exp. Sta. 19: 179-182.
4. Brown, G.G., W.M. Mellenthin, and L. Childs. 1964. Observations on winter injury to apple and pear trees in the Hood River Valley. Sta. Bull. Ore. Agric. Exp. Stat. 595, 34 pp.
5. Clark, F.B. and K.W. Seidel, 1961. Climatic injury found on planted black walnut in Kansas. Sta. Note Cent. St. For. Exp. Sta. No. 147, 2 pp.
6. Davis, S.H. and J.L. Peterson. 1980. *Trunk decay on Greenspire linden,* J. Arboric. 6: 258-260.
7. Eggert, R. 1944. *Cambium temperatures of peach and apple trees in winter.* Proc. Amer. Soc. Hort. Sci. 45: 33-36.
8. Godman, R.M. 1959. *Winter sunscald of yellow birch.* J. For. 57: 368-369.
9. Grabenstedt. 1964. *Prevention of sunscald on Beech.* Forst-u. Holzw. 19: 347-348.
10. Green, S.B. 1902. Forestry in Minnesota. Geological and Natural History Survey of Minnesota, St. Paul. 401 pp.
11. Hart, J.H. and G.K. Dennis. 1978. *Effect of tree wrap on the incidence of frost crack in Norway maple.* J. Arboric. 4: 226-227.
12. Harvey, R.B. 1923. *Cambial temperatures of trees in winter and their relation to sun scald.* Ecology 4: 261-265.
13. Harvey, R.B. 1930. *Sprays for the protection of trees against sunscald and rodent injury.* Proc. Amer. Soc. Hort. Sci. 27: 548-549.
14. Holmes, F.W. 1979. Research program: Shade tree laboratories, Univ. Mass. Abstracts of Urban Forestry Research in Progress — 1979, U.S.D.A. Forest Service GTR-NE-60.
15. Huberman, M.A. 1943. *Sunscald of Eastern white pine, Pinus strobus L.* Ecology 24:456-471.
16. Johnson, A.L.S. 1971. *Residual effects of sunscald and frost injury on young Douglas-fir.* Bi-m. Res. Notes 27:14-15.
17. Kesner, C.D. and C.M. Hansen. 1976. *Prevention of winter sunscald injury in Michigan orchards.* J. Amer. Soc. Hort. Sci. 101:546-550.
18. Meier, L. and H.R. Walther. 1962. *How can damage from sun scorch be avoided on the frost margins created by the construction of national trunk roads?* Schweiz. Z. Forstw. 113:516-517.
19. Mosher, D.G. and R.A. Cool. 1974. *Protective paint induces canker formation.* Arborist's News 39:42-44.
20. Okamoto, S. 1952. *Sunscald of peach trees. I. Sunscald in relation to tree temperature.* J. Hort. Ass. Japan 20:243-249.
21. Pellett, H.P. 1974. Personal communication.
22. Savage, E.F. 1970. *Cold injury as related to cultural management and possible protective devices for dormant peach trees.* HortScience 5:425-428.
23. Solov' eva, M.A., V.K. Novikov, V.V. Grokhol' skii, and Yu. M. Goryl'ko. 1975. *Tree trunk damage caused by sun scorch,* Sadovodstvo 2:20-22.
24. Tattar, T.A. 1978. Diseases of Shade Trees. Academic Press, Inc., New York. 361 pp.
25. Vasiloff, G.N. and J.T. Bashram. 1963. *Defect associated with trunk wounds in young second-growth sugar maple.* Bi-m. Progr. Rep. For. Ent. Path. Br. Dep. For. Can. 19:1-2.

University of Minnesota Landscape Arboretum
3675 Arboretum Drive
Box 39
Chanhassen, MN 55317