LAC BALSAM® AS A TREATMENT TO HASTEN WOUND CLOSURE AND MINIMIZE DISCOLORATION AND DECAY

by G.W. Hudler[1] and S. Jensen-Tracy[2]

Abstract. Lac Balsam® with or without Binab® (a commercial formulation of *Trichoderma* spp.) or orange shellac was applied to shallow wounds made in Norway maple, honeylocust, eastern white pine, and eastern hemlock in November and June. Subsequent dissection and measurement of the wounded portions of the trees 16 to 24 months later indicated that the dressings had little or no consistent effect on wound closure or compartmentalization except for honeylocust wounded in June where all of the dressings appeared to reduce the lengths of columns of discolored wood. Lac Balsam also reduced pitch mass borer colonization of wounds in eastern white pine. None of 36 Lac Balsam–treated wounds were colonized by the insect, whereas 5 of 27 untreated wounds were.

Key Words. Compartmentalization; wound dressing; woundwood.

Application of coatings to wood and live bark exposed by pruning or accidental abrasion was endorsed by pioneers in the field of tree care long before arboriculture distinguished itself as a profession, and the practice continued to be a recommended component of a sound tree care program well into the second half of the 20th century. Early treatments were primarily aimed at preserving health and wood quality of forest trees and included Forsyth's method of coating open wounds with a mixture of cow dung, lime, and wood ashes (Mercer 1979). However, as private homeowners became more concerned with the health and appearance of trees in their landscapes, what began as an effort by foresters to salvage damaged timber trees eventually shifted toward preservation of desirable shade trees as well. Because there was no plan to harvest or mill landscape trees, people were less concerned about stains caused by wound dressings, and arborists thus had greater license to test a wider array of materials and methods to accomplish their goals (Peets 1925).

Coal tar was the treatment of choice during the early part of the 20th century (Davey 1907), but it seemed that with each passing decade researchers and practitioners were increasingly questioning its value and looking for better alternatives. Webster (1916) was one of the first to report beneficial effects from other materials such as white lead paint and creosote, but he also continued to recommend coal tar above the others in most cases. Later, Peets (1925) questioned the therapeutic value of coal tar and paint, noting that their major effects seemed to be cosmetic. He believed that single applications of these dressings on large wounds provided no lasting barrier to insects and fungi because the dressings cracked as the wood checked on drying. Significant decay, Peets asserted, might even be hidden from view by ineffective but persistent dressings.

In subsequent years, many other materials were tested and retested. Brooks and Moore (1926) and Brooks and Brenchley (1931) had some success in preventing silverleaf disease (caused by a wood decay fungus, *Chondrostereum purpureum*) in wounded fruit trees with white lead paint and with grafting wax. Marshall (1931) determined that although shellac applied to wounds between February and June (the best time for woundwood formation in the species of trees he observed) had little or no effect on natural wound repair, it did boost the average initial rate of woundwood formation when applied to wounds between July and January. McQuilkin (1950) noted that lanolin or a combination of shellac and plastic asphaltum improved wound closure, but several growth regulators did not.

Efforts to improve performance of wound dressings with the addition of fungicides began early in the 20th century with pretreatment with antiseptic washes of copper sulfate and bichloride of mercury. In some cases, fungicides were added to wound paints, but concern about mammalian toxicity of such formulations made applicators reluctant to use them in places where children or animals might be exposed (Collins 1934). Padfield (1955) tested petrolatum in combination with several fungicides including Bordeaux mixture, mercuric chloride, and pentachlorophenol and found that all were reasonably persistent (lasting for at least four years) and allowed for good woundwood formation. However, none of the fungicides provided better control of silverleaf disease than petrolatum alone.

Dye and Wheeler (1968) reported better success in reducing incidence of silverleaf of fruit trees if they added captafol or thiram to bituminous water emulsion than if the fungicides were not added.

More recently, Mercer (1983) tested a wide array of commercially available dressings for their effect on woundwood formation on European beech *(Fagus sylvatica)*. His report included the first published data of woundwood formation around wounds treated with more contemporary dressings, including Lac Balsam®, TreHold®, and Arbrex®. All wounds on European beech treated with these dressings formed significantly more woundwood than those that were left untreated. However, when Dujesiefken et al. (1999) measured wound repair around Lac Balsam–treated increment borer holes in horsechestnut *(Aesculus hippocastanum)*, large-leaved lime *(Tilia platyphyllos)*, small-leaved lime *(T. cordata)*, and silver birch *(Betula pendula)*, they found no obvious differences between Lac Balsam–treated and untreated holes with respect to apparent compartmentalization of discolored and/or decayed wood.

Since the 1970s, application of wound dressings has been decried by Shigo and colleagues who, while studying compartmentalization in xylem, concluded that dressings used at that time were of no value and were possibly detrimental to normal defense reactions in trees (Pottle and Shigo 1974; Shigo 1975, 1977; Shigo and Wilson 1977; Shigo and Shortle 1983). They were not the first to suggest the questionable value of wound dressings, but they had the attention of a larger and better-informed audience. Recommendations evolving from the work of Shigo and associates effectively caused most conscientious tree care professionals to stop using tree wound dressings in their management programs. Concurrently, interest in developing and testing new materials also waned, except in the area of tree fruit production where tests of dressings to control wound pathogens continued seemingly unabated.

In experiments reported herein, we measured the effectiveness of Lac Balsam (GmbH & Co., Minden, Germany), an artificial resin dispersion emulsion that has found some favor by practitioners in Europe and North America. In some cases, Binab (BINAB Bio-Innovation AB, Sweden), a commercial formulation of two species of fungi in the genus *Trichoderma* with purported inhibitory action to growth of an array of wood rotting fungi, was applied with Lac Balsam. Performance of the materials was compared with orange shellac, a recommended treatment for wounds on trees threatened by fireblight or Cytospora (*Valsa leucostoma*) cankers (Hudler and Jensen-Tracy 2002).

MATERIALS AND METHODS

On November 3, 1992, nine Norway maple *(Acer platanoides)* and nine honeylocust *(Gleditsia triacanthos)* ranging from 14 to 23 cm (5.5 to 9 in.) diameter [measured 1.4 m (55 in.) above the root collar (dbh)] and 5 to 8 m (15 to 24 ft) tall, growing in a research nursery near Freeville, New York, U.S., were wounded by cutting into the bark with a 5-cm (2-in.) diameter hole-cutting saw powered by an electric drill. Holes were cut to a depth of approximately 2 mm (1/16 in.) below the vascular cambium with the centering bit extending an additional 1.5 cm (5/8 in.) into the wood. Each tree was wounded nine times in that portion of the trunk extending from just above the root collar to a height of about 2.3 m (7 ft). On each tree, three randomly selected wounds were left untreated and two groups of three others were treated with either Lac Balsam or Lac Balsam plus Binab (Binab mixed according to label directions) or orange shellac (Zinsser 3 lb Orange, Sommerset, NJ). On completion of treatments, then, for each tree species, three individuals had three untreated wounds, three wounds treated with Lac Balsam, and three wounds treated with Lac Balsam plus Binab. Three others had untreated wounds, wounds treated with Lac Balsam, and wounds treated with orange shellac. Three more had untreated wounds, wounds treated with Lac Balsam plus Binab, and wounds treated with orange shellac. A group of nine naturally seeded eastern white pines (*Pinus strobus* L.) growing in a former pasture near Slaterville Springs (Tompkins County, NY), ranging from 15 to 25 cm (6 to 10 in.) dbh, were wounded and treated in a similar manner on November 5, 1992. On June 14 through 18, 1993, similar wounds and treatments were imposed on nine more individuals of the same species at the same site. Nine eastern hemlock [*Tsuga candensis*; 18 to 25 cm (7 to 10 in.) dbh and 7 to 10 m (20 to 30 ft) tall] at the Slaterville Springs site were also wounded and treated in June 1993.

In November and December 1994, the previously wounded honeylocust and Norway maple were felled, and the bolts with wounds were transported to the Cornell campus where they were held outdoors, uncovered, for four to six weeks. During that time, as weather permitted, they were cut crosswise between the wounds to determine the extent of discolored and decayed wood. Measurements were made from the center of each wound to the topmost portion of visibly discolored wood. Growth ring width for the past five years and wound width (circumferential distance between woundwood rolls) were also measured, and cultures of fungi were grown from decayed wood to determine the species of decay fungi present. Sectioned wood was also photographed soon after it was cut to provide a more lasting record of the discoloration patterns and to enable a redetermination of the extent of discoloration and decay, if needed. The dimensions of open wounds in standing white pine were measured on November 8, 1995. Harvest of that species and final measurements of wound size on both pine and hemlock were done in spring 1997.

Statistical analysis of all data was by way of a general linear model for analysis of variance where sources of variation were the individual trees and the treatments. Each population of six trees of the same species wounded at the same time and receiving the same treatment was analyzed separately from the others and each tree was considered as an independent variable. Thus, the response of each tree species to any one of the treatments was compared only to the response of untreated wounds on the same trees. Significant differences of means were identified by Tukey's test ($P = 0.05$).

Figure 1. Wounded honeylocust treated with Lac Balsam in June and photographed in November of the same year.

RESULTS

Lac Balsam was easily applied at temperatures as low as 8°C (46.4°F), and it provided a durable cover that remained intact until the trees had added about 1 cm (0.4 in.) of radial growth (Figure 1). Then, the coating was lifted off of the wound surface and eventually cracked and peeled as growth continued (Figure 2).

Where Binab amendments were used, an off-white to gray mold (*Trichoderma* spp.) was visible against the darker gray Lac Balsam surface. With all treatments on honeylocust and Norway maple, *Nectria cinnabarina* also appeared commonly, growing on bark and coating near the edges of the wounds but apparently not causing death of living phloem or creating enlarging cankers. Two species of wood decay fungi occasionally fruited on both treated and untreated wounds on honeylocust. One was *Irpex lactuae* (Figure 3) and the other was *Schizophyllum commune*. None of the other species of trees showed symptoms or signs of structural decay after two (for deciduous trees) or four (for conifers) growing seasons.

Figure 2. Wounded Norway maple treated with Lac Balsam in November and photographed one year later.

For honeylocust wounded in the fall and measured 24 months after wounding, there was no significant difference in the extent of discolored wood following any of the treatments as compared to untreated wounds (Table 1). The average circumferential distances between woundwood rolls on wounds treated with Lac Balsam and Lac Balsam + Binab were significantly greater ($P = 0.05$) than untreated wounds (Table 2). However, we were not able to judge the impact of those differences on long-term tree health or structural integrity. The discolored portions seemed to be effectively compartmentalized.

For honeylocust wounded in the spring and measured 16 months after wounding, application of any one of the dressings considered in this study significantly reduced the length of the column of discolored wood by about 25% (Table 1). Whether such reductions have any practical significance in terms of tree health or mechanical stability remains unknown. All three dressings also resulted in significantly less exposed xylem (as measured by distance between woundwood rolls) than for untreated wounds, but the differences between treated and untreated wounds were less than 1 cm (0.4 in) (Table 2).

Figure 3. Lac Balsam–treated wound on honeylocust with fruit-bodies of *Irpex lactuae* on exposed wood.

Table 1. Mean length (cm) of column of discolored sapwood associated with wounds inflicted 24 or 16 months prior to harvest and measurement.

Species	Treatment vs. check					
	LB[z]	Check	LBB	Check	OS	Check
Honeylocust						
24 months	23.7	27.2	24.7	29.5	14.9 a	19.9 a[y]
16 months	13.4 b	18.6 b	14.9 c	19.9 c	14.9 d	19.9 d
Norway maple						
24 months	19.5	20.2	15.1	16.1	17.3	17.5
16 months	7.5	7.8	8.8	8.5	8.3	8.7

[z]LB = Lac Balsam, LBB = Lac Balsam + Binab, OS = orange shellac.
[y]Pairs of means with the same superscript are significantly different from each other at $P = 0.05$.

Table 2. Mean width (cm) of exposed xylem in wounds inflicted 24 or 16 months prior to measurement.

Species	Treatment vs. check					
	LB[z]	Check	LBB	Check	OS	Check
Honeylocust						
24 months	4.9 e[y]	3.6 e	3.2 f	2.6 f	2.6	2.4
16 months	2.5 g	3.2 g	2.7 h	3.4 h	3.1 i	3.4 i
Norway maple						
24 months	3.5 k	2.3 k	3.2	2.6	2.6	2.4
16 months	3.1	3.1	3.4 m	2.6 m	2.9	2.7

[z]LB = Lac Balsam, LBB = Lac Balsam + Binab®, OS = orange shellac.
[y]Pairs of means with the same superscript are significantly different from each other at $P= 0.05$.

For Norway maple, there were no significant differences between lengths of columns of discolored wood with various wound treatments in either fall or spring (Table 1). However, the columns of discoloration in Norway maple were significantly shorter and narrower than those in honeylocust as determined by comparison of responses around untreated wounds in both species (Figure 4a,b). This difference was more pronounced around wounds inflicted in spring than in fall. In view of the apparent speed and efficiency with which the compartmentalization process occurred around untreated Norway maple wounds, there seemed to be little to be gained by improving on it with external dressings except to mask the appearance of the wounds.

For eastern white pine wounded and treated at the same time as the deciduous species but harvested in 1997, dissection of three stems from both fall and spring wounding times showed no evidence of decay. Discoloration was so difficult to discern that measurement of it was of highly variable between observers and deemed to be of little or no practical value. Thus, efficacy of wound treatments in that species was determined based solely on the amount of closure after treatment. There, comparisons of maximum widths of treated and untreated wounds showed no significant differences (Table 3). However, the pitch mass borer, *Syanthedon pini*, colonized 5 of 27 untreated wounds, whereas none of 36 wounds covered with Lac Balsam and 1 of 18 wounds covered with orange shellac were so colonized.

DISCUSSION

Results of these experiments failed to show that application of orange shellac or Lac Balsam with or without Binab to wounds on four species of trees consistently reduced discoloration or decay or hastened wound closure, except in the case of honeylocust wounded in the spring. Dujesiefken et al. (1999) had similar results when they measured the effectiveness of various treatments, including Lac Balsam, on compart-

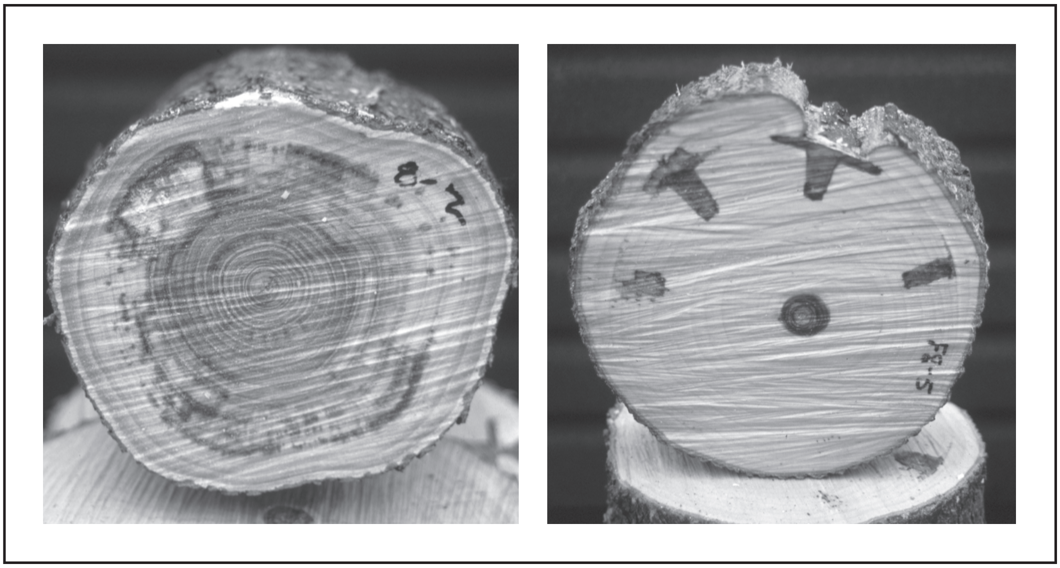

Figure 4. Typical cross-sections of honeylocust (left) and Norway maple (right) stems wounded two growing seasons prior to harvest. Discoloration/decay columns were sufficiently distinct from one another that their lengths could be measured by sectioning each log through each wound and following individual columns to completion.

Table 3. Mean width (cm) of exposed xylem (circumferential distance between woundwood rolls) in wounds inflicted 48 or 40 months prior to measurement.

	Treatment vs. check					
Species	LB[z]	Check	LBB	Check	OS	Check
Eastern white pine						
48 months	2.4	2.7	4.0	4.1	4.2	4.1
40 months	2.9	3.0	3.6	3.9	3.1	3.4
Eastern hemlock						
40 months	3.7	3.7	3.3	3.6	3.7	3.7

[z]LB = Lac Balsam, LBB = Lac Balsam + Binab, OS = orange shellac.

mentalization around boreholes, whereas Mercer (1979) found Lac Balsam to be the best of eight dressings tested to improve woundwood formation over an 18-month period following pruning of European beech *(Fagus sylvatica)*. The reduction in the lengths of the columns of discolored wood in our honeylocust (approximately 25% reduction compared to untreated wounds) was statistically significant, but its practical significance remains open to question.

We also found no evidence to indicate that use of the dressings we tested caused any harm to the trees or reduced their ability to contain invading microbes. Thus, in cases where manmade or natural wounds leave scars that are considered to be unsightly, we have no reservations about recommending use of Lac Balsam to lessen the visual impact of the wounds.

Although our experiments were not intended to test for such, it did appear that Lac Balsam prevented colonization of wounds in eastern white pine by the pitch mass borer (Johnson and Lyon 1988). This insect typically causes little structural damage to trees, but its feeding in the outer xylem causes effusion of resin, which can be aesthetically offensive to owners of trees cultivated for ornamental purposes, and the issue warrants further examination.

LITERATURE CITED

Brooks, F.T., and G.H. Brenchley. 1931. Silver leaf disease—VI. J. Pomol. 9:1–29

Brooks, F.T., and W.C. Moore. 1926. Silver leaf disease—V. J. Pomol. 5:61–97.

Collins, J.F. 1934. Treatment and Care of Tree Wounds. USDA Farmer's Bulletin 1726. 38 pp.

Davey, J. 1907. The Tree Doctor: The Care of Trees and Plants. Saalfield Publications, New York, NY. 235 pp.

Dujesiefken, D., A. Rhaesa, D. Eckstein, and H. Stobbe. 1999. Tree wound reactions of differently treated boreholes. J. Arboric. 25:113–123.

Dye, M.H., and P.J. Wheeler. 1968. Wound dressing for the prevention of silver-leaf in fruit trees caused by *Stereum purpureum* (Pers.) Fr. NZ J. Agric. Res. 11:874–882.

Hudler, G.W., and S. Jensen-Tracy. 2002. Disease and nematode control for trees and shrubs, pp 75–92. In 2002 Pest Management Guidelines: Trees and Shrubs. Cornell University, Ithaca, NY.

Johnson, W.T., and H.H. Lyon. 1988. Insects That Feed on Trees and Shrubs (2nd ed.). Comstock Publishing, Ithaca, NY. 588 pp.

Marshall, R.P. 1931. The Relation of Season of Wounding and Shellacking to Woundwood Formation in Tree Wounds. USDA Technical Bulletin 246. 28 pp.

McQuilkin, W.E. 1950. Effects of some growth regulators and dressings on the healing of tree wounds. J. For. 48:423–428.

Mercer, P.C. 1979. Attitudes to pruning wounds. Arboric. J. 3:457–465.

——.1983. Callus growth and the effect of wound dressings. Ann. Appl. Biol. 103:527–540.

Padfield, C.A.S. 1955. Dressings for tree wounds: Testing new materials. Orchardist NZ 28(7):7–11.

Peets, E. 1925. Practical Tree Repair (rev. ed.). McBride & Co., New York, NY. 270 pp.

Pottle, H.W., and A.L. Shigo. 1974. Treatment of wounds on *Acer rubrum* with *Trichoderma viride*. Eur. J. For. Pathol. 5:274–279.

Shigo, A.L. 1975. Some new ideas in tree care. J. Arboric. 1:234–237.

——. 1977. "New" ideas in tree care. J. Arboric. 3:1–6.

Shigo, A.L., and W. Shortle. 1983. Wound dressings: Results of studies over 13 years. J. Arboric. 9:317–329.

Shigo, A.L., and C.L. Wilson. 1977. Wound dressings on red maple and American elm: Effectiveness after five years. J. Arboric. 3:81–87.

Webster, A.D. 1916. Tree Wounds and Diseases: Their Prevention and Treatment. Lippincott. Philadelphia, PA. 215 pp.

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Résumé. Du Lac Balsam® avec ou sans Binab®—une formule commerciale de *Trichoderma* spp.—ou du shellac a été appliqué en novembre et en juin sur des blessures superficielles faites sur des érables de Norvège, des féviers, des pins blancs de l'Est et des pruches du Canada. Les mesures prises lors d'une dissection subséquente des sections blessées des arbres à 16 et 24 mois après ont indiqué que le produit de recouvrement avait peu ou pas d'effet consistent sur la fermeture des blessures ou la compartimentation, et ce à l'exception des féviers blessés en juin où le produit semblait réduire la longueur des colonnes de décoloration du bois. Le Lac Balsam permettait aussi de réduire la colonisation des blessures par le perceur du pin chez le pin blanc de l'Est. Aucune des 36 blessures traitées avec le Lac Balsam était colonisée par cet insecte tandis que 5 des 27 blessures non traitées l'étaient.

Zusammenfassung. Lac Balsam® mit und ohne Binab® oder orangem Schellack wurde auf kleine Wunden bei Bergahorn, Gleditschie, Weißkiefer und Hemlock im November und Juni appliziert. Die nachfolgende Dissektion der verwundeten Partien nach 16–24 Monaten zeigte, dass die Bedeckung wenig oder keinen Effekt auf den Wundverschluss oder Kompartmentalisierung hatte mit Ausnahme der im Juni verletzten Gleditschie, wo der Auftrag die Länge der Holzverfärbung reduzierte. Lac Balsam reduziert auch die Kolonisation von Insekten bei den untersuchten Kiefern. Keine der 36 mit LacBalsam behandelten Wunden wurde mit Insekten besiedelt, während 5 von 27 unbehandelten Wunden Kolonisationen aufwiesen.

Resumen. Lac Balsam® con o sin Binab® (una formulación comercial de *Trichoderma* spp.) o laca naranja, fue aplicado a heridas superficiales hechas en arce Norway, honeylocust, eastern white pine y eastern hemlock en Noviembre y Junio. La disección subsiguiente y la medición de las porciones heridas de los árboles, 16–24 meses posteriormente, indicaron que las pinturas tuvieron poco o nulo efecto consistente en el cierre de la herida o compartimentación, excepto para honeylocust en Junio, donde todas las heridas parecieron reducirse a líneas de columnas de madera decolorada. Lac Balsam también redujo la colonización de barrenadores en eastern white pine. Ninguna de las 36 heridas tratadas con Lac Balsam fue colonizada por insectos mientras 5 de 27 no tratados sí lo fueron.