

Field Production

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Section Editor

The Effects of Tree Shelters on Field Grown Maple Liners

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Significance to the Industry This research demonstrates that the use of tree shelters as a physical barrier on field grown maple liners did not provide protection from flatheaded borer attacks during a three-year evaluation. There was no apparent advantage with the use of tree shelters for height or trunk diameter growth when compared to the control or Discus® N/G Insecticide treated trees.

Nature of the Work Young tree liners are commonly affected by flatheaded appletree borer (*Chrysobothris femorata* [Olivier]), especially in the years following transplanting into field nurseries. Prophylactic trunk sprays with contact insecticides like chlorpyrifos (e.g., Dursban), bifenthrin (e.g., Talstar or OnyxPro), or permethrin (e.g., Perm-Up 3.2EC) are commonly used to prevent flatheaded borer attacks, however losses still occur in many field nurseries. Surveys in middle Tennessee indicate flatheaded borers are not being adequately managed in some nursery crops like dogwood and maple, where crop losses near 25 to 40% are common (Oliver and Fare, unpublished data). Oliver et al. (2010) (4) reported that a single application of some neonicotinoid insecticides can provide multi-year prevention from flatheaded borer damage, as well as increased height and trunk growth. However, neonicotinoid chemistry has recently been unsubstantially targeted as a potentially harmful pesticide to important pollinators and honey bees.

Tree shelters have been used in forestry plantings to provide support and protection of young tree seedlings, but reviews of their benefits are conflicting. Ponder (5) reported a benefit in growth of northern red oak with the use of tree shelters, but black walnut and green ash had no difference in growth between non-treated and shelter-treated treatments during a ten-year evaluation. Field grown Kentucky coffee tree liners had increased shoot elongation with the use of tree shelters compared to no tree shelters, but sheltered trees had less trunk diameter growth (2). Tree shelters have shown to increase survivability with some tree species, but with a mixed report on growth improvement (1, 6). The use of shelters also showed protection from rodents, sunscald and deer damage, but had limited effects on growth (3).

This research evaluated the use of tree shelters on red maple, *Acer rubrum* L. 'Sun Valley' liners for flatheaded appletree borer activity and subsequent tree growth in a field nursery.

On Apr 1, 2015, Sun Valley maples grown in #3 nursery containers, were planted in a field nursery in Warren County, Tennessee with Etowah Cherty Silt Loam and Talbott Silt Loam soil types. Trees were planted in rows 1.5 m (5 feet) apart with 1.8 m (6 feet) in-row spacing. Immediately after planting, each tree received 90 g of 13N-5.8P-10.8K (13-13-13) agricultural grade fertilizer spread around a 15 cm (6-inch) radius at the base. Two weeks after planting, lower branches on the trunks were removed to have a 120 cm (4 feet) branch-free trunk to allow for installation of the trunk shelters. Trunk shelters evaluated were: 1) Tree Pro Tree Protector (Tree Pro, West Lafayette, IN), a solid rigid single-walled 100% recycled polyethylene tube, 36 cm x 120 cm (14 in x 48 in), wrapped on the trunk and secured with three adjustable zip ties, 2) Tree Wrap Crinkled paper, 21 cm (4 in wide) (Agriculture Solutions LLC., Strong, ME), a double layered Kraft paper with asphalt tar sandwiched in between layers and wrapped around the trunk for complete coverage, 3) Verdura® Biodegradable Tree Spiral (EcoXtrusion, Hengelo, Netherlands), a 6.3 cm wide (2.4 in) starch based bioplastic wrap with sparsely spaced 10 mm diameter holes, wrapped around the trunk for complete coverage, and 4) Tubex TreeShelter® (Tubex USA, Old Hickory, TN), a polypropylene twin-walled translucent tube, 21.5 cm x 120 cm (8.5 in x 48 in) wrapped around the trunk and secured with three adjustable zip ties. All shelters were installed to protect the lower 120 cm (48 in) of tree trunk. A fifth treatment was an application of a neonicotinoid insecticide, Discus® N/G Insecticide (cyflurthrin and imidacloprid) at a rate of 15 ml product per 2.5 cm (1 in) trunk diameter applied in 125 ml (4.2 oz) of water, directed at the soil within 15 cm (6 in) of the base of the tree. An untreated, unprotected control was included.

Within 5 days post-planting, there were two rain events totaling 2.3 cm (0.9 in). Trees were maintained with traditional nursery practices for fertilization and weed control during the three-year test.

Tree shelters were rated for performance in Aug 2015, Dec 2015, Feb 2017, and Nov 2017 with the following scale: 1 = 100% intact, 2 = 75% - 99% intact, 3 = 50% - 74% intact, 4 = 25% - 49% intact and 5 = displaced. Flatheaded borer damage and *Nectria canker* [caused by the fungus *Nectria galligena* (Bresadola)] incidence were evaluated in Jul 2016, Feb 2017 and Dec 2017. Based on previous studies (3), all flatheaded borer attacks on trees likely were flatheaded appletree borer. At the onset of the experiment, trunk diameter [measured 15 cm (6 in) above the substrate surface] and height were recorded, and subsequent measurements were made each year during winter dormancy.

The experimental design was a randomized complete block with 39 replications. All data were analyzed using the general linear model in SAS 9.1. Mean separations were performed with Fisher's least significant difference (LSD) test with $\alpha = 0.05$.

Results and Discussion *Tree shelter performance.* The Tree Pro Tree Protector and Tubex TreeShelter® stayed intact during the three-year test and provided 100% trunk coverage (Table 1). In Aug 2015 (4 months post-treatment), the Tree Wrap Crinkled paper was beginning to show signs of degradation and was not entirely covering the trunk. By Jul 2016 (16 months post-treatment), the Tree Wrap Crinkled paper was either off the trunk or

was only around the lower section of the trunk providing less than 50% trunk coverage. The Tree Wrap Crinkled paper was completely deteriorated by third year Nov 2017 rating. The Verdura® Biodegradable Tree Spiral started degrading in the early months of the test and by Aug 2015 (4 months post-treatment), less than 50% of the trunk was covered. The Verdura® Biodegradable Tree Spiral maintained this status until Jul 2016, when less than 75% of the trunk was covered. The starch-based material was very brittle and would break in pieces when touched.

Flatheaded borer and Nectria canker incidence. Tree shelters were gently removed to determine flatheaded borer and Nectria canker incidence (Figure 1A). By Jul 2016 (16 months post-treatment), all treatments had at least one borer attack (two attacks on the Verdura® Biodegradable Tree Spiral and the Tubex TreeShelter®) with the exception of the Discus insecticide treated trees which had no attacks. In Feb 2017, borer attacks had continued with all treatments, including the Discus-treated trees. At termination of the test in Dec 2017 (33 months post-treatment), the trees with the Tree Pro Tree Protector had 8% borer attacks and was similar as the Discus-treated trees. The Tree Wrap Crinkled paper and Verdura® Biodegradable Tree Spiral were providing less than 75% trunk coverage and resulted in 10-12% of the trees with borer attacks. The Tubex TreeShelter® was completely intact providing 100% tree coverage but trees with this treatment still had 12% flatheaded borer damage. There was a small amount of space between the trunk and the tree shelters, Tree Pro Tree Protector and Tubex TreeShelter®, which allowed for trunk growth. Borer attacks on these trees were primarily at the lower section of the trunk near the soil line, which might suggest that the female borer crawled into the area to lay eggs (or that eggs were laid indiscriminately, but survived only when deposited in sites suitable for larval establishment). The lower rate of Discus applied at application did not provide multi-year protection as seen in other research due to the smaller liner size used in this experiment compared to other research (4).

During 2016 and 2017, Nectria canker was found on trees with the Tree Pro Tree Protector, the Verdura® Biodegradable Tree Spiral, the Tubex TreeShelter® and the control (2017) (Figure 1B). The presence was < 3% with the Tree Pro Tree Protector Tube, the Verdura® Biodegradable Tree Spiral and the control. However, by the end of the test, about 18% of the trees with Tubex TreeShelter® had evidence of a Nectria canker. A digital temperature probe did not confirm the suspicion that trunk temperature inside the Tubex TreeShelter® was higher than the Tree Pro Tree Protector, which could have been a factor in the increased presence of borer activity and canker. Higher humidity and trunk moisture could be another issue that favored Nectaria canker with some tree shelter treatments that had tighter wrapping and probably less air exchange, but moisture values were not measured in this study.

Height and trunk diameter growth. After one year, trees treated with Discus insecticide had similar height growth as trees grown with Tree Pro Tree Protector, but had more growth than trees with other tree shelters or the control (Table 2). At the end of year three, the Discus treated trees had less growth than the trees with the Verdura® Biodegradable Tree Spiral wrap, but was similar among other treatments. However, overall tree height

growth during the three-year period was similar with the Tree Pro Tree Protector, the Verdura® Biodegradable Tree Spiral wrap, the Discus treatment and the control.

Trunk diameter growth was greater with Discus-treated trees in year one than other treatments with the exception of the control which was similar. In year three, there were no differences detected among treatments in the amount of trunk diameter growth. The Discus treated trees had the most overall trunk diameter after three years compared to the Tree Pro Tree Protector and the Tubex TreeShelter® and was similar to the other tree shelters and the control.

The authors have reported greater trunk diameter and height growth from Discus insecticide treated trees compared to untreated controls (4). However, in this test, the untreated controls and the Discus treated trees had similar growth during the three-year period with the exception of year one. In other research, tree shelters had provided greater shoot growth of small seedling trees and provided some trunk support (1, 2); however, in this test there was no apparent advantage with the use of tree shelters for tree height or trunk diameter growth when compared to the control or Discus-treated trees. In addition, there was less than satisfactory protection from flatheaded appletree borers, and some evidence of an increase in disease severity with some treatments (e.g., Tubex TreeShelter).

Literature Cited

1. Burger, D.W., P. Vihra and R. Harris. 1992. Treeshelter use in producing container-grown trees. *HortScience* 27:30-32.
2. Kjelgreen, R. 1994. Growth and water relations of Kentucky Coffee tree in protective shelters during establishment. *HortScience* 29:777-780.
3. Kjelgreen, R. 1997. Establishment in treeshelters I: Shelters reduce growth, water use and hardiness, but not drought avoidance. *HortScience* 32:1281-1283.
4. Oliver J.B., D.C Fare, N. Youssef, S.S. Scholl, M.E. Reding, C.M. Ranger, J.J. Moysenko, and M.A. Halcomb. 2010. Evaluation of a single application of neonicotinoid and multi-application contact insecticides for flatheaded borer management in field grown red maple cultivars. *J. Environ. Hort.* 28(3):135–149.
5. Ponder, Jr., F. 2003. Ten-year results of tree shelters on survival and growth of planted hardwoods. *Northern J. of Applied Forestry* 20:104-105.
6. West, D.H., A.H. Chappelka, K.M. Tilt, H.G. Ponder and J. D. Williams. 1999. Effect of tree shelters on survival, growth and wood quality of 11 tree species commonly planted in the southern United States. *J. of Arboriculture* 25:69-74.

Figure 1. Flatheaded appletree borer damage (A) and Nectria canker incidence (B) on the trunks of field grown Sun Valley maple during a three-year evaluation of tree shelters. Jul 2016, Feb 2017, and Dec 2017 ratings were 16, 23, and 33 months or days post-treatment exposure, respectively.

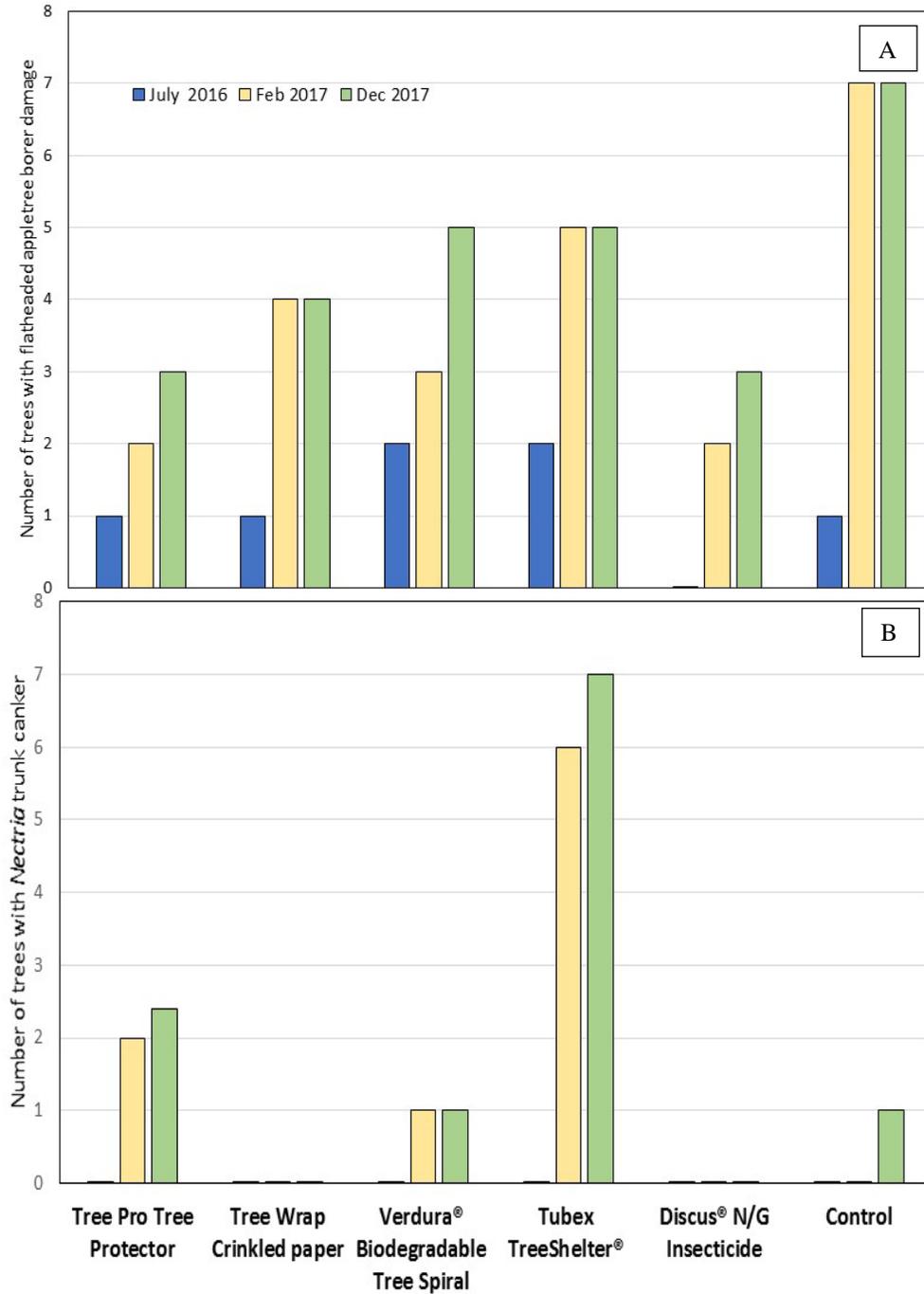


Table 1. Trunk coverage rating of tree shelters during a three-year evaluation, 2015-2017.

Treatments	Rating ^Z			
	Aug 2015	Dec 2015	July 2016	Dec 2017
Tree Pro Tree Protector	1.0 c ^X	1.0 c	1.0 c	1.0 b
Tree Wrap Crinkled paper	1.7 b	2.1 b	3.2 b	-
Verdura® Biodegradable Tree Spiral	3.5 a	3.5 a	4.1 a	4.2 a
Tubex TreeShelter®	1.0 c	1.0 c	1.0 c	1.0 b
Discus insecticide	-	-	-	-
Control	-	-	-	-
LSD	0.3	0.2	0.2	0.2

^Z Rating scale: 1 = 100% intact, 2 = 75% intact, 3 = 50% intact, 4 = 25% intact and 5 = displaced. Ratings on Aug 2015 were 4 months after treatment application, Dec 2015 were 8 months after treatment application, July 2016 were 16 months after treatment application and Dec 2017 were 33 months after treatment application.

^X Means within columns followed by different letters were significantly different. Means separated using Fisher's least significant difference (LSD) test with alpha = 0.05.

Table 2. Height and trunk diameter growth of *Acer rubrum* 'Sun Valley' during a 3-year evaluation of tree shelters, 2015-2017.

Treatment	Height growth, cm ^Z						Total Height Growth, cm ^Y	Trunk Diameter Growth, mm ^Z						Total Trunk Diameter Growth, mm ^Y		
	2015		2016		2017			2015		2016		2017				
Tree Pro Tree Protector	69.2	ab ^X	60.0	ab	69.2	ab	198.7	a	9.3	c	12.6	b	10.3	a	32.2	b
Tree Wrap Crinkled paper	63.3	b	58.6	ab	62.1	ab	184.0	b	9.5	c	13.5	a	10.7	a	33.7	ab
Verdura® Tree Spiral	64.3	b	63.9	a	70.2	a	198.4	a	10.4	b	12.8	ab	10.3	a	33.5	ab
Tubex TreeShelter®	64.2	b	55.8	b	65.5	ab	186.0	b	8.2	d	12.4	b	10.7	a	31.7	b
Discus insecticide	76.1	a	60.8	ab	61.8	b	198.7	a	11.7	a	12.6	b	10.6	a	34.8	a
Control	64.0	b	62.8	a	64.2	ab	191.0	ab	11	ab	12.8	ab	9.2	a	32.9	ab
LSD	7.2		5.6		8.2		11.5		0.9		0.8		1.6		2.1	

^Z Trunk diameter [measured 15 cm (6 in) above the substrate surface] and height were recorded at the onset and at the end of each yearly growing season during winter dormancy. Measurements for 2015 were 9 months after treatment application, 2016 were 21 months after treatment application and 2017 were 33 months after treatment application.

^YTotal height and trunk diameter growth were from the onset in Apr 2015 through Dec 2017.

^XMeans within columns followed by different letters were significantly different. Means separated using Fisher's least significant difference (LSD) test with alpha = 0.05.