Infestation Levels of Dogwood Borer (Lepidoptera: Sesiidae) Larvae on Dogwood Trees in Selected Habitats in Tennessee[1]

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ABSTRACT Infestation levels of dogwood borer [*Synanthedon scitula* (Harris)] on flowering dogwood (*Cornus florida* L.) in commercial nursery, urban, and forest habitats in eastern and middle Tennessee were measured during 1987 and 1988. The highest average infestation level (ca. 60%) was found in the urban habitat, where mechanical injury, e.g., damage caused by lawn mowers or string trimmers, may have provided oviposition or larval entry sites. Dogwood borer larvae were found in all nursery blocks examined, with ca. 7% of the trees infested/block. Infested trees are not marketable; thus, economic losses averaged ca. $1,800/block ($\bar{x}$ = 1,770 trees/block) of dogwoods. Infestation levels were lowest (ca. 1%) in the forest habitat, where dogwoods grow as a natural component of the forest understory.

KEY WORDS Dogwood borer, *Synanthedon scitula,* dogwood, *Cornus florida,* infestation, clearwing moths, Sesiidae.

The flowering dogwood, *Cornus florida* L., an ornamental plant species widely used in the eastern United States, is the most popular tree sold by commercial nurserymen in Tennessee (Williams et al. 1985). Gross sales in Tennessee are estimated to be 24 millions dollars annually (John W. Day, pers. commun.) and account for 16% of the total landscape (ornamental) plant production in the state.

The dogwood borer (DB), *Synanthedon scitula* (Harris), is the most destructive insect pest of dogwood in Tennessee (Williams et al. 1985). Little information is available on infestation levels of DB on flowering dogwoods in commercial nurseries, urban landscapes, and forest habitats. Their impact on trees grown in the urban landscape and the resultant monetary losses to homeowners are difficult to estimate (Nielsen 1978). The use of pesticide sprays is often the primary management tactic in the urban landscape and may be an expensive method of control (Smith and Raupp 1986). Previous researchers have reported low infestation of DB on native dogwoods in forested areas (Pless and Stanley 1967, Underhill 1935). Most of the infestations in urban landscapes and nurseries are associated with bark injuries to young trees and pruning scars or cankers in older trees, i.e. > 20 cm diameter (Potter and Timmons 1981).

In 1987, a two-year study was initiated to determine infestation levels of DB larvae on flowering dogwood in commercial nursery, urban, and forest habitats in Tennessee.

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Materials and Methods

Levels of infestation on dogwoods in selected habitats in eastern and middle Tennessee were measured in 1987 and 1988. Infestations in the nursery habitat were determined by examining each tree in 13 dogwood blocks ($\bar{x}$ = 1,770 trees/block, range = 275 to 7624 trees/block, total of 23,007 trees) in commercial nurseries in middle Tennessee for DB incidence. Each block was characterized by age of trees, i.e., the number of years that the tree had been in the field, and prior applications of pesticides. To determine infestation levels in urban and forest habitats, dogwoods (ca. 75 and 125 at each forest and urban site, respectively) were randomly selected and examined at two urban sites in Knox County and 13 forest sites in the Great Smoky Mountains National Park in Blount County in eastern Tennessee.

To determine DB incidence, the trunk and base of each tree in all habitats were examined for the presence of potential larval entry sites and frass. Dogwood borer larvae expel frass during galley construction (Pless and Stanley 1967). Infestation was confirmed by removing bark to expose the larva. Infested trees were then flagged with colored ribbon for easy identification.

Trunk diameter at 30 cm above ground level and tree height were measured for each infested tree as well as for a random sample (ca. 50 trees at each site) of non-infested trees. For each infested tree, the height of the infestation site above ground level and tree diameter at the site of infestation were also measured. If multiple infestations occurred on the same tree, the height of, and tree diameter at, each infestation site were also recorded. Where appropriate, significant ($P \leq 0.05$) differences between means were determined using a t-test.

Results and Discussion

Commercial nursery. Infestation levels in nurseries averaged 6.6 ± 2.3% infested trees/block, ranging from 0.1 to 24.9%/block (Table 1). Although overall infestation level was low, infestation levels in two of the blocks were greater than 21%. Grant (unpubl. data) found infestation levels greater than 40% in some dogwood blocks in Tennessee. Variability in infestation levels among the nursery blocks may be the result of pest management practices, dogwood variety, or the number of years that the trees had been in the field.

Table 1. Infestation levels of dogwood nursery blocks (n = 13) in commercial nurseries in middle Tennessee.

Infestation Level (%)	Number of Blocks/Classification	Range of Infestation Levels
0	0	0
< 01.00	5	0.1 - 0.9
1.01 - 05.00	2	1.0 - 2.5
5.01 - 10.00	3	5.1 - 9.0
10.01 - 15.00	1	11.1
15.01 - 20.00	0	0
20.01 - 25.00	2	22.0 - 24.9
> 25.00	0	0

The average height of infested trees was not significantly different ($P > 0.05$, t-test) from that of non-infested trees (127.6 ± 7.2 and 121.0 ± 6.4 cm, respectively). Tree diameter also was not significantly ($P > 0.05$, t-test) different between infested and non-infested trees (Table 2). The heights of the infestation site on dogwood averaged ca. 12 cm above ground level (range 0-65 cm). Several previous researchers have reported that DB infestations on younger trees were mostly located in the crown of the tree (Underhill 1935, Schread 1965). Potter and Timmons (1981) reported that almost all of the infestation sites found on younger trees, i.e., < 15 cm diameter, were on the main trunk and within 50 cm of the ground. In our study, 98.4% (n = 724) of infestation sites on trees in nurseries were within 50 cm of the ground.

Table 2. Selected measurements of infested and non-infested dogwoods in the commercial nursery, urban landscape, and forest habitats.

	n		$\bar{x}$ Tree Diameter* (cm)		$\bar{x}$ Height of Infestation	$\bar{x}$ Diameter at Infestation Site
Habitat	Infested	Non-infested	Infested	Non-infested	(cm)	(cm)
Nursery	736†	787	1.9 ± 0.2a‡	1.7 ± 0.1a	12.0 ± 3.2	2.7 ± 0.3
Urban	146	97	16.5 ± 0.8a	16.4 ± 0.9a	39.4 ± 2.3	16.4 ± 0.6
Forest	9	859	5.3 ± 1.9a	5.9 ± 0.4a	96.5 ± 17.8	5.2 ± 1.7

* Tree diameter was measured at 30 cm above ground level.

† 23,007 trees were examined for borer infestation in commercial nurseries.

‡ Mean ± SE. Means within a habitat followed by the same letter are not significantly different according to a t-test ($P \leq 0.05$).

Tree age, as defined by the number of years that the tree had been in the field, influenced infestation level. Average infestation in nurseries was highest (ca. 12%) on trees that had been in the field for 3 to 4 years (Table 3). Trees that had been in the field for less than 2 years had the lowest infestation levels (ca. 0.2%). Establishment of DB in nursery blocks is believed to require at least one growing season to allow time for oviposition or larval entry sites to develop, adults to lay eggs, and larvae to penetrate the bark tissue; this information is supported by our results. Infestation levels on trees in the field for 5 or more years were lower than on those trees in the field for 3 to 4 years. Blocks with older trees were usually abandoned blocks with many weeds and small trees providing a thick undergrowth around the base of the trees. This change in habitat may adversely affect the repoductive behavior and biology of DB or simply reduce chances for mechanical injury that provides oviposition or larval entry sites.

Certain management practices also influenced infestations in nursery blocks. Dogwood blocks (n = 9) treated with insecticides (e.g., chlorpyrifos, lindane) for control of borers and other insect pests had significantly ($P \leq 0.5$) lower infestation levels than those blocks (n = 4) that had not been treated (3.2 ± 1.3 and 14.2 ± 5.6% infestation/block, respectively). Average infestation ranged from 0.1 to 11.1% in insecticide-treated blocks and from 1.0 to 24.9% in non-treated blocks. Because DB eggs and larvae are vulnerable to chemical insecticides only from the time of oviposition until larvae penetrate the bark, high infestation levels in treated blocks may suggest improper timing of insecticide application.

Table 3. Influence of dogwood age on selected characteristics of dogwood borer-infested trees in the commercial nursery.

Tree Age*	n	$\bar{x}$ Tree Diameter† (mm)	$\bar{x}$ Infestation Level (%)	$\bar{x}$ Height of Infestation (cm)	$\bar{x}$ Diameter at Infestation Site (mm)
<2 years	1	12.9	0.2	0.0	15.1
2 years	4	17.8 ± 1.2†	0.6 ± 0.2	15.1 ± 8.5	24.9 ± 3.1
3-4 years	6	18.8 ± 2.0	11.9 ± 3.9	14.4 ± 3.8	25.4 ± 2.2
>5 years	2	27.6 ± 8.6	5.7 ± 3.2	4.9 ± 1.2	39.8 ± 12.7

* Age was determined by the number of years that the tree had been in the field.
† Tree diameter was measured at 30 cm above ground level.
‡ Mean ± SE.

Urban. Infestation of dogwood in the urban habitat in eastern Tennessee averaged 60.1% (n = 243). This high infestation level may be primarily due to adverse environmental conditions which can weaken the tree and increase susceptibility (Potter and Timmons 1983). Dogwoods are particularly susceptible to DB infestation when planted in full sunlight in the urban landscape (Potter and Timmons 1981). In this habitat, they also are more likely to become mechanically injured, e. g., damaged by a lawn mower or string trimmer, providing entry sites for DB.

Diameter at 30 cm above ground level of infested trees was similar to that of non-infested trees (Table 2). Infestation sites were located higher on trees in the urban habitat than on those in the commercial nursery. The average height of the infestation site above ground level in the urban habitat was ca. 39 cm, ranging from 0 to ca. 127 cm. Most infestation sites on older trees, i. e., > 20 cm diameter, typical of an urban habitat, are higher in the limb crotches or major banches and are usually associated with pruning scars, cankers, or areas of cracked and raised bark (Potter and Timmons 1981). Our results indicated similar trends with infestation sites higher on the older trees in the urban landscape than on the younger trees in the commercial nursery. Average tree diameter at the site of infestation in the urban habitat was ca. 16 cm, ranging from ca. 3 to 40 cm.

Forest. Fewer DB-infested trees were found in the forest habitat than in the urban or nursery habitats (Table 2). This low infestation level (1.0%, n = 868) may be primarily attributed to the natural condition of dogwoods as a component of the forest understory. Native dogwoods are partially shaded in the forest and are not subjected to frequent mechanical injuries, e.g., damage caused by lawn mowers. Most of the infested trees were located in highly visible and traveled areas of the forest. Research has suggested that male DB are rarely collected in pheromone-baited traps placed in forest habitats in eastern Tennessee (Rogers and Grant, unpubl. data).

Average diameter at 30 cm above ground level of non-infested trees was similar to that of infested trees in the forest habitat (Table 2). Diameter of non-infested trees ranged from 0.6 to 27.9 cm, and diameter of infested trees ranged from 1.9 to 10.8 cm. Variability among diameters of infested and non-infested trees is due to the broad range of tree ages in the forest.

Height of the infestation site in the forest habitat averaged ca. 97 cm, ranging from 33.0 to 139.7 cm, above ground level and was much greater than the height of

infestation sites in the nursery or urban habitats (Table 2). Infestation sites in the forest may be located higher on trees than in other habitats because of extensive underbrush that may hinder or prevent adult moths from ovipositing on lower trunk areas. Many of the trees in the forest are often covered with moss which may interfere with oviposition. Limb breakage, occurring higher on older trees in the forest, may also provide wounds for DB entry sites.

In conclusion, few DB-infested trees were found in the forest, where dogwoods grow as a natural component of the forest understory. Infestation levels on dogwoods grown under "unnatural" conditions in an urban habitat, where exposure to sunlight and mechanical injury may have encouraged infestation, were high. These data suggest that DB rarely infests dogwoods in their native environment; however, when dogwoods are transplanted into the landscape or grown in nurseries, environmental stress factors may make them more susceptible to infestation.

Dogwood borer is an important pest of dogwoods in commercial nurseries in Tennessee, where ca. 7% of trees was infested. In our study, economic losses incurred by nurserymen due to DB averaged ca. $1,800/block of dogwoods. This estimate is based on averages of ca. 7% infestation/block, 1,770 trees/block and $14.00/tree. Because infested trees are not marketable, nurserymen must implement effective management strategies to reduce their losses to this pest species.

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References Cited

Nielsen, D. G. 1978. Sex pheromone traps: a breakthrough in controlling borers of ornamental trees and shrubs. J. Arboric. 4: 181-183.

Pless, C. D. and W. W. Stanley. 1967. Life history and habits of the dogwood borer, *Thamnosphecia scitula* (Lepidoptera: Aegeriidae), in Tennessee. J. Tenn. Acad. Sci. 42: 117-123.

Potter, D. A. and G. M. Timmons. 1981. Factors affecting predisposition of flowering dogwood trees to attack by the dogwood borer. Hortscience 16: 677-679.

Potter, D. A. and G. M. Timmons. 1983. Biology and management of clearwing borers in woody plants. J. Arboric. 9: 145-150.

Schread, J. C. 1965. Dogwood borer, *Thamnosphecia scitula* (Harris). Conn. Agric. Exp. Stn. Circ. 199. 3 pp.

Smith, D. C. and M. J. Raupp. 1986. Economic and environmental assessment of an integrated pest management program for community-owned landscape plants. J. Econ. Entomol. 79: 162-165.

Underhill, G. W. 1935. The pecan tree borer in dogwood. J. Econ. Entomol. 28: 393-396.

Williams, D. B., W. T. Witte, C. H. Hadden, and H. E. Williams. 1985. The flowering dogwood in Tennessee. Tenn. Agric. Ext. Serv. Publ. 589. 20 pp.