Winter Oviposition of the Azalea Lace Bug (Hemiptera: Tingidae) in North Carolina[1]

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ABSTRACT Adult azalea lace bugs survived the winters of 1990-91, 1991-92, and 1992-93 in central North Carolina. Females were capable of winter oviposition under both laboratory and field conditions. Two life-stages, egg and adult, commonly overwinter in North Carolina.

KEY WORDS *Stephanitis pyrioides,* azalea lace bug, oviposition, overwintering.

Based on records of samples submitted to the North Carolina State University Plant Disease and Insect Clinic, the azalea lace bug *Stephanitis pyrioides* (Scott) (Hemiptera: Tingidae) is the most common pest of cultivated azaleas in North Carolina. It has a significant impact in nurseries and commercial landscapes, as well as in home gardens. Feeding by *S. pyrioides* causes a stippled appearance on the upper side of leaves and varnish-like excrement speckles the lower surface. Plant vigor is reduced and in severe infestations the leaves may brown and drop prematurely.

Azalea lace bug is difficult to control because the eggs are inserted into leaf tissue and covered with a spot of excrement; because of this protection, eggs are unaffected by standard control measures. The current recommendation in North Carolina for control of this insect is to spray twice per year, the first time in April/May, shortly after hatch of the first generation of the year; the second spray is recommended between mid-July and mid-September (Baker 1990).

The life history of this insect in North Carolina is not clearly defined. Baker et al. (1980) indicated that *S. pyrioides* overwinters in the egg stage and the eggs begin to hatch in late February; two or more generations occur per year. Horn et al. (1979), however, reported overwintering of adult lace bugs in North Carolina. They observed azalea lace bugs feeding in February and early March of 1976; by mid-March, however, only young nymphs were present. Reports of the phenology of azalea lace bug in other states indicate that eggs are the overwintering stage (Dickerson and Weiss 1917, Neal and Douglas 1988, Braman et al. 1992).

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The objectives of this study were to determine if adult *S. pyrioides* were commonly present and could oviposit in the field and laboratory during winter months in North Carolina. Winter oviposition by this pest may have consequences for the synchrony of spring hatch and thus affect timing of control measures.

Materials and Methods

Winter sampling for adults. In 1991, two separate plots of azaleas were planted and observed for the winter presence of adult azalea lace bug. Twenty azaleas (var. Mrs. Gerbing) infested with *S. pyrioides* were obtained from an outdoor nursery and planted in Raleigh, NC in two locations (10 plants in each): the first along the foundation of the east facing wall of a building (Plot 1 - established 21 November 1990), and the second in an open field on a southwest facing slope of a slight rise (Plot 2 - established 15 January 1991). Biweekly inspections of the plants in both plots were conducted 14 February to 25 April 1991 to monitor the presence of azalea lace bug adults. The source nursery was also sporadically inspected for azalea lace bugs, as were commercial and homeowner sites in the Raleigh area in 1991, 1992, and 1993. Beat samples (minimum of 25 "beats") at two sites were taken to determine sex ratios of adults: 16 December 1991 (commercial site) and 21 February 1991 (nursery site). The sampling technique consisted of holding a white plastic pan beneath the plant while striking the foliage with a wooden stick.

Oviposition cages. Oviposition cages for laboratory and field studies were constructed by cutting out the bottom and side sections of 227 g (8 oz.) plastic yogurt containers (Fig. 1). One end of a sleeve made of netting was attached near the upper rim of the container using a glue gun; the other end of the sleeve was fitted with a drawstring. A hole was cut into the lid of each container using a 1.3 cm brad point bit. For the laboratory studies, the cages were inverted, hung from a wire rack, and a floral container fitted into the hole in the lid (Fig. 1A). For the field studies, cages were placed over individual, randomly chosen terminals on an azalea bush, and the hole in the lid was fitted with a cork (Fig. 1B).

Laboratory oviposition by overwintering females. Laboratory oviposition studies were conducted in both 1991 and 1992. Females were placed individually into oviposition cages on a sprig of terminal growth (4-10 leaves) taken from a single field grown bush of the Southern Indica hybrid group (probably var. G. G. Gerbing). The stem of the sprig was inserted into a floral container filled with water, which was replenished as needed. Oviposition cages were placed near an unshaded west-facing window and held without artificial lighting; temperature ranged from 22-28°C.

In 1991, twenty adult female *S. pyrioides* were collected on 5 April 1991 from the azaleas in Plot 1 and placed into oviposition cages the same day; the cages were checked 5 days after they were set up, then daily until the death of the insect. All females were fully sclerotized, suggesting that they were overwintering adults and not the first generation of the year. In 1992, laboratory oviposition studies were conducted earlier in the year; azalea lace bugs used were collected 10 January 92 from a homeowner's shrubs (variety unknown) in Raleigh, NC and placed into oviposition cages the same day. Cages

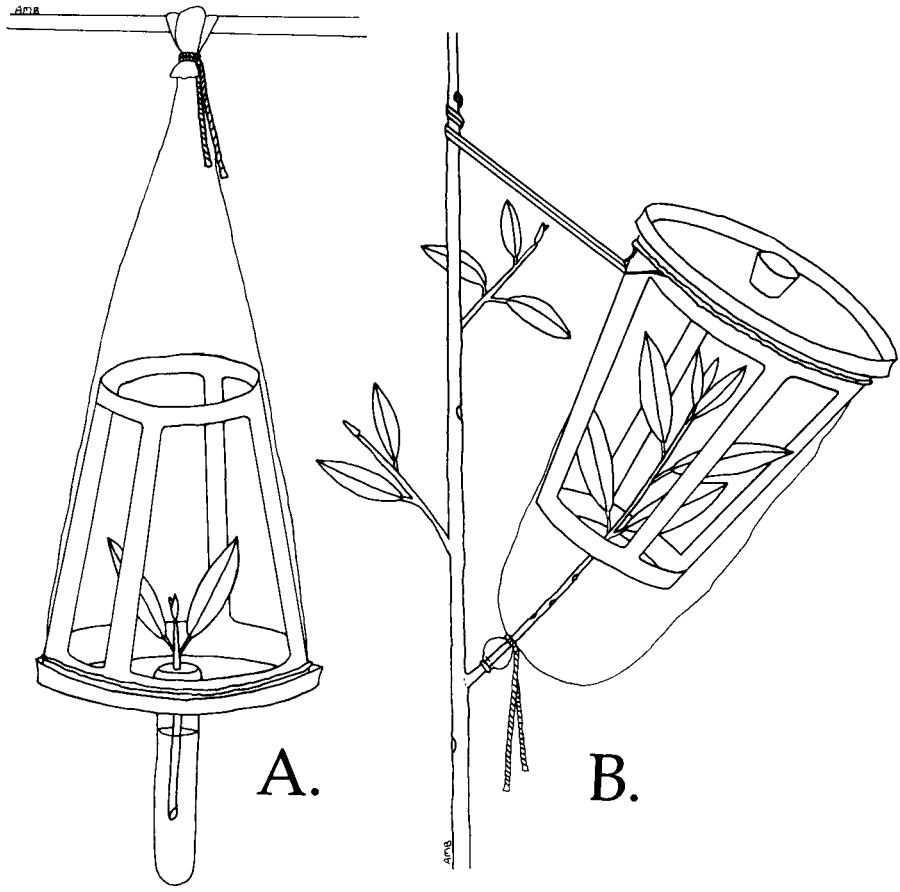

Fig. 1. Cages used in azalea lace bug oviposition studies. A) Set up for laboratory studies. B) Set up for field studies.

were checked daily until the death of the insect. In both years, the azalea sprig was then removed from the oviposition cage and examined for eggs by backlighting and inspecting individual leaves with a dissecting microscope. Viability of eggs was not determined, but young instars were present in cages at the termination of the study.

Field oviposition by overwintering females. Adult azalea lace bugs were collected from potted azaleas in a Wake County nursery on 17 February 1992. The same day, six female and one male *S. pyrioides* were placed into each of five oviposition cages on an azalea (1.5 m in height; Southern Indica hybrid group) planted near the southeast corner of a white stucco house. The azalea was determined to be "lace bug free" by visually inspecting leaves for damage and excrement and by removing and microscopically examining any suspicious leaves for eggs; no eggs were found. Oviposition and survivorship of the females

were checked by cutting the azalea branch below the point where the oviposition cages were attached, then bringing both the cage and the branch into the laboratory for inspection. All eggs were counted and insects that survived were replaced onto a fresh caged branch in the field. The first cage was initially checked 9 March 1992, then weekly until all females died. The second cage was checked 16 March 1992, then weekly; this pattern was repeated, with one new cage initially checked at each new sampling period. All females died by 20 April 1992.

Nursery Inspections. Ten commercial nurseries known to have chemically treated for *S. pyrioides* during the summer of 1991 were each inspected once during the period 30 January to 6 March 1992 to determine the winter presence of azalea lace bug. The nurseries were located in eight counties in central North Carolina (Chatham, Johnston, Lee, Nash, Sampson, Wake, Wayne and Wilson). Beat samples (minimum of 25 "beats") were taken from each variety of azalea that showed evidence of azalea lace bug damage.

Weather Data. Data on winter temperatures were obtained from the National Weather Service Forecasting Office in the Raleigh-Durham International Airport.

Results

Observations of adults. In 1991, adult azalea lace bugs were observed on every sampling date in both plots, with one exception (11 April sample in Plot 2). New adults (unsclerotized) of the first generation of the year were first observed in Plot 1 on 11 April, and in Plot 2 on 28 March. The sex ratio of adults in these samples was approximately 4 females to 1 male (n = 46). The sex ratio of the sample taken from the commercial site on 16 December 1991 was 3.7:1 (n = 192); the sex ratio of the beat sample taken from the nursery site on 21 February 1991 was 4.5:1 (n = 77). In 1992, overwintering adults were observed sporadically in the Raleigh area until at least April 1st. In 1993, adult *S. pyrioides* were taken in beat samples from two of four sites sampled in the Raleigh area on 9 March 1993. Both positive sites were foundation plantings; 19 adults were collected in one site (13 females, 6 males), 26 adults were collected at the other (20 females, 6 males).

Laboratory oviposition by overwintering females. *S. pyrioides* females collected 5 April 1991 and 10 January 1992 were capable of oviposition under laboratory conditions. In 1991, 10 (50%) of the females in this study died within the first 5 days; 4 of these females oviposited before dying. Eight of the 10 females that survived the first 5 days eventually laid eggs. Thus, a total of 12 of the 20 females (60%) oviposited; the number of eggs ranged from 2 to 48 per female. The mean (± S. D.) number of eggs laid per female was 15 ± 13. In 1992, one female died without ovipositing the day after the study was initiated; all remaining females (95%) laid eggs. The number of eggs ranged from 3 to 66, with a mean of 23 ±16. The number of eggs laid was related to the number of days females survived (Fig. 2).

Field oviposition by overwintering females. In the field studies, a mean of 170 ± 24 eggs (range 142 to 202) were laid per cage (6 females, 1 male in each cage). Surviving *S. pyrioides* females continued oviposition in the field until the third week of April (Table 1).

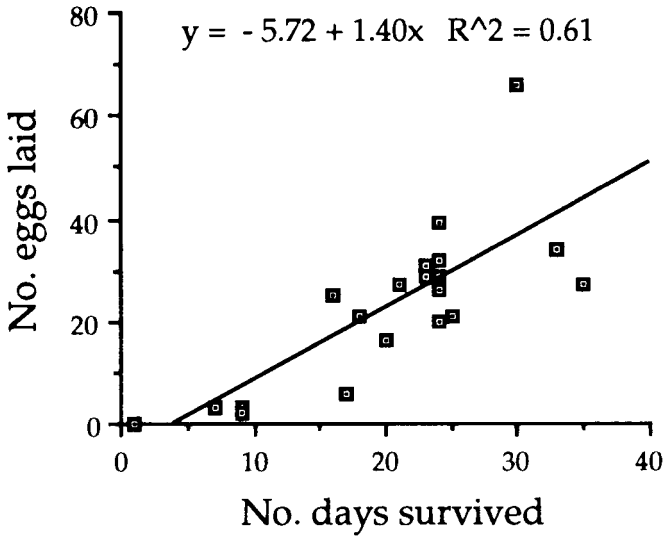

Fig. 2. Number of eggs laid by individual winter-collected (10 January 1992) azalea lace bugs in the laboratory in relation to the number of days they survived (n = 20 females).

Winter nursery inspections. Adult azalea lace bugs were found in potted azaleas in 6 of the 10 nurseries inspected 30 January to 6 March 1992. Plants were tightly grouped in all nursery sites; however, the plants were sheltered under black plastic mesh in just one of the positive sites.

Weather Data. Based on records of the National Weather Service Forecasting Office for the Raleigh-Durham Airport, the winters of 1990-91, 1991-92, and 1992-93 were relatively mild (Table 2). By contrast, the winter of 1975-76, when Horn et al. (1979) observed overwintering *S. pyrioides,* was harsher. December 1975 had almost normal averages although there were 5 nights of -6.7°C or lower. January 1976 had 7 nights of -6.7°C or lower and averaged 1.7°C below the 30 year average minimum. February and March 1976 were somewhat milder than the 30 year average.

Discussion

Adult azalea lace bugs were observed to survive the winters of 1991-93 in central North Carolina and overlapped with hatched nymphs, and possibly adults, of the first generation of the following year. Overwintering *S. pyrioides* females were present and capable of oviposition as late as April in both 1991 and 1992, and adults were observed during March in 1993. That Horn et al. (1979) observed adult winter survival during relatively harsh weather and our observations for relatively mild indicates that some adult azalea lace bugs can

Table 1. Cumulative number of eggs laid by azalea lace bug in the field, 17 February to 20 April 1992; 6 females and one male per cage.

Date checked	No. days in field	Cumulative no. eggs laid				
		Cage 1	Cage 2	Cage 3	Cage 4	Cage 5
9 March	21	101				
16 March	28	116	114			
23 March	35	132	136	137		
30 March	42	139	149	149	167	
6 April	49	141	151	158	–	165
13 April	56	142	154	186	–	181
20 April	63	–	–	202	–	185

Table 2. Deviation from 30 year average temperatures during the winters of 1990-91, 1991-92 and 1992-93 in central North Carolina*.

Date	Deviation from maximum (°C)	Deviation from minimum (°C)
Dec 1990	+3.2	+3.7
Jan 1991	+0.7	+1.9
Feb 1991	+3.2	+2.7
Mar 1991	+2.6	+2.9
Dec 1991	+2.9	+2.7
Jan 1992	+2.1	+2.1
Feb 1992	+2.3	+2.9
Mar 1992	+1.2	0
Dec 1992	-0.9	+1.4
Jan 1993	+1.3	+2.8
Feb 1993	-0.8	+0.5
Mar 1993	-1.4	+0.3

* Data from the National Weather Service Forecasting Office for the Raleigh-Durham International Airport.

survive most winters in central North Carolina. Temperatures actually experienced by *S. pyrioides* no doubt vary greatly depending upon microhabitat. The location of our outdoor winter oviposition study may have favored azalea lace bug survival. However, the landscaping practice of planting azaleas along the foundation of houses and the nursery practice of providing winter shelter to azaleas probably allow adult *S. pyrioides* to survive even relatively cold North Carolina winters. Additionally, these studies were conducted in the Central Piedmont of the state; winter survival of azalea lace bug would be even more likely in the Coastal Plains.

The number of eggs laid by overwintering *S. pyrioides* was related to the number of days they lived (Fig. 2). If adult lace bugs are observed in the field during winter, then there is potential for oviposition during mild periods. Corroborative evidence for winter oviposition was recently obtained by the authors (unpublished): azalea lace bugs caged outdoors during the month of December, 1993 laid eggs. The sex ratio reported here is more skewed toward females than that reported in Georgia (2:1) (Braman et al. 1992), but it is unknown whether this difference is geographic, seasonal, or the result of different sampling techniques.

This study suggests that, in addition to the egg stage, adult azalea lace bugs commonly overwinter in North Carolina. These findings have implications for the phenology of hatch of the first generation of the year and, consequently, for the efficacy of control measures taken. Control efforts are commonly aimed at the hatch of the first generation developing from overwintering eggs (Dickerson and Weiss 1917, Neal 1985). In Georgia, *S. pyrioides* eggs deposited during October or later overwinter (Braman et al. 1992). If oviposition also is occurring sporadically throughout the winter, the hatch of the first generation of the year may be less discrete than previously suggested.

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