CITIZEN ATTITUDES TOWARD ORANGESTRIPED OAKWORM: IMPACT, CONTROL, HOST AESTHETICS, AND IPM PRACTICES

by Mark A. Coffelt and Peter B. Schultz

Abstract. A random survey of two Norfolk, VA residential neighborhoods (N=132) revealed citizen attitudes toward the orangestriped oakworm, *Anisota senatoria.* The majority of citizens surveyed (98.5%) considered *A. senatoria* a serious problem, experienced greater than 50% defoliation (56%), and were willing to tolerate some damage (70%). Chi-square analysis showed the greater the damage, the less tolerant citizens were to *A. senatoria* infestation (P<0.0001). The physical presence of *A. senatoria,* as measured by frass and larvae on property, was the primary citizen complaint and defoliation effects were considered as minor. Citizens were willing to pay for professional *A. senatoria* control. Many (43.5%) felt municipal control was ineffective because of poor timing of treatments. They felt that trees (35%) and the lawn (34%) were aesthetically the most important components in the landscape. Most citizens (80%) were willing to pay for natural control, and some (38.5%) felt that pesticides were unsafe. The attitudes toward *A. senatoria* provided a framework for designing an urban pest management program.

The orangestriped oakworm, *Anisota senatoria,* is a native insect and pest of both forest and urban plantings (1). It is listed as one of the 30 major shade tree pests in the United States (10) and a major oak defoliator in the southern states (14). Major outbreaks have occurred in Connecticut, Mississippi, Michigan, New Jersey, New York and Pennsylvania (8). Over 15,000 ha were defoliated in Connecticut (7). *Anisota* sp. (*A. virginiensis, A. senatoria,* and *A. stigma*) and oak leaf miners (*Cameraria* sp.) defoliated or browned 36,500 ha in Mississippi (15). In Norfolk, VA defoliation has been severe and insecticidal control based on citizen complaints has been implemented by city officials over the last 7 years. This policy has been expensive and perceived as ineffective (3).

Surveys are effective in determining public knowledge of target pests and in evaluating control and management practices (9, 12, 19). A survey by Byrne et al. (2) revealed the negative public attitudes toward arthropods and implications for urban pest management. Zungoli & Robinson (20) surveyed residents and found that specific attitudes of the target audience need to be addressed when designing pest management programs.

Our objectives were to evaluate public attitudes toward a major defoliating insect and to provide a framework for designing an urban integrated pest management program.

Materials and Methods

Ten percent of the homeowners in two Norfolk, VA residential neighborhoods (West Ghent [WG] N=82; Roland Park [RP] N=50) were randomly chosen for interviews (13). Rental units were not included in the survey because of a possible biased response. Byrne et al. (2) found that renters responded more positively to both indoor and outdoor arthropods than homeowners. If a citizen could not be interviewed after two attempts on separate days, then replacements were interviewed. The survey was conducted by the same person in both areas as a door-to-door interview. There were 18 largely open-ended questions (answers not selected from a list), and time was recorded for each interview. The survey was tested in June, 1988; slight revisions were made in format, and it was conducted in October. A competitive market analysis of the two areas was obtained to determine real estate values and to estimate incomes.

Descriptive statistics (mean % response) were calculated for each question, and analysis of variance (ANOVA) was conducted to determine differences in responses between the two areas (13). Chi-square analysis was applied to determine significant relationships between questions (13).

Results and Discussion

Survey demographics. Interviews averaged

5.8±0.2 minutes, which were in an acceptable range (20). Mean respondent age was 50.5 years with no significant difference between West Ghent (WG) and Roland Park (RP). Significantly more women were surveyed in WG (74%) than in RP (50%) ($P<0.01$). Sexual difference did not appear to influence the survey, since questions dealt with impact and control and not insect preference or sociological beliefs. Byrne et al. (2) found that females responded more negatively to arthropods when they were asked how they felt about insects.

Citizens of RP had lived significantly longer at their residence than WG citizens (46% and 27% lived at their residence more than 24 years respectively)($P<0.01$). However, this was not a factor since *A. senatoria* defoliation was most severe from 1986 to 1988, and most citizens were familiar with damage.

A competitive market analysis of the two areas showed homes located in WG were significantly higher in price ($P<0.0001$)($N=53$, median = $127,500) than homes in RP ($N=33$, median = $68,000). WG and RP median incomes were estimated to be $51,000 and $27,200, respectively, based on home purchases averaging 2.5 times annual household gross income (17). These income differences may have influenced citizen response to *A. senatoria* control.

A. senatoria impact. The majority of residents (98.5%) responded affirmatively when they were asked, "Has this insect *(A. senatoria* fifth instar photograph) been a serious problem to the trees in your yard?" These data indicate that citizens correctly identified *A. senatoria* as the major shade tree defoliator in Norfolk, VA. Citizen responses were not influenced by the presence of *A. senatoria* larvae because the October survey was conducted 2 months after larvae had pupated. Time of year when surveys are conducted can influence survey outcome, depending on insect abundance and biology. Robinson & Bao (11) showed that residents surveyed in August considered smokybrown cockroaches, *Periplaneta fuliginosa*), to be a more serious problem than residents surveyed in April because *P. fuliginosa* was more abundant.

A. senatoria impact was shown by the amount of damage (Table 1). Citizens were shown color photographs of trees which had received 15, 25, 50, 75, and 100% defoliation by *A. senatoria* (Questions 3 and 4). The majority of citizens (56%) had experienced at least 50% defoliation during a 3 year period with RP citizens experiencing significantly more damage than WG citizens (24% observed total defoliation)(Table 1). Equal responses were given between acceptance of 0, 15, and 25% damage (Table 1). Most citizens (70%) were willing to accept limited *A. senatoria* damage. An IPM program utilizing an aesthetic injury level was developed partly based on this citizen tolerance of *A. senatoria* damage (4).

There was a significant relationship between the amount of damage citizens experienced (Question 3), and how much citizens were willing to accept (Question 4) ($X_2=78.5$, $P<0.0001$, $df=5$). The greater the damage, the less tolerant citizens were to *A. senatoria* infestations. Zungoli & Robinson (20) stated that tolerance levels are variable depending on the extent of pest infestation. They found the opposite relationship with the German cockroach, *Blattella germanica*; the larger the infestation, the greater the tolerance level. When designing an urban IPM program, the relationship between damage and tolerance levels for each pest must be established.

A. senatoria impact was evaluated by citizen response to the question "Did you notice frass or droppings falling from your trees?" Most citizens (84%) noticed frass accumulating on area streets and sidewalks and RP citizens were significantly ($P<0.10$) more aware (92%) of frass than WG citizens. This could be because RP trees had

Table 1. Citizen response to pictorial question 3 "How much damage did this insect do to your trees this year or the last 2 years?" and question 4 "How much damage would you be willing to accept? "

	% Responding			
	Question 3*		Question 4	
%damage	WG	RP	WG	RP
0	4	2	30	30
15	18	10	33	30
25	29	24	28	28
50	32	32	4	12
75	5	8	1	0
100	12	24	4	0

* Significant difference between areas ($P<0.05$).
WG = West Ghent, RP = Roland Park

more defoliation and concurrent frass accumulation. There was a significant relationship between a citizen's attitude that *A. senatoria* was a serious problem, and whether frass was observed (X_2=18.1, P<0.0001, df=2). Citizens complained that frass was a major nuisance and the time spent sweeping and cleaning it from sidewalks and driveways was considerable. Citizens averaged 3.7 hours per week during August and September sweeping frass from their property and RP citizens spent significantly (P<0.10) more time sweeping frass (6.8 hours) than WG citizens (1.3 hours).

There were nonsignificant (P>0.10) responses between areas when citizens were asked to name the worst problem associated with *A. senatoria* damage. Citizens disliked *A. senatoria* fifth instar larvae crawling on their property seeking suitable habitats to pupate (mean = 39%), and were slightly less offended about defoliation impact (mean = 36%). Despite the considerable time spent sweeping frass, it received the lowest response (mean = 22%). The physical impact of *A. senatoria,* as measured by caterpillars crawling and frass, received a higher response (61%) than defoliation impact (36%). Citizens observed that *A. senatoria* nuisance infestations were worse than actual defoliation damage.

A. senatoria control. Citizen perception of *A. senatoria* damage to trees on public property was evaluated from their desire for pesticide application. When citizens were asked if they ever called city officials to request *A. senatoria* pesticide application, 61% responded affirmatively. This was a public service provided at no cost. Over half of the citizens (54%) would hire a professional to treat their private or city trees if city officials did not spray (Table 2).

A measure of pest status can also be determined by the willingness to pay for treatment. Significantly more citizens of WG would hire a professional (66%), and they were willing to pay more than RP citizens ($56 and $21, respectively) (Table 2). Even though RP citizens had experienced significantly more damage, they were less willing to pay for control, possibly because they had lower income. In a similar example, Lemke & Kissam (9) found willingness to pay for red imported fire ant, *Solenopsis invicta* , control was directly related to income.

Effectiveness of *A. senatoria* chemical control was evaluated by asking citizens if it was possible to eradicate *A. senatoria* on their city or private trees. Roland Park citizens experienced more damage and requested more treatment than WG citizens, and they were significantly (P<0.05) more cognizant (62% versus 44%) that eradication was impossible because of ineffective city pesticide application. When RP and WG citizens were asked why *A. senatoria* was not controlled, many (mean = 42.5%) said pesticide application was not timed to *A. senatoria* life stages. City officials based their treatment schedules on citizen demand, which proved ineffective. Improved *A. senatoria* control was achieved by replacing this policy with pest management strategies (4). Other perceived reasons for ineffective A. *senatoria* control included weak chemicals, too many caterpillars, inadequate pesticide coverage within the tree, improperly trained applicators, the need for area wide coverage of private trees, and insecticide resistance.

Host aesthetics. Citizen attitudes toward aesthetic value of urban shade trees was evaluated. Both survey areas had a mean of two oaks (*Quercus* spp.) per property. Citizens were asked to choose the most important component in their

Table 2. Citizen response to question 5 "If the City of Norfolk did not spray, would you hire a professional pest control operator or tree service?" *

	% Responding	
Response	WG	RP
Yes	66	34
No	33	64
Not sure	1	2

and question 6 "How much would you be willing to pay per tree to have a professional spray?"*

$/tree		
0	34	66
1-50	27	14
51-101	32	16
102-152	3.5	4
>153	3.5	0
Mean ($)	56	21

* significant difference between areas (P<0.001).
WG = West Ghent, RP = Roland Park

landscape (Table 3). Trees (35%) and lawns (34%) received the highest mean response. However, significantly more RP citizens considered the lawn (42%) the most important, while WG citizens considered trees (36%) more important than lawns (22%). RP citizens experienced more damage, frass, and pesticide applications, and several citizens stated that trees were a nuisance because of high maintenance requirements. Several RP citizens felt that the disadvantages of urban shade trees exceeded the benefits, and some requested that oaks be removed. The benefits of urban shade trees have been well documented (5, 16); however, our data show insect infestations adversely affect tree aesthetic value and citizen perception of the benefits.

Citizens were asked the amount of time they spend caring for trees and shrubs (not the lawn) each week. Differences were not significant between areas (WG=2.4, RP=3.2 hours per week), although citizens differed in their evaluation of tree importance (Table 3). RP citizens felt that tree care was important and applied water and fertilization treatments. When asked if *A. senatoria* defoliation would kill their trees, 73% responded affirmatively. Citizens felt that defoliation in August and September was serious and mortality could occur. This contradicts research which indicates that late season defoliation has less physiological impact on tree vigor than early season defoliation (18). However, in 1988, three mature RP trees that had received 4 years of successive *A. senatoria* defoliation died, although other factors such as physiological stress and disease may have contributed to tree mortality.

IPM practices. Citizen attitudes toward IPM practices such as nonchemical or natural control and pesticides were surveyed. Most citizens were familiar with natural control, and question clarification was not needed. Natural control was considered to be a viable IPM strategy, as evidenced by 80% of the respondents being willing to pay a user fee for such a program (Table 4). Significantly more WG citizens were willing to pay for such a service probbly because of higher estimated incomes. Frankie & Levenson (6) surveyed people in Dallas, TX during 1975 and 1976 and found that 30% had knowledge of nonchemical methods to control insects, and 70% were aware of beneficial insects. In the 14 years since their survey, these data suggest public perception of natural control has increased (80%), although regional and sampling differences may exist.

There was a significant relationship between the IPM strategies of accepting tolerance levels and accepting natural control (X_2=69.5, P<0.0001, df=5). If a citizen accepted the concept of tolerance levels for *A. senatoria* defoliation, then natural control was also acceptable. These responses indicate that IPM tactics such as aesthetic thresholds and injury levels are viable options.

When RP and WG citizens were asked if they felt that pesticides were unsafe, 38.5% responded affirmatively (Table 4). This was lower than expected because of the recent national publicity over pesticide use. Negative attitudes toward pesticides has increased since Frankie & Levenson (6) conducted their survey (12% felt chemicals were unsafe). Some RP and WG citizens were unsure about pesticide safety (mean = 25.5%), illustrating the need for educating residents on disadvantages and advantages of pesticides. There was a significant relationship between citizens willing to pay for natural control and their response to pesticides being unsafe (X_2=46.6, P<0.0001, df=2). Citizens who felt that natural control measures would help control *A. senatoria* also felt that pesticides were unsafe.

Citizen education. Educating the target audience and determining where they obtain their information is important when designing urban pest management programs (2, 20). The majority of citizens (77%) obtained information about pest control, primarily from four sources: nurseries (15%), pest control operators (14%), Norfolk Bu-

Table 3. Citizen response to the question "Which of these do you think is the most important?"

Character	% Responding WG *	RP
Attractive lawn	27	42
Attractive trees	36	34
Attractive shrubs	22	12
Not sure	15	12

* *significant difference between areas (P<0.10).*
WG = West Ghent, RP = Roland Park

Table 4. Citizen response to question 7 "Would you be willing to pay $10 to help control the oakworm with nonchemical or natural control agents?" and question 8 "Do you think the pesticides sprayed on your trees are unsafe?"

	% Response			
	Question 7*		Question 8	
Response	WG	RP	WG	RP
Yes	89	64	39	38
No	7	26	34	38
Not sure	4	10	27	24

* significant difference between areas ($P<0.01$).
WG = West Ghent, RP = Roland Park

reau of Parks and Forestry (13%), and Virginia Polytechnic Institute and State University Cooperative Extension Service (11%). Frankie & Levenson (6) surveyed Dallas, TX residents and found that pest control operators and nurseries provided 43% and 20%, respectively, of all public information. While lack of formal training in entomology from these two sources was apparent, residents were satisfied with results. VPI & SU (Cooperative Extension Service and Agricultural Experiment Station) served as information sources for 17% of residents in our study. Educational programs will enhance efforts to effectively manage *A. senatoria* populations.

These data show that conducting a citizen survey is an important first step when developing urban IPM programs. The response to survey questions on *A. senatoria* impact and control were incorporated into a pest management program (4).

Acknowledgments. We thank the City of Norfolk, Bureau of Parks & Forestry for their cooperation and W. H. Robinson for assistance in survey format.

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Department of Entomology
Virginia Polytechnic Institute & State University
Hampton Roads Agricultural Experiment Station
Virginia Beach, Virginia 23455