SELECTED EFFECTS OF SUBLETHAL DOSAGES OF THREE INSECTICIDES ON THE BAGWORM

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Abstract. A survey was made under field conditions of the effects of sublethal dosage by ingestion of bagworm larvae, *Thyridopteryx ephemeraeformis* placed on diazinon, carbaryl, or toxaphene treated juniper. Low dosage ingestion did not effect survival, egg number, pupation duration, or emergence patterns. Test populations on diazinon treated trees completed development through the pupation stage in significantly higher numbers. Treatments with toxaphene resulted in significantly larger egg size but treatment with carbaryl produced a significant decrease in egg size.

Control problems exist with the bagworm *Thyridopteryx ephemeraeformis* (Haworth) in urban areas. Historically control recommendations have stressed timing the insecticide application to coincide with hatching (1, 7). Sublethal ingestion is possible as a result of inaccurately timed insecticide application. Late season control using recommended dosages have produced mortality percentages no higher than 28 percent (2) suggesting sublethal ingestion by the surviving population. Insecticide application made during the hatching period may also produce sublethal dosage ingestion due to such variables as incomplete coverage, effects of weathering, or alterations in expected hatching patterns.

The purpose of the present study was to survey a numerically controlled bagworm population feeding on insecticide treated trees under field conditions. Measurements were made to assess the effects of sublethal dose ingestion by larvae feeding on trees treated with diazinon, carbaryl, or toxaphene. The bagworm is an ideal candidate for such a study as the population is naturally confined to a given location. The study was designed to determine if such dosage would have an effect upon the test population's survival, fecundity, or developmental stage duration. Egg measurements were included to examine possible effects of sublethal dosage ingestion upon the next generation of bagworms.

Methods and Materials

A *Juniperus virginiana* 'Canaertii' grove located on the Texas Tech University campus, Lubbock, Texas was selected as the test site. These trees had not been chemically treated the previous year. Bags remaining from the previous bagworm populations were removed by hand from all trees. Using a randomized design, four trees were selected for each treatment and the untreated check. Dosage determination trials were made using laboratory hatched populations. Female pupal cases filled with eggs were exposed to temperature regimes to facilitate early hatching (4). Larvae were reared in the laboratory for 30 to 60 days on branches of *J. virginiana*. Several different fractions of the recommended dosage for the tree test insecticides were given mortality ranking by placing larvae upon treated branches of *J. virginiana*. Larvae were confined on the branches within cages. Application rates were chosen which produced no more than a 50% mortality to assure adequate dosage to produce sublethal effect. The formulations and dosage rates selected were as follows: Diazinon AG 500® at 1/8th the recommended dosage for bagworm control; Sevin® 80% WP at 1/16th of the recommended dosage; and toxaphene 8E at 1/16th of the recommended dosage.

Insecticide application was made at the test site using these rates with a John Bean® power sprayer set to deliver 400 pounds of pressure with a John Bean® gun. Eight hours after insecticide application, the test populations of larvae were placed on the treated trees. These larvae were approximately 35 days old based on initial field hatching dates and were gathered 24 hours before placement from a previously selected natural population occurring on *J. virginiana* which had received no chemical treatment during the previous year. Foil covered plastic cups fitted with air holes and food provided temporary housing for these larvae which were held in groups of ten.

One hundred larvae were placed on each test tree.

Trees were monitored twice a week at 11:00 a.m. throughout the summer. Records were kept on the number of bags tied for pupation and the number of male pupal cases extruding from bags. The maximum daily temperature as recorded at the local weather bureau was used to determine if a positive correlation exists between high temperature and high frequency of male emergence numbers (6).

At the completion of the life cycle in the fall all bags were removed and the contents of each bag examined. Counts were made of male and female pupal cases, bags with larval remains which measured less than or more than one inch, and bags showing evidence of parasitism. Thirty-two female pupal cases from each treatment category were dissected for egg counts. Eggs were separated from pupal cases and surrounding scales following the method described by Morden (4). Eggs were rinsed in a 70 percent solution of ethyl alcohol and poured onto filter paper where dark and light colored eggs were counted using a dissecting microscope. Dark eggs were considered non-viable (8). Egg size was measured for 100 eggs chosen at random in each sample using a micrometer eye piece. As a second check of egg viability, a controlled temperature hatch using five bags per treatment was made. Although exact counts were not possible, observations were recorded.

Results and Discussion

Survival determinations were made on the basis of bag contents. An analysis of variance for treatment effect upon surviving adult means indicated no significiant difference (P 0.05). There was no significant effect upon survival between the sexes (P 0.05). An analysis of variance for treatment effect upon size of larvae at death provided no significant treatment difference (P 0.05). The number of parasitized larvae and pupae were judged too small for meaningful analysis.

In an examination of the mean numbers of bagworms to complete the pupal attachment, diazinon treatments differed significantly (P 0.01). Diazinon treated populations completed development through the pupation stage at higher numbers (Table 1).

Treatment effect on the number of eggs per female was not significant (P 0.05). Egg numbers ranged from 650 to 1550 and averaged 1100 eggs per bag. No significant differences were evident in an analysis of variance for vital and nonvital eggs (P 0.05). Observations indicated the egg viability to be essentially identical for the three treatments and the check.

All bagworms, regardless of treatment, followed the expected pupation and emergence patterns (3). There was no correlation between high temperature and high frequency of male emergence. These findings do not substantiate earlier emergence studies in Illinois (6). However, temperatures recorded in this study were approximatley 20° C above those in the Illinois study suggesting that a 42° to 50° C range may be too far above the minimum required temperature to

Table 1. A comparison of the mean numbers of bagworms attached to trees for pupation on insecticide treated and untreated check trees based on 400 larvae per treatment.

Type of treatment	*Mean numbers tied for pupation*[1]	
diazinon	70.38	a
toxaphene	47.50	b
carbaryl	36.25	b
check	32.75	b

1. Means not followed by a common letter are significantly different at the 5 percent level according to Duncan's multiple range test.

Table 2. Effect of sublethal dose ingestion of three insecticides by larvae upon subsequent size of eggs oviposited by adult females (32 bags per treatment).

Type of treatment	*Mean egg length in mm*[1.]			
toxaphene	1.264	a		
diazinon	1.223	a	b	
check	1.184		b	
carbaryl	1.119			c

1. Means not followed by a common letter are significantly different at the 5 percent level by Duncan's multiple range test.

show a correlation. The emergence period for the 1979 season in Lubbock, Texas encompassed 60 days and substantiates the longer emergence period exhibited by populations in the southern range (5).

Egg measurement suggested a significant treatment effect upon egg size (P 0.0003). Eggs averaged 1.2 mm in length as noted in an earlier study (7). The mean values for egg length (Table 2) indicated that eggs from toxaphene treatments were significantly larger than those from carbaryl treatments or untreated checks. but eggs from carbaryl treatments were significantly smaller than those of all other catagories. Egg size was measureably affected by sublethal dosages of two toxicants used. The effect on egg size noted in toxaphene and carbaryl treatments may have an indirect impact upon overwintering egg survival, subsequent larval survival and/or other effects which were not resolved in tests reported here.

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ABSTRACT

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Plants have a way of making a liar out of even the best-intentioned teacher! Since coming to the Midwest, I have become even more of a realist in making plant recommendations. Nowhere is there fear more prevalent than when I make plant recommendations for the urban environment. First, the variables of climate are innumerable. Buildings create wind tunnels, they shade plants to the north, they magnify the impact of heat and glare to the south, and they create many related effects to the east and west. Add to this the variety of height and spacing characteristics of urban buildings and the wide range of color contrasts, and you arrive at an incredibly complex set of climatic variables. How then does one go about recommending plantings in the harsh settings under such totally unpredictable conditions and over regions of the country with enormous differences of temperature, rainfall, and wind? Realistically, it cannot be done. But I shall point to a few principles and plants in the continued pursuit of the difficult task of establishing urban plantings.