Chemical Control of Anthrenus oceanicus Attacking Stored Cocoons of the Silkworm with Commercial Formulations Containing Permethrin, Tetramethrin, Phenothonin and Allethrin

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Abstract: Adult samples of a species destroying the cocoons of the mulberry silkworm in store were identified as Anthrenus oceanicus Fauvea 1903 (Coleoptera: Dermestidae). The beetles were treated with a commercial dust formulation containing 0.60% permethrin and an aerosol containing tetramethrin (0.20%), Phenothonin (0.12%) and allethrin (0.28%). The commercial dust formulation was applied at 0mg, 20mg, 100mg and 200mg while the aerosol was sprayed for 0, 1, 2, 3 and 4 seconds. These two formulations were effective in killing the beetles even at the lowest concentrations applied.

Keywords: Anthrenus oceanicus, cocoons, Bombyx mori, stored product pest

Introduction
Africa’s enormous potentials in raw silk production (Hardingham, 1988; ICPE, 1997), are faced with some constraints, which are likely to pose problem to local cocoon producers in the near future. Apart from the lack of infrastructure, sufficient inputs and technical expertise, sericulture industry in Africa faces a major threat from pests and diseases at various levels of the sericultural activities. Pests and diseases attack the mulberry plant on the field (Akinmunni, 1995; Akinmunni et al., 1999; Sengupta et al., 1991). The silkworms also have various pests and diseases limiting its productivity (Lim et al., 1990; Hazama, 1996). Finally, the cocoon while in the store, are attacked both by invertebrate and vertebrate pests (Vijay Veer et al., 1996). Notable among these invertebrates are insects in the order Coleoptera, family: Dermestidae. In the family Dermestidae, members of the genus Anthrenus have been reported in many regions of the world, including America (Hoebelke et al., 1985; Mortins 1985), Europe (Hummel and Kleeberg, 1997; Watson et al., 1997), Africa (Ali, 1997), Asia (Vijay Veer et al., 1996, Ansari and Basalingappa, 1995) and Australia (Haines, 1991). Vijay Veer et al. (1991) reported Anthrenus oceanicus among other dermestid beetles as pests of woolen fabrics in India, but this species was not reported as a pest of silkworm cocoons in India. Other species in this family found as pest of silkworm cocoons in India include Dermestes undulatus, D. frischii, D. ater, D. leachi, D. lardarius, Attagenus fasciatus, A. birmanicus, A. brunneus, A. pellio, A. unicolor, Tododerma halstedi, T. sternale, T. varium, T. variicolour, Orphanus fulvipes, Anthrenus flavipes, A. pimpinellae, A. verbascei and Trinodes rufescens (Vijay Veer et al., 1996). D. maculatus was however reported as vector of the pebrine disease of the silkworm in Italy (Vijay Veer et al., 1996).

Anthrenus oceanicus was recently found attacking dried cocoons of the mulberry silkworm in store at Ibadan. This pest had been exported from Nigeria to United Kingdom, with animal products in 1960s. It is therefore very important to explore available control measures in order to avert imminent cocoon loss to these beetles. This study was conducted to determine the effectiveness of some available commercial formulations containing permethrin, tetramethrin, phenothonin and allethrin in the laboratory.

Materials and Methods
Pest Identification: Beetles were collected from stored dry cocoons of the mulberry silkworm Bombyx mori L. These were killed in an air tight Kilner jar containing ethyl ether soaked cotton wool. The samples were collected, mounted and preserved (Youdeowei, 1977; Mc Swen, 1997). The insect was identified to the family level in the Insect Reference Collection and Identification Centre in the Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan and to the species level at the Central Research Laboratory, United Kingdom.

Insect Cultures: A culture of Anthrenus oceanicus was raised on dry cocoons of the Nistari race of the mulberry silkworm at a temperature range of 25-30°C and relative humidity of 70-85% in the laboratory. The insect culture was made inside a medium-sized Kilner jar provided with wire mesh lid during the wet season from April to October.

Bioassay: Round holes measuring 2.5 cm (diameter) were made on the lids of plastic disposable petri dishes and fine nets (mesh size - 1 nm) were cut and glued to cover the holes on the lids. Clean filter papers (90 mm) were placed inside the disposable petri dishes. Ten adult beetles were randomly selected from the insect culture and placed in each of the petri dishes. Two commercial formulations were tested in this study. The first is the dust formulation containing 0.60% permethrin and the other an aerosol containing a combination of tetramethrin (0.20%), Phenothonin (0.12%) and allethrin (0.25%). The dust formulation of permethrin was weighed out into separate petri dishes at 20mg, 100mg and 200mg using an AND digital balance (200g: 0.01mg). Each measured permethrin dust formulation was taken as a treatment. Each treatment and a control (0mg of the formulation) were replicated four times and these were laid out in completely randomized design on a laboratory table at temperature range of 25-30°C and relative humidity of 70-85%. This set up was monitored for 48 hours.

Also, the aerosol formulation of tetramethrin (0.20%), Phenothonin (0.12%) and allethrin (0.25%) were applied to another set of adult beetles placed in groups of ten on filter paper in petri dishes. The aerosol was sprayed through the holes prepared on the lid of the dishes after the introduction of the beetles into the petri dishes. The spray durations used were 1, 2, 3, and 4 seconds each of these represents a treatment. The treatments and a control (which was not sprayed at all) were replicated four times. These were arranged in completely randomized design on a laboratory table.
Akinkunmi and Odebiyi: Anthrenus oceanicus, cocoons, Bombyx mori, stored product past

Results
The beetle was identified as a member of the order Coleoptera and family Ptinidae at the Insect Reference Collection and Identification Centre in the Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan. The beetle was later identified as Anthrenus oceanicus at the Central Research Laboratory, United Kingdom. Within the first 20 minutes of introduction to permethrin dust, the beetles were observed running haphazardly in the petri dishes, making attempts at flight in a bid to escape, whereas this kind of agitation was not observed in the control which contained no permethrin. This agitation was observed in all the three treatments containing permethrin. Within the first 60 minutes of permethrin treatment, all the treated beetles were knocked down and most of them were seen lying on their backs. The knocked down beetles were still able to move their appendages slightly when touched. When turned to keep an upright posture, the beetle showed high level of immobility and they often fall again on their backs.

Similar agitation was observed in all the groups of beetles treated with the aerosol within the first 20 minutes of application of the spray. All the beetles were knocked down and killed thereafter. It is however interesting to know that the two commercial formulations tested on the beetles were effective in killing the beetles even at the lowest concentration of 20mg and 1 second of spray.

Although the damaging stage of this species is the larval stage, controlling the adults is equally important so as to prevent them from breeding and producing another generation of the damaging larval stage. This is also a convenient point of getting rid of the pest without allowing further damage to the cocoons and also preventing the establishment of the pest on our valued cocoons. Further work will investigate the effect of these chemicals on the larval stages of the beetle.

The use of the dust formulation as against the aerosol is preferred due to the liquid nature of the aerosol, which may have some side effects on the biochemical and physical nature of the cocoons. The cocoons are made up of two proteins called fibrin and sericin and these are likely to be affected if sprayed with aerosol. On the other hand the dust formulation can be spread on the base of the storage container and still be effective without much contact with the cocoons. The behavior of this pest is such that both the adults and the larvae show high preference for dark and unexposed places. They are rarely found on the upper regions of the storage container.

Metcalfe (1993) categorized the control of Anthrenus spp. in the household into two distinct phases. One phase involves measures aimed at preventing the beetles from becoming established and the other phase involves the eradication of the beetles after damage has begun. These authors however recommended fumigation (where practicable) or the use of chemicals such as diazinon, malathion, chlorpyrifos, resmethrin, or other pyrethroids in the control of these beetles.

Watson et al. (1997) studied the behavioral response of A. verbasci to permethrin 25% (ec) and an insect repellent, N, N-diethyl-m-toluamide (DEET) using a computerized tracking system. The larvae however did not respond to DEET but were seen moving away from the areas treated with permethrin (ec). The use of the dust formulation of permethrin in the storage of silkworm (B. mori) cocoons is recommended for producers and buyers of the cocoons in Africa due to its effectiveness and easy availability.

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References


