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Biological effect of some plant extraction on *Anthrenus flavipes* (Order: Coleoptera, Family: Dermesitae)

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Abstract

The toxicity effects of *Eucalyptus camaldulensis*, *Euphorbia prostrate*, *Melia azedarach, Myrtus communis* and *Nicotiana tabacum* extracts and powders were studied on the larvae of furniture carpet beetle, *Anthrenus flavipes* (LeConte). The results of insecticidal effect with four concentrations 0.5, 1.0, 1.5 and 2.0ml and 0.5, 1.0, 1.5 and 2.0gm. With four period of time. the Response varied with plant species and concentrations depending on the time of exposure. Highest mortality percentage against *Anthrenus flavipes* larvae was achieved with extract of *Melia azedarach, Myrtus communis* and *Euphorbia prostrate* which reached 86, 80 and 70% after two days of treatment in 2.0ml of extracts, and 76, 77 and 64gm powder after 48days of treatment. The lowest percentage of mortality was 3 and 6% which recorded in *Eucalyptus*, *Nicotiana* extracts treatment at 0.5gm of plant after 1hr of treatment. This plant extract and powder described potential insecticidal or its anti-feeding activity against *Anthrenus flavipes* larvae.

Keywords: Plant extract, Toxicity, *Anthrenus flavipes*, Carpet beetle.

Introduction

The furniture carpet beetle, *Anthrenus flavipes* (LeConte, 1854), is a common pest of upholstered furniture. Like other species of carpet beetles, it is able to digest keratin, the principal protein found in animal hair and feathers. The *Anthrenus flavipes* is widely spread throughout different part of the world. There are many species such as *Anthrenus scrophulariae* (L.), *Anthrenus flavipes* (Vorax) and *Anthrenus verbasci* (L.). Beside these *Ataginus piceus* (Oliver) is also included among the carpet beetle, (Ayappa *et al.,* 1958; Metcalf and Flint, 1973).

A. flavipes generally lives in the dry and warm places. The beetles are found in clothing, rugs, the upholstery covers and interior padding furniture, curtains, especially those containing wool, fur, feathers or hair and brushes made of animal bristles (Metcalf and Flint, 1973). The life cycle is longer in places where the climatic conditions are favorable. It takes longer time during the winter. Generally in the spring, the pupae develop into new adults. Usually there are three to four generations were observed per year (egg_larva_pupa_adult) except for the black or varied carpet beetle, which may have one generation per year The body length varied from 3.00mm – 5.00mm. (Hasan *et al.,* 2007). The furniture carpet beetle undergoes complete metamorphosis, passing through the egg, larva, pupa, and adult stages. The complete life cycle requires four to 12 months depending upon the temperature (Traynier, 1994). Adult carpet beetles are small with compact, rounded, oval bodies. Their legs and head are not obvious and are often hidden under the body. The variegated carpet beetle (*Anthrenus verbasci*) and furniture carpet beetle (*Anthrenus flavipes*) are 2-3ml long and mottled yellow (Blake, 1961).

The black carpet beetle (*Attagenus unicolor*) is larger, ranging from 3-5ml, more elongate and black with brownish legs.The Australian carpet beetle (*Anthrenocerus australis*) is 2-3ml long and dark with light markings. of the four species, only the Australian carpet beetle is native.Larvae are golden to dark brown and about 7.00mm long with the body. A long brush bristles is at the tail end of the larvae. (Hasan *et al.,* 2007). *Anthrenus flavipes* is a common species of wool-destroying insect in India (Armes, 1990). and its common in Iraq (Yunis, 2009). The larvae can destroy upholstered furniture by devouring both the padding and the covering. Carpet beetle larvae move slowly and are 4-7ml long, depending on the species. They are brown in color and covered in bristles. As the larvae grow

they molt, leaving cast brown skins. The furniture carpet beetle consumes any suitable food source rendering products unusable or aesthetically unappealing. Furniture carpet beetles are found on furniture where they feed on hair, padding, and upholstery (Robinson, 1996).

Black (2004) indicates that the Furniture carpet beetles are the common pests in a museum, library or archive environment can cause serious damage to highly valuable and irreplaceable materials. Natural history collections are particularly vulnerable to pest attack because much of the collection is composed of edible plant material or animal protein. Carpet beetles pass through the egg, larva, pupa and adult stages. Adult's beetles feed outdoors on flower pollens, crepe myrtle and buckwheat. A single female can lay up to 100 or more white eggs, which hatch in 8 to 15 days depending on species and favorable conditions. Eggs were particularly laid near the food source; sometimes eggs were laid in air ducts, under heavy furniture, underneath baseboards, etc. Larvae begin their destructive feeding soon after hatching, avoiding light and molting several times as they develop.

Nisimura and Numata (2001) studied on endogenous timing mechanism controlling the circannual pupation rhythm of the varied carpet beetle *Anthrenus verbasci*. Larval stage of the furniture carpet beetle is responsible for causing damage. The larva is 5mm long, oval, and covered with brown hair. The larva of the common carpet beetle, *Anthrenus scrophulariae*, is difficult to distinguish from that of the furniture carpet beetle. One way to distinguish the furniture carpet beetle from the common carpet beetle is to look for the presence of a long pencil of hairs at the end of the body that continually vibrates, which is indicative of the furniture carpet beetle. Larval color is dependent on the color of the food substrate. The number of larval instars may vary from 6-12 and requires two to three months before pupation occurs.

The larvae of the furniture carpet beetle pupate in their last larval skin and are white in color. Pupation occurs on or near the larval food source. The pupa stage lasts an average of two to three weeks depending on temperature. The furniture carpet beetle is capable of significant damage if infestations are undetected. It can destroy upholstered furniture by devouring both the padding and the covering. The furniture carpet beetle consumes any suitable food source rendering products unusable or aesthetically unappealing. Furniture carpet beetles are found on furniture where they feed on hair, padding, and upholstery. Other food sources include carpet, fur, horns, and silk. Cotton, linen, rayon, and jute may be attacked when stained with animal body oils or excreta. The current practice of encasing furniture horsehair in a green rubber coating does not protect horsehair from infestation. Dried insect specimens such as those found in insect collections are also devoured. Additionally, individuals in close association with infested items may suffer allergic reactions as a result of exposure to beetle fragments, cast skins, or dusts. Furniture carpet beetles can be detected by a close and thorough inspection of susceptible household goods. The presence of any furniture carpet beetles could warrant corrective actions. Depending upon the value of the infested items, some may choose to discard the items while others may choose control options in an effort to salvage the goods (Lawrence *et al.,* 2000). Careful inspection is the first step in controlling furniture carpet beetle infestations. All susceptible materials must be inspected for the presence of larvae, their cast skins, and damage. The adults may also be observed emerging during the warm summer months.

Best way to avoid carpet beetle problems is through prevention. Woolens and other susceptible fabrics should be dry cleaned or laundered before being stored for long periods. Cleaning not only removes perspiration odors that are attractive to the beetles, but also kills any eggs or larvae that may be present. Articles to be stored should then be packed with moth balls or flakes in tight-fitting containers. Insecticides should not be used to treat clothing. However, mothproofing solutions may be applied to susceptible clothing by professional dry cleaners (Nisimura and Numata, 2001; Mallis, 2004).

The aim of this study is to find the effect of these plants extract and powder on larvae of *Anthrenus flavipes* as well as to minimize the extent of the use of pesticides

Materials and Methods

Insect culture: The study was carried out in the college of science, department of biology; it was conducted in the laboratory under the natural conditions. The adults of *Anthrenus flavipes* obtained by collecting samples of the adult from wool materials infested with it. The adult reared in plastic cans with cylindrical shape covered with alaorquenza clothes and added wool material continuously to obtain the culture for the experiment.

In order to prepare the colony of *A. flavipes* , and option larvae of it. Isolated ten pairs of adult (male and female) taken from the culture were used. Each

pair was confined in a covered petri-dish of 7 cm diameter embedded with filter paper and the wool material.

Plant materials collection and extraction: Five Plants were collected from public parks (Table 1). *Eucalyptus camaldulensis* (Myrtaceae), *Nicotiana tabacum* L. (solaniaceae), *Euphorbia prostrate* (Euphorbiaceae) *Melia azedarach* (meliaceae) and the leaves of *Myrtus communis* (Myrtaceae), Then distributed on the table in the laboratory to dried it after that the all plant has been milled at room temperature, Then preserved until used experimentally.

Essential experiment: Pieces of wool (weight 164mg) (AATTC) (American Association of textile Chemists and colorist) has been treated with concentration of each plant which has been previously extract by electrical soxholet gerhardet which used firstly in Iraq in central environmental laboratory (Figure 1). 0.5, 1,1.5, and 2ml, per pieces of wool placed in a Petri dish of 7cm diameter, and exposed to open air to all the organize solvent to evaporate, then 0.5ml of distilled water was added to entire surface of the each treatment on filter papers as a carrier of extractor. Biology of larvae was investigated under laboratory condition of 30± 3°c , relative humidity 50±5 and photoperiodicity (hr) 1 light : 23dark. 10 larvae of 1-3 week old (modern emerge) were introduce into the each Petri dish and control treatment , then introduce into incubator 23hrs darkness / 1hr light) every treatment replicate three time , mortality of larvae was converted at 1, 3, 24 and 48hrs.

Figure(1): electrical soxholet

Powder experiment: A weight of 0.5, 1, 1.5 and 2gm of each plant powder mixed with 164gm (AATTC) of pieces of wool and 0.5g of talc powder was added as distributed materials on each pieces of wool. The control treatment treated with the talc powder only. The material put in Petri dish (7cm diameter) 10 larvae (modern emerge) were introduced into each Petri dish and control treatment then introduced into incubator. Every treatment replicate three time, mortality of larvae was converted at 1, 3, 24 and 48hrs.

Table (1): Type of the plants and their family and user part of its.

Common name	Scientific name	Family	Usage part
Eucalyptus	*Eucalyptus camaldulensis*	Myrtaceae	Leaf
Nicotien	*Nicotiana tabacum*	Solanaiceae	Leafs
Euphorbia	*Euphorbia granulate*	Euphorbiaceae	Leafs & roots
Melia	*Melia azedarach*	Meliaceae	Leafs
Myrtus	*Myrtus communis*	Myrtaceae	Leafs

Statistical analysis: The treatment included four concentrations of five plant extracts in addition to control treatment.

Cumulative mortality counts obtained from experiments were corrected for natural mortality using Abott's formula (Abbott, 1925). Mortality data were statistically analyzed using analysis of variance (ANOVA) to estimate statistical differences between means. The means were compared using Duncan's multiple range tests at $p \leq 0.05$.

Results and Discussion

Essential experiment: The results indicated that the effects of extracts taken from the leaves and flowers of four plants, *Eucalyptus camaldulensis* (Myrtaceae), *Nicotiana tabacum* L. (Solaniaceae), *Euphorbia prostrate* (Euphorbiaceae) *Melia azedarach* (Meliaceae) and the leaves of *Myrtus communis* (Myrtaceae) were studied on the larvae of furniture carpet beetle, *Anthrenus flavipes* (LeConte).Toxicity effect in Tables (2, 3, 4, 5 and 6) indicated that the five types of plant extracts were found to be toxic to furniture carpet beetles *Antrenua flavepes*, however there was a variation in their effective against this insect. The mortality of the larvae after 48hrs of different extracts was significantly higher than that of control treatment with distilled water.

Table (2): Effect of *Myrtus comminus* extracts on the mortality of *Anthrenus flavipe*s larvae.

	Concentration			
Time(hrs)	0.5ml	1.0ml	1.5ml	2.0ml
1	10%	23%	50%	53%
3	16%	23%	56%	66%
24	16%	26%	60%	73%
48	23%	36%	60%	80%
LSD=0.099641			control:10	

Table (3): E**ff**ect of *Melia azedarach* extracts on the mortality of *Anthrenus flavipe*s larvae .

	Concentration			
Time(hrs)	0.5ml	1.0ml	1.5ml	2.0ml
1	16%	30%	60%	63%
3	20%	33%	60%	76%
24	20%	26%	73%	50%
48	30%	50%	76%	86%
LSD: 0.083816			control: 10	

Table (4): E**ff**ect of *Euphorbia granulate* extracts on the mortality of *Anthrenus flavipes* larva

	Concentration			
Time(hrs)	0.5ml	1.0ml	1.5ml	2.0ml
1	6%	13%	36%	43%
3	10%	16%	43%	56%
24	13%	23%	56%	63%
48	23%	26%	70%	70%
LSD=0.095789			control=10	

Table (5): E**ff**ect of *Nicotiana tabacum* extracts on the mortality of *Anthrenus flavipes* larva

	Concentration			
Time(hrs)	0.5ml	1.0ml	1.5ml	2.0ml
1	6 %	10%	10%	16%
3	13 %	20%	23%	26%
24	16 %	23%	23%	30%
48	20 %	26%	30%	40%
LSD=0.065583		control = 10		

Table (6): E**ff**ect of *Eucalptus camaldulensis* extracts on the mortality of *Anthrenus flavipes* larva

	Concentration			
Time(hrs)	0.5ml	1.0ml	1.5ml	2.0ml
1	3%	6%	6%	10%
3	6%	10%	13%	13%
24	13%	6%	13%	16%
48	16%	23%	30%	36%
LSD=0.054961		control=10		

A significant insecticidal activity against furniture carpet beetle, *Anthrenus flavipes* (LeConte) larvae was observed with extracts of *Melia azedarach*, followed by *Myrtus comminus* extract and then *Euphorbia granulate*, *Nicotiana tabacum* and the less effect was with *Eucalyptus camaldulensis* which mortality reached after 24hrs to 63%, and 70% after 48hr respectively when we use 2.0 concentration of plant extract.

While at an extract concentration of 2.0% from *Nicotiana tabacum*, mortality of *Anthrenus flavipes* (LeConte) larvae was increased to 40% after 48hrs. but also other treatments like *Myrtus comminus* showed the same Results after 24 hrs . *Anthrenus flavipes* (LeConte) larvae mortality caused at a concentration of control was significantly 10% when compared to other concentration treatment.

The results indicated that the mortality percentage increased with increasing the concentration and the Time of exposing . The highest percentage of mortality was reached to 86% after 48hrs. of treatment by *Melia azedarach* extracts when use 2.0ml concentration. The lowest percentage of mortality was 3.0% which recorded in *Eucalyptus camaldulensis* treatment at 0.5 concentration after one hour of treatment and it is not differing significantly from the mortality of control treatment. Within periods of one hour the extracts of *Eucalyptus camaldulensis* and *Nicotiana tabacum* concentration 2.0ml produced significantly lower mortality percentage in the *Anthrenus flavipes* (LeConte) larvae which was (10% and 16%) mortality (Tables-11,and 10). During the same period but produced 43%, 63%, 53% larvae mortality when use 2.0ml of *Euphorbia*, *melia, myrtus* extracts respectively and significantly differs from that of *Eucalyptus* and *Nicotiana* extracts. While, *Anthrenus flavipes* larvae didn't showed significant susceptibility to the *Euphorbia* and *Nicotiana* extract at 0.5 concentration after one hour, that the mortality was 3% and 6% respectively.

The *myrtus* and *melia* extracts resulted significantly greater mortality in the larvae than the other plants after one hour which was 50%, and 60% mortality when we use 1.5ml of this plant extracts. (Tables 2 and 3). while within the same period of *Euphorbia, Eucalyptus, Nicotiana* extracts caused 36%, 6% and 10% mortality at the same concentration respectively (tables4,5and6).

Boland *et al.* (1999), recorded that the cineole-based eucalyptus oil is used as an insect repellent and biopesticide. Also added that in the U.S., eucalyptus oil was first registered in 1948 as an insecticide and matricide. Mishra (2012b), recorded that 20ml of the eucalyptus seed extract at concentration 1000ppm. Killed all the mosquito larvae within 14hrs.

There was a significant difference between the *Eucalyptus camaldulensis* and *Myrtus communis* extracts regardless of the period after treatments or increasing the concentration. The maximum percentage of mortality by Myrtus reached (80%) after 48hrs of treatment, while the minimum percentage was (10%) which not differ when compared with mortality percentage of control treatment after the same period. Mishra (2012b), mentioned that the effect of both eucalyptus leaves and seed extracts seem to be time dependent as the mortality of mosquito larvae exposed to the extracts increased significantly from the first hour to the last one. Daizy *et. al*. (2008), who studied the

effect of four medicinal plant extracts against *Tribolium castaneum*, recorded a good insecticidal activity of *Peganum harmala* seeds, followed by *Ajuga iva*, *Aristolochia baetica* and *Eucalyptus camaldulensis* aerial parts and results of this research similar to current study.

Powder experiment: All treatment caused significant dead in larvae of *Anthrenus flavipes* after two days compared with control treatment this indicate that the active ingredients of botanical responsible for the toxicity of the plant to kill the larvae gradually, may be the reason of this difference is due to the sensitivity of larvae to chemical compounds in these plant powder or that the dosage that used in experiments were all influential to the larvae in this age. The results of this effective experiments showed that all treatments of plant extracts were relatively toxic to *Anthrenus flavipes* after two days but not toxic after one hour that the mortality in larvae reach to 77, 76 and 64 % after two days in 2.0ml concentrations of *Myrtus, Melia* and *Eucaleptus* treatment (Tables 7, 8 and 9) .

Current search is compatible to Nagssoum *et al*. (2007) research who has also reported effective of extraction of *Eucalyptus hybrida* leaf on some insects, the extracts were tested for the presence of chemical constituents such as alkaloids, saponins, flavinoids, protein, carbohydrates, triterpenoids, tannin and glycosides plant extracts showed that the mortality rate increased with increasing concentration as well as the length of exposure.

Table (7): E**ff**ect of *Myrtus comminus* powder on the mortality of *Anthrenus flavipe*s larvae.

	Dosage			
Time(hrs)	0.5gm	1.0gm	1.5gm	2.0gm
1	5%	11%	16%	17%
3	14%	23%	56%	36%
24	16%	35%	60%	46%
48	23%	39%	60%	77%
LSD=0.039644			control =10	

Table (8): Effect of *melia azedarach* powder *on* the mortality of *Anthrenus flavipes* larva

	Dosage			
Time(hrs)	0.5gm	1.0gm	1.5gm	2.0gm
1	11%	32%	32%	37%
3	21%	16%	43%	54%
24	23%	34%	56%	66%
48	25%	45%	70%	76%
LSD=0.075342			control =10	

Table (9): E**ff**ect of *Euphorbia granulate* powder on the mortality of *Anthrenus flavipes* larva

	Dosage			
Time(hrs)	0.5gm	1.0gm	1.5gm	2.0gm
1	11%	32%	32%	35%
3	23%	33%	43%	52%
24	24%	35%	62%	62%
48	28%	37%	62%	64%
LSD=0.087653			control =10	

Table (10): E**ff**ect of *Nicotiana tabacum* powder on the mortality of *Anthrenus flavipes* larva

	Dosage			
Time(hrs)	0.5gm	1.0gm	1.5gm	2.0gm
1	5 %	8%	10%	13%
3	11 %	12%	23%	22%
24	14 %	15%	23%	28%
48	15 %	22%	30%	40%
LSD=0.067355			control =10	

Table (11): E**ff**ect of *Eucalptus camaldulensis* powder on the mortality of *Anthrenus flavipes* larva

	Dosage			
Time(hrs)	0.5gm	1.0gm	1.5gm	2.0gm
1	10%	14%	22%	26%
3	12%	16%	28%	33%
24	18%	26%	26%	33%
48	25%	27%	30%	34%
LSD=0.066425		control =10		

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