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Control of wax moth, G*alleria mellonella* L. (Lepidoptera: Pyralidae) in post harvest honey comb

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Abstract
An experiment was carried out in the laboratory to control the infestation of larger wax moth, *Galleria mellonella,* after honey extraction. Different quantities of salt in water and hermetic storage were used as methods of controlling the larvae. A treatment containing Aluminium phosphide tablet was incorporated as a chemical method of control and the treated honeycomb samples were stored for two month. Of all the treatments used, the hermetic storage and Aluminium phosphide had the best result in that the comb retained their freshness post two months storage. The number of emerged moth in opened untreated control (61.00) was higher than other treatments but significantly higher than the number of emerged moth observed in salt- treated comb in opened containers. Wax and slum gum weight were not significantly affected by the treatments. Hermetic storage is therefore recommended as a better method of controlling wax moth in honeycomb after the extraction of honey than Aluminium phosphide, due to the possibility of residue of Aluminium phosphide in the treated honeycomb.

Key words: Honeycomb, *Galleria mellonella***,** salt, hermetic storage, Aluminium phosphide, bee wax, wax moth control

1 Introduction

Beekeeping, as a practice is no longer just the rustic hobby of days past. Today it is an integral part of modern agriculture as it provides pollination for nation's staple crops, honey to the food sector, and bee's wax to a broad spectrum of industries. As a result, monitoring the health and productivity of the honeybee colonies is essential (FAO, 2003). Although, beekeeping is known popularly for its honey as the major produce, but there are other produce which are also good sources of income. Such produce includes; beeswax, pollen, propolis, royal jelly and venom. But all these produce are limited in production as a result of environmental factors; such as unfavourable weather, noise, physical disturbances amongst others, and biotic factors; such as pest, predators and diseases like mites, wax moth, birds, lizard, nosema, sac brood amongst others (Denr-car, 1997). These limitations lead to late colonization and absconding (Babarinde *et al.,* 2012). Wax moth has been identified as a major pest in Nigeria due to climatic factors such as temperature and humidity which is responsible for absconding (Babarinde *et al.,* 2010*)*. This moth destroys the beeswax which is a valuable product that can provide a worthwhile income in addition to honey. In fact one kilogram of beeswax is worth more than one kilogram of honey (FAO, 2009). To control the menace of the wax moth, different kinds of researches have been carried out. Different chemicals such as moth balls, particularly the Naphthalene ones, and PDB (Para Dichlorobenzene) has been the use of insecticides at the larval stage. But these measures may not be safe due to the residuals which are left behind in the wax. This may lead to pollution of the wax and be difficult to use for domestic and baiting new hives for colonization.

In view of this, the present research work was designed to evaluate the efficacy of control methods on greater wax moth infestation of honey comb and to evaluate the effect of the control methods on the quantity of the bee wax extracted from the honey comb.

2 Materials and methods

2.1 Experimental site

The experiment was carried out at the laboratory of Department of Crop and Environmental Protection, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

2.2 Collection and treatment of honey comb

After the extraction of honey, the honey combs infested by wax moth were acquired from beekeepers within Ogbomoso Metropolis. The treatments applied to the infested honeycomb include: 10 g salt in 2 litres of water stored in a closed container (Treatment A), 20 g salt in 2 litres of water stored in a closed container (Treatment B), 40 g salt in 2 litres of water stored in a closed container (Treatment C), 1 tablet of Aluminium phosphide

(Treatment D), 2 litres of water (Treatment E), Control stored in an airtight container (Treatment F), 10 g salt in 2 litres of water stored in an opened container (Treatment G), 20 g salt in 2 litres of water stored in an opened container (Treatment H), 40 g salt in 2 litres of water stored in an opened container (Treatment I), Control stored in an opened container (Treatment J). Eight hundred grams of infested honeycomb were weighed into 4 liter capacity plastic jar. The treatment was applied as indicated above and replicated in two. Each experimental set up was stored for 2 months after which ax extraction was carried out.

2.3 Wax Extraction

Wax was extracted from each of the stored treated honeycomb using the local extraction method as described by Segeren *et al.* (1997). The treated honeycomb was heated using iron steeled pot and sieved using a wire mesh sieve. This was done in order to melt out the wax in the honeycomb and separate the wax from the slum gum respectively.

2.4 Data Collection

After 2 months after treatment, data was collected on number of dead wax moth observed before wax extraction, the physical assessment of the treated comb before wax extraction was also collected, weight of bee wax extracted from each treatment, weight of slum gum after wax extraction.

2.5 Experimental Design and Statistical Analysis

The experiment was set up using CRD. All data was subjected to analysis of variance using SAS (2005) and significant means was separated with LSD at 5% of probability level.

3. Results

3.1Effect of treatments on population of emerged *Galleria mellonella* larvae, weight of wax and slumgum

Although, the highest numbers of emerged larvae were observed in untreated controls which were 59.00 (untreated control in closed containers) and 61.00 (untreated control in opened containers), 100% mortality was observed in all treatments at 2 months post treatment of the combs. None of the treatments had significant effect on the weight of the wax and slum gum (Table 1).

3.2 Effect of treatment on physical appearance of honey comb before wax extraction:

Of all the treatments used, Aluminium phosphide and untreated control in closed containers (which was a simulated hermetic storage) had the best results which preserved the state of the comb. Other methods had fermented odour or growth of fungi except the opened control that has dry powdery dust (Table 2).

4. Discussion

The wax moth, *Galleria mellonella*, is one of the most devastating and economically important pests of wax throughout the world (Burges, 1978; Chang & Hsieh, 1992; Haewoon *et al*., 1995; Smith, 1965). It is a major pest that prevents farmers form storing honey combs after the extraction of honey. Therefore there is a need for beekeepers to control wax moth from damaging the comb after extraction of honey. Many studies have been conducted to find ways of controlling it (Burges, 1978).

After two months of storing the treated combs, it was observed that all the treatments controlled the development of wax moth by killing them thereby preventing the destruction of the honey comb in storage. But of all the treatments used, Aluminium phosphide and the hermetic storage had the best result which preserved the state of the comb by maintaining freshness of the comb while the other treatments had fungal growth and fermented odour. The development of fungi was due to high moisture content of the wax due to the water introduced for the storage. Also it was observed that none of the treatments had a significant effect on the weight of the wax and slum gum obtained. This implies that either of the treatment can give the same quantity of wax and slum gum. However, since certain treatments caused fermentation and fungal growth, they cannot be recommended for preservation of the comb. Hermetic storage without salt reduced cost and was eco-friendly. It is therefore recommended as a better control method rather than Aluminium phosphide for the control of wax moth in post harvest honey comb. This is because synthetic pesticide like using Aluminium phosphide, paradichlorobenzene or naphthalene can lead to accumulation of toxic residues in the ecosystem (Bogdanov *et al*., 2004).

Further studies are recommended to monitor the age of wax moth and the effect of the treatment for a short term period. Identification of the fungi associated with the different methods is also necessary.

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Table 1: Population of emerged *Galleria mellonella* larvae, percentage mortality in honeycomb after treatment and wax and slum gum weight after wax extraction

Treatment*	Emerged moth	% Mortality	Wax weight	Slum gum
10 g salt closed	50.50abc	100.00a	125.00a	219.00a
20 g salt closed	51.50abc	100.00a	136.50a	314.00a
40 g salt closed	37.00abc	100.00a	192.00a	269.50a
2 litre of water closed	34.00abc	100.00a	94.50a	293.00a
Phosphine tablet closed	54.00ab	100.00a	148.00a	272.50a
Untreated control closed	59.00ab	100.00a	160.00a	279.00a
10 g salt opened	24.50bc	100.00a	90.00a	177.50a
20 g salt opened	28.50bc	100.00a	139.50a	255.00a
40 g salt opened	16.00c	100.00a	122.50a	265.00a
Untreated control opened	61.00a	100.00a	128.50a	264.50a

Means with similar alphabet along the column are not significantly different at 5% probability using Fishers' LSD.
*Closed implies that the treated combs were stored in closed containers.
*Opened implies that the treated combs were stored in opened containers.

Table 2: Physical conditions of treated honey combs before wax extraction

Treatment*	Conditions
10 g salt closed	Whitish caked mucor with highly fermented odour
20 g salt closed	Greyish caked mucor with highly fermented odour
40 g salt closed	fermented odour
2 litre of water closed	Whitish mucor
Aluminium phosphide tablet closed	Fresh comb retained
Untreated control closed	Fresh comb retained
10 g salt opened	Slightly fermented odour with no mucor
20 g salt opened	Slightly fermented odour with no mucor
40 g salt opened	Slightly fermented odour with no mucor
Untreated control opened	Dry powdery dust

*Closed implies that the treated combs were stored in closed containers.
*Opened implies that the treated combs were stored in opened containers.