

## CERTAIN BIOLOGICAL ASPECTS OF THE STORED DRUG BEETLE, (*Stegobium paniceum* L.) (COLEOPTERA : ANOBIIDAE) ON DIFFERENT APIACEAE HOSTS

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### ABSTRACT

*Stegobium paniceum* was transporting from field to storage to infest Apiaceae fruits hardly. Thus the fruits were loosed and their economic value was reduced. The percentage of infestation with this insect was differed according to Apiaceae plants. Therefore, the aim of yje present work is to study the effect of different Apiaceae fruits on the biology of this insect.

The average number of eggs/female was 40.25 eggs during 5 to 7 days. Incubation period ranged from 8 to 13 days, and the percentage of hatching ranged from 76 to 86 %.

The larva of *S. paniceum* have five instars.

The more suitable diet to *S. paniceum* larvae is the milled caraway followed by coriander. Khella, dill, cumin and fennel were unsuitable diets. The duration of larval stage was affected by the type of food. The total larval duration ranged from 49 to 60 days when the larvae were reared on caraway and from 52 to 68 days on coriander milled fruits. The larvae were died in the first instar on khella and dill, in the second instar in cumin, and in the fourth instar on fennel. Meanwhile, the larvae were capable to survive and complete their larval stage when reared on caraway and coriander.

The duration of pupa ranged from 4 to 7 days when reared on caraway and ranged from 4 to 5 days on coriander.

The adults longevity was affected by the type of larval food. In case of caraway, the adults were survived from 23 to 38 days, while in case of coriander it survived from 15 to 27 days.

**Keywords** : Biology, *Stegobium paniceum*, Apiaceae.

### INTRODUCTION

Most of Apiaceae (Umbelliferae) fruits are mainly used for spicing, flowering and popular phytotherapeutic uses. These fruits have high amounts of essential oils which used in many therapy preparation, as well as the cosmetics and perfumic industry. These uses reveal the important role of Apiaceae fruits in the Egyptian income (Arslan *et al.*, 1989; Gurdip *et al.*, 1990, Avater *et al.*, 1991, Bernath *et al.*, 1996, Al-Kordy, 1997 and Abou-El-Nasr, 1999).

The most serious problem to Apiaceae fruits is the damage caused by the stored insect pests. Stored drug beetle, *Stegobium paniceum* (L.) is one of the most common pests which attacks a wide range of stored medicinal

fruits, especially family Apiaceae, causing highly reduction ratio of these fruits income (Narasimhan, 1987; Olsen *et al.*, 1987; Kosolapova, 1989; Basak, 1991; Simova *et al.*, 1997 and Toh & Toh, 1998).

Therefore, the present investigation was carried out to throw the light on certain biological aspects of this insect on different Apiaceae fruits.

## **MATERIALS AND METHODS**

To determine the suitability of certain milled aromatic seeds to *Stegobium paniceum*, six kinds of food were used, *i.e.* coriander, fennel, caraway, cumin, dill and khella (All belonging to family Apiaceae).

Twenty to thirty pairs of adults were placed each in a Petri-dish (4 cm diameter x 1 cm height) containing enough amount of coriander powdered seeds. All dishes were examined daily for any deposited eggs. The deposited eggs were removed and placed individually in glass tubes (3 x 1 cm), supplied with suitable amount of diet, and covered with cotton. Ten replicates of each kind of diets were done, each replicate contained ten glass tubes. All tubes were kept under constant condition of  $27\pm 1^{\circ}\text{C}$  and  $65\pm 5\%$  R.H.

To determine the incubation period of eggs, 50 tubes (each has one egg) were examined daily and the date of larval emergence was recorded. Also, the hatchability of eggs was estimated.

The effect of each food material was studied. Newly hatched larvae were reared individually on each food material in glass tube 1 x 3 until formed pupae. Records of the measurements of larval instars head capsule, duration of larval and pupal stage were taken. Ten pairs of adults were separated in a mating position and placed in Petri dishes 1 x 4 mm containing enough amount of each food. Daily counts of eggs laid were made till beetles died. Longevity of adults and number of eggs per female were estimated.

## **RESULTS AND DISCUSSION**

### **The egg stage :**

The egg has white colour and elliptical shape (Fig. 1). Its length ranged from 0.35 to 0.41 mm, with mean of  $0.38\pm 0.01$  mm. While the egg width ranged between 0.23 and 0.25 mm with mean of  $0.24\pm 0.0$  mm.

As shown in Table (1), the incubation period ranged from 8 to 13 days, with a mean of  $9.61\pm 0.35$  days. The highest percentage of hatching was 86 %, while the lowest was 76 % with a mean of  $81.5\pm 1.05$  %.

These results are nearly to the findings of El-Nattar (1961) who found that the incubation period of the eggs ranged from 7.3 to 18.9 days and the hatchability between 55-75 %. Also, Brar and Chahal (1980) stated that the average of incubation period was 9.2 days.

**Table (1) : Mean egg measurements, the incubation period (days) and hatchability (%) of eggs of *Stegobium paniceum* bred on coriander fruits at 27±1°C and 65±5 % R.H.**

Egg measurements (mm.)		Incubation period (days)	Hatchability (%)
Length	Width		
0.38±0.01	0.24±0.0	9.61±0.35	81.5±1.05
0.35-0.41	0.23-0.25	8-13	76-86

**Fig1**

**The larval stage :**

Five larval instars were recorded for *Stegobium paniceum*, according to the measurements of the larval head capsule, on the tested foods as shown in Table (2). El-Nattar (1961) found that the larvae of this insect had four or five instars according to the type of foods. While, Janisch (1923) accounted four larval instars of this insect, and Azab (1943) stated that the larval instars number were three or four instars.

**The first larval instar :**

The length of the head capsule of newly emerged larvae ranged from 0.13 to 0.15 mm with a mean of 0.14±0.0 mm, while the width ranged between 0.14 and 0.16 mm with a mean of 0.15±0.0 mm . It is interesting that the length of head capsule was smaller than width, (Table, 2 and Figs. 2 & 3).

**Table (2) : Mean measurements of head capsule of *Stegobium paniceum* larvae, under laboratory conditions of 27±1°C and 65±5 % R.H.**

Larval instars	Measurements (mm.)	
	Length	Width
<b>1st</b>	0.14±0.00 (0.13-0.15)	0.15±0.00 (0.14-0.16)
<b>2nd</b>	0.16±0.00 (0.15-0.18)	0.20±0.01 (0.18-0.23)
<b>3th</b>	0.25±0.00 (0.24-0.28)	0.30±0.01 (0.29-0.33)
<b>4th</b>	0.40±0.01 (0.38-0.43)	0.47±0.01 (0.45-0.49)
<b>5th</b>	0.52±0.01 (0.48-0.56)	0.67±0.01 (0.64-0.73)

Data in Table (3) showed that the first instar larva was very susceptible to the type of foods. All larvae were died on khella and dill.

Table (3) showed that the shortest first larval duration was noticed on cumin powders with a mean of 11±0.00 days. The mean duration was increased from 16.19±0.2 on caraway to 17.22±0.36 days on coriander and 18.25±1.39 on fennel.

**The second larval instar :**

As shown in Table (2) and Figs. (2 & 3), the length of the head capsule of the second instar ranged from 0.15 to 0.18 mm. with a mean of 0.16±0.03, while the width ranged from 0.18 to 0.23 with a mean of 0.20±0.01 mm.. It was noticed from the data in Table (3) that all larvae in the second instar were capable to survive on cumin mill and died before complete its duration. On fennel, larvae had the longest duration (28.5±3.5 days), followed by coriander (9.92±0.74 days). The caraway milled fruits was the most suitable food for this instar (6.75±0.26 days).

**The third larval instar :**

The head length of the third instar larvae ranged between 0.24 and 0.28 mm. with a mean of 0.25±0.0. While the width ranged from 0.29 to 0.33 mm. with a mean of 0.3±0.01 mm. (Table, 2 and Figs. 2 & 3).

The longest duration of the third larval instar of *S. paniceum* was on the fennel (53 days). On the contrary, the shortest duration was on both caraway and coriander, where the means were 5.84±0.17 and 6.68±0.38 days on caraway and coriander, respectively (Table, 3).

**The fourth larval instar :**

The larvae of the fourth instar had a mean head capsule of 0.40±0.01 mm. length and 0.47±0.01 mm. as the head width (Table, 2 and Figs. 2 & 3). In this instar, all larvae died before completed their durations on the fennel diet.

Fig2,3



While on the powders of both caraway and coriander, the duration of the fourth larval instar was the shortest period. So the means were  $5.34 \pm 0.14$  days on caraway, and  $6.7 \pm 0.61$  days on coriander (Table, 3).

**The fifth larval instar :**

The length of head capsule of the fifth larval instar ranged from 0.48 to 0.56 mm. with a mean of  $0.52 \pm 0.01$  mm., while the width ranged from 0.64 to 0.73 mm. with a mean of  $0.67 \pm 0.01$  (Table, 2 and Figs. 2 & 3).

As shown in Table (3), the duration of the fifth instar larva did not significantly differ when the larvae fed on either caraway or coriander diets. The duration means for this instar were  $19.83 \pm 0.85$  and  $19.43 \pm 0.97$  days when the larvae were reared on caraway and coriander, respectively.

**The total larval duration :**

The total larval duration, as represented in Table (3) showed that the caraway milled fruits was the most suitable diet for *S. paniceum* larvae followed by coriander. While the other four foods (khella, dill, cumin and fennel powders) were unsuitable foods so all larvae had died before completed their durations. The total larval duration on caraway and coriander ranged from 49 and 52 to 60 and 68 days with means of  $53.99 \pm 1.1$  and  $59.66 \pm 1.63$  days, respectively.

The total larval durations were 53.99 and 59.06 days for the larvae which fed on caraway and coriander, respectively. These results are in accordance with those of Brar and Chahal (1980), who stated that the larval period averaged 50.1 days, while El-Nattar (1961) reported that the length of the larval life decreased as the temperature increased from 18°C (84.4 days) to 30°C (39.2 days).

**Prepupal stage :**

As shown in Table (3), the duration of prepupa showed insignificant differences between caraway and coriander diets. Prepupal period ranged from 2 to 3 days with a mean of  $1.97 \pm 0.11$  days on caraway, and 2 to 3 days with a mean of  $2.07 \pm 0.15$  days on coriander.

**Pupal stage :**

The mean duration of pupa fed on caraway was longer ( $5.74 \pm 0.29$  days) than on coriander diet ( $4.5 \pm 0.5$  days) (Table, 3 and Fig. 4). The present results are in agreement with the finding of Brar and Chahal (1980).

The differences between male and female during pupal stage were cleared. Pupal females were almost bigger than pupal males in size. Moreover, the genital papillae in the pupal abdomen end at the ventral position were also differed between sexes. These organs are globular and not protuberant in pupal male, but they are protuberant including three segments, and distinctly divergent in pupal female (Fig. 5).

**The adult stage :**

The differences between sexes of this insect in the adult stage were studied. Adult female is bigger than adult male. In addition, the end of adult abdomen in the ventral position was circularity in female, but triangular shape in male (Figs. 6 & 7). The anatomy of reproduction system confirmed the above mentioned differences.

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Fig4,5,6,7



**Adult longevity :**

As shown On Table (3), the adult longevity was affected by the type of larval food. In caraway, the adults were survived about  $28.5 \pm 1.63$  days with a range of 23-38 days. While on coriander, the longevity was shorter ( $21 \pm 6$  days) with a range of 15-27 days. El-Nattar (1961) found that the adult longevity ranged between 42.8 and 55.4 days according to the type of food. Brar and Chahal (1980) stated that the adult life span averaged 73.7 days for males and 72.5 days for females.

**Fecundity :**

The mean of total number of eggs per female was  $40.25 \pm 4.12$ . El-Nattar (1961) obtained 79.2-83.9 eggs at 25°C and 90 % R.H.

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### بعض المظاهر البيولوجية لحشرة خنفساء العقاقير *Stegobium paniceum* على أنواع مختلفة من نباتات العائلة الخيمية

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تم دراسة بعض المظاهر البيولوجية لحشرة خنفساء العقاقير المرباة على عوائل مختلفة من نباتات العائلة الخيمية حيث وجد أن متوسط وضع البيض لكل أنثى بلغ ٤٠,٢٥ بيضة خلال فترة وضع البيض التي استغرقت ٥-٧ يوم. وكانت فترة حضانة البيض ٨-١٣ يوم ونسبة الفقس ٧٦-٨٦ %.

لحشرة خنفساء العقاقير خمس أعمار يرقية تم تحديدها بدقة من خلال قياسات لصندوق الرأس. كان طحين كل من الكراوية والكزبرة أفضل الأنواع لتغذية اليرقات على العكس من طحين كل من الخلعة، الشبث، الكمون، والشمر حيث ماتت اليرقات المرباة عليهم قبل أن تستكمل فترة نموها اليرقي. بلغت فترة طور اليرقة ٤٩-٦٠ يوم عند تربيتها على طحين الكراوية، ٥٢-٦٨ يوم عند تربيتها على طحين الكزبرة. وقد وجد أن العمر اليرقي الرابع كان أقصر الأعمار اليرقية بينما كان العمر اليرقي الخامس أطولها. وقد تأثر طول العمر اليرقي تأثيراً معنوياً بنوع الغذاء. بلغت فترة طور العذراء ٤-٧ يوم عند تربية يرقاتها على طحين الكراوية، ٤-٥ يوم عند تربية يرقاتها على طحين الكزبرة. كما بلغت فترة الطور الكامل ٢٣-٣٨ يوم عند تربيتها على طحين الكراوية، ١٥-٢٧ يوم عند تربيتها على طحين الكزبرة.

**Table (3) : Mean durations of different stages of *Stegobium paniceum* as related to various types of foods under 27±1°C and 65±5 % R.H.**

Food	Larval duration in days						Prepupal	Pupal	Adult
	1st	2nd	3rd	4th	5th	Total	duration (days)	Duration (days)	longevity (days)
<b>Caraway</b>	16.16±0.20 (15-17)	6.75±0.26 (6-8)	5.84±0.17 (5-7)	5.34±0.14 (5-6)	19.83±0.85 (17-26)	53.99±1.10 (49-60)	1.97±0.11 (2-3)	5.74±0.29 (4-7)	28.5±1.63 (23-38)
<b>Coriander</b>	17.22±0.36 (15-19)	9.92±0.74 (6-13)	6.68±0.38 (5-9)	6.70±0.61 (4-9)	19.43±0.97 (16-26)	59.06±1.63 (52-68)	2.07±0.15 (2-3)	4.5±0.5 (4-5)	21.0±6.0 (15-27)
<b>Fennel</b>	18.25±1.39 (16-33)	28.50±3.5 (25-32)	53.0±0.0 (53-53)	-	-	-	-	-	-
<b>Cumin</b>	11.0±0.0 (11-11)	-*	-	-	-	-	-	-	-

\* Larva did not complete its duration