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Growth and Development of Cotton Mealybug (*Phenacoccus solenopsis* Tinsley) (Hemiptera: Pseudococcidae) on Potato in a Laboratory Experiment

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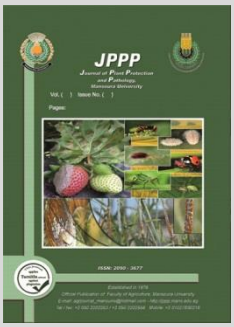

ABSTRACT

The aimed of this study was to investigate some biological aspects of cotton mealybug (CM), *Phenacoccus solenopsis* Tinsley, found on potato in Sharqiya Governorate, Egypt. The results showed that there are three nymphal stages in females. Adult males have two nymphal and pupal stages, they are winged, delicate and do not feed. The development period for the first, second and third nymphal instas for insect female were 6.20, 4.26 and 4.46 days. While, in the male nympal stage, the first, second in stars were 6.90 and 7.00 days, respectively. The ovipostional periods were 15.08, 15.98 and 4.36 days were recorded for the pre-oviposition, oviposition period and post ovipostion period, respectively. The adult longevity for female and male presented by 35.4 and 2.2 days, respectively. The generation period and the life cycle for the insect females recorded 30.52 and 86.34 days, respectively. Female fecundity shows a dynamic pattern with the number of female-producing reptiles varying between 122 and 459, with an average of 335±11.00 /female.

Keywords: Biological aspects, cotton mealybug, *Phenacoccus solenopsis.*

INTRODUCTION

The cotton mealybug, *Phenacoccus solenopsis*, Tinsley (Hemiptera: Coccidiidae), scientifically known as is an important pest in agricultural areas, responsible for 21 different families of agricultural and horticultural (Vennila *et al*., 2010; Nabil and Hegab 2019; Mostafa *et al*., 2023 and Arif *et al.*, 2009). Diseases transmission by adults and immatures cause major crop losses. They consume leaves by removing tissue and extracting fluid from cells, causing leaves to turn yellow. While feeding, they secrete honeydew, causing mold growth and inhibiting photosynthesis, ultimately causing plant death (Wang *et al.*, 2009). The first time in Egypt this insect affected vegetation was recorded (Abd-Rabou, *et al.*, 2010) and since then many efforts have been made to record the impact of this line on many crops. *Phenacoccus solenopsis* was first recorded on tomatoes in Qalyoubia Governorate (Ibrahim, *et al.*, 2015). In Al-Sharkia Governorate, four sectors were registered for the first time: eggplant, maize, pomegranate, jute and okra (Nabil, *et al.*, 2015). Also, *Phenacoccus solenopsis* has been described as a new potato insect species in Abu-Hummus area, Behira Governorate, Egypt (Rezk, *et al.*, 2019). Therefore, the aim of this study was to investigate some biological characteristics (developmental stage, longevity, fecundity, life cycle and generation) of the cotton mealybug (*P.solenopsis*). The disease of the pest was studied on foil-treated potato sprouts. The data generated can be used to develop comprehensive pest management plans and predictive models specifically developed for this insect species.

MATERIALS AND METHODS

Insects Collection

Biological research on *Phenacoccus solenopsis* Tinsely was conducted at Faculty of Agriculture, Zagazig University, Egypt. The pests were collected from okra (Balady var.) in Hihya district, Sharqiya Governorate, Egypt.

A study on potato cultivation and cotton mealybug rearing.

Rinse the *Solanum tuberosum* L. potatoes thoroughly with water and place them in a wet plastic container with a diameter of 30 cm. Sprinkle water into the plastic container every day to stimulate growth. After one month, the potatoes will have 5-7 cm buds. Then the sprouted potatoes are placed one by one in a light glass cage. The lines were then transferred to the potato shoot using a camel hairbrush and kept in the laboratory at 25 ± 2 °C, 65 ± 5% relative humidity and 2000 lx intensity with a 12-h photoperiod. Female mealybugs colonize potato sprouts and begin to egg laying. After the crawlers emerge, they begin to feed and develop into adults. Recently, older females were separated from each other using beautiful tables and placed on new potatoes stored in the same laboratory. Biological studies begin with taking of the second generation of crawlers. 50 reptiles selected from different females born on the same day were observed and followed to study the biological characteristics of adult females and males separately. Examine the reptiles every morning using a microscope and measure the period of initial nymphal stage by examining the apparent dissolution of loose waxy filaments. Calculate the pre-oviposition, oviposition, post-oviposition length, lifespan, life cycle and generation of

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females. The fertility of *P. solenopsis* was determined by examining and counting the reptiles released by females under a binocular camera. The lifespan of males and the proportion of males surviving to adulthood in the total population were evaluated (Nabil, 2019).

RESULTS AND DISCUSSION

The data shown in Table (1) indicated that for females show three nymphal instars, while males go through both nymph and pupal stages.

Biological aspects of *Phenacoccus solenopsis*

Female and male nymphal developmental stages

According to the information shown in Table (1) and Figure (1), three nymphal instars were found in females. The average length of the first nymphal instar was 6.80 ± 0.11 days, ranging from 6 to 8 days. The average second nymphal developmental period lasts 4 to 5 days (4.26 ± 0.06 days). The third nymphal instar lasts four to six days; These findings are consistent with the findings of Akintola and Ande (2008) and Nabil (2019) who found that the first instar of newly hatched female nymphs lasted 6.41 ± 0.05 days and the duration of the second nymphal instar of females ranged from 3 to 5 days, with an average of 4.45 ± 0.04 days. The third nymphal stage was observed only in females and lasted 7.09 ± 0.14 days. The average length of the first-stage males of the new nymphs was 7.10 ± 0.19 days, ranging from 6 to 9 days. After molting, the second-stage nymph appears. The molt of the disease stage is seen at the posterior end of the abdomen. Except for body differences, all appearance and morphological features of the second-stage nymphs are the same as those of the first-stage nymphs. There are two nymphal stages in the male colony. The reproduction period of male first-stage nymphs of cotton beetles varies between 6 and 9 days, lasting an average of 6.90 ± 0.38 days. The second nymphal stage is average (7.00 ± 0.67 days) and lasts 6 to 11 days.

Males pupal stage

Data illustrated in Table (1) show that the average length of the male pupal stage is 9.60 ± 0.31 days with a range of 9 to 11 days. The results of this study were consistent with Nabil (2019), who described that males produce white flowers after the second molt of the second nymphal instar, although this phenomenon was not observed in females. Male cocoons last for 5 to 11 days with an average duration of 9.05 ± 0.37 days.

Table 1. Biological parameters of the female and male nymphal stage of *Phenacoccus solenopsis* Tinsley rearded on potato.

Biological parameters		immature stages Durations (days)		
Gender	**Instar**	**No.**	**Rang**	**Mean ± SE**
Female nymphal stage	1st	50	6-8	6.80 ± 0.11
	2nd	50	4-5	4.26 ± 0.06
	3rd	50	4-6	4.46 ± 0.11
Male nymphal stage	1st	10	6-9	6.90 ± 0.38
	2nd	10	6- 11	7.00 ± 0.67
	Pupal stage	10	9- 11	9.60 ± 0.31

***Phenacoccus solenopsis* longevity of adult stage**

Adult female

Data tabulated in Table 2 indicate that, the time from maturation to the first egg (preoviposition period) lasted between 10 and 19 days, with a mean of 15.08 ± 0.22 days. Female of P. solenopsis continued to deposit eggs for 15.98 ± 0.22 days, Averaging 11 to 18 days. Before death, it stopped egg laying for a period of 4.36 ± 0.10 days, ranging from 3 to 5 days. The longevity period of female was (25-40 days). Females live longer than males.

Table 2. The ovipositional periods and the female and male adult longevity of *Phenacoccus solenopsis*

Biological parameters		Adult stage durations (days)		
Gender	**period**	**Number**	**Rang**	**Mean ± SE**
Female	Pre-oviposition period	50	10-19	15.08 ± 0.22
	Oviposition period	50	11-18	15.98 ± 0.22
	Post-oviposition period	50	3-5	4.36 ± 0.10
	Female longevity	50	25- 40	35.4 ± 0.50
Male	longevity	10	2- 3	2.20 ± 0.13

Adult male

The present results arranged in table (2) show that the lifespan of males is between two and three days. The mean male lifespan is 2.20 ± 0.13 days. These findings are consistent with the findings reported by Vennila *et al.,* (2010) and Nabil (2019) who stated that males have wings, are fragile and do not feed, and their lifespan is longer than 2 days. The overall lifespan of males ranges from 1 to 3 days, with a mean of 2.0 ± 0.12 days. Male has a longer lifespan than females, probably due to the additional molt and pupal stages in males.

Fecundity, life cycle and generation

Regarding, the data presented in Table (3) show that the number of crawlers produced by a female during her lifetime (fecundity) varies from 122 to 459 with an average of 335 ± 11.00 nymph per female. The difference between the generation (Generation (the period in which the egg-to-egg cycle is completed)) and life cycle (the time from egg to adult) of the female cotton mealy bug, *Phenacoccus solenopsis*, durated 25 to 34 days and 64 to 97 days with an average of 30.52 ± 0.44 days and 86.34 ± 1.07 days, respectively. The findings presented here are consistent with those reported by Charleston *et al.,* (2010) who found that the total life span of females varies from 30 to 48 days while the adult life span is about 21 days. A study by Hanchinal *et al.,* (2010) found that the eggs produced by female Phenacoccus solenopsis vary greatly depending on the host. The average number of eggs laid per potato litter is 226.1 eggs/female. Vennila *et al.,* (2010) and Nabil (2019) noted that these females exhibited poor reproductive patterns, with the reptiles producing an average of 344 ± 82 offspring per female, ranging from 128 to 812, over 6 days, and dying on the second day after the completion of the process of parturition. Improved pest management and CM prediction models are based on this finding.

Table 3. Fecundity, generation, and life cycle of *Phenacoccus solenopsis* Tinsley females raised on potato

Biological aspects	Adult Stage Durations(Days)		
	Number	**Rang**	**Mean ± SE**
Fecundity (Total average of crawlers / female)	50	122- 459	335 ± 11.00
Generation	50	25-34	30.52 ± 0.44
Life cycle	50	64-97	86.34 ± 1.07

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تطور وتكاثر بق القطن الدقيقي *Phenacoccus solenopsis* (Hemiptera: Pseudococcidae) Tinsley على البطاطس فى تجربة معملية

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الملخص

يهدف البحث الحالي إلى دراسة بعض الخصائص البيولوجية لحشره البق القطن الدقيقي *Phenacoccus solenopsis* Tinsley على نباتات البطاطس في محافظة الشرقية، مصر. أجريت هذه التجربة في قسم وقاية النبات بكلية الزراعة - جامعة الزقازيق بمصر. أشارت النتائج إلى وجود ثلاثة أطوار من طور الحورية في الإناث. كان للإطوار الكامله من الذكور طوران من طور الحورية وطورعذراء وكانوا مجنحين ولا يتغذون .كانت فترة تطور المراحل الحورية الأولى والثانية والثالثة للإناث 6.20 و 4.26 و 4.46 يومًا. بينما فى الذكر كانت الاطوار الأولى والثانيه من طور الحوريه مدتها 6.90 و7.00 يوم على التوالى .تم تسجيل فترات وضع البيض 15.08 و 15.98 و 4.36 يومًا لفترة ما قبل وضع البيض وفترة وضع البيض وفترة ما بعد وضع البيض على التوالي .بلغ متوسط فتره عمر الأنثى الكامله والذكر 35.4 و2.2 يومًا على التوالي .وسجلت فترة الجيل ودورة الحياة للإناث البالغه 30.52 و86.34 يومًا على التوالي. أظهرت الخصوبة في الإناث أنماطًا ديناميكية، حيث تراوح عدد الحوريات (الزاحفات) للاناث بين 122 و459 بمتوسط 335±11.00 حوريه /أنثى .