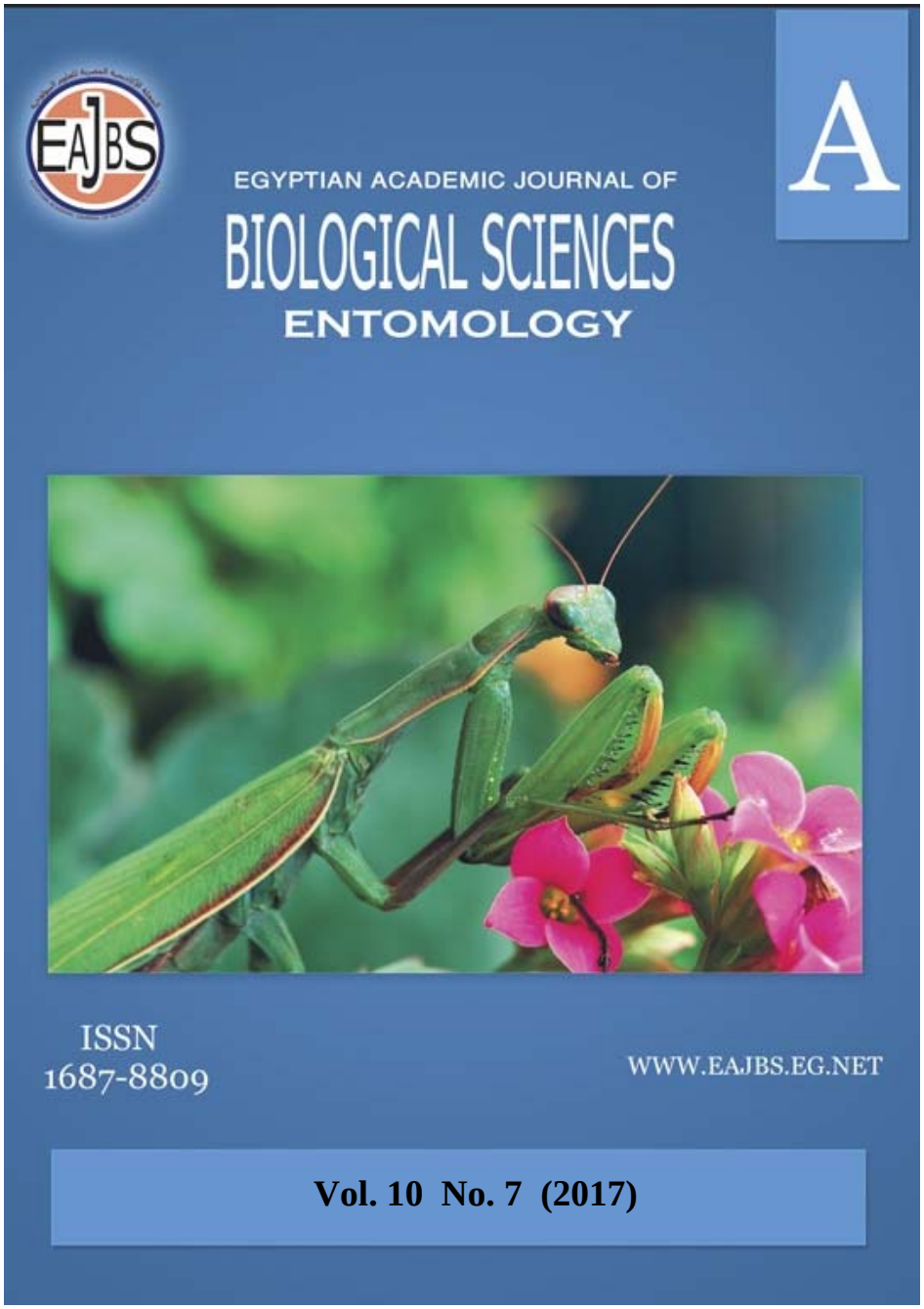

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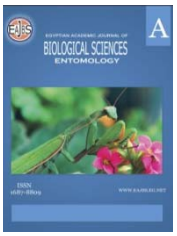

Biological Studies on Cotton Mealybug *Phenacoccus solenopsis* Tinsley (Hemiptera: Sternorrhyncha: Coccoidea: Pseudococcidae) under Laboratory Conditions

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ABSTRACT

The studies were carried out on the cotton mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Sternorrhyncha: Coccoidea: Pseudococcidae) in Scale Insects and Mealybugs Department Laboratory, Plant Protection Research Institute, Sharkia Branch during the period extended from July to October 2015 to study the developmental stages periods of the insect under laboratory conditions 25 ± 1˚C, 65 ± 5% RH and a photoperiod 12 hrs. Three numphal instars were recorded for males and females but males had an additional stage that pupal stage. The results indicated that eggs incubation period was 1.06 days for males and females. The developmental periods for first, second and third nymphal instars, adult female longevity, life cycle and generation were 6.15, 7.26, 7.81, 18.91, 41.20 and 26.95 days, respectively. The developmental periods for first, second and third nymphal instars, pupal stage and adult male longevity were 5.91, 7.06, 6.68, 6.12 and 2.97 days, consecutively. The sex ratio was 1: 6.65 male and female, respectively. This study may be useful information for mass rearing and designing a comprehensive pest management program and prediction models for the cotton mealybug.

INTRODUCTION

The cotton mealybug, *Phenacoccus solenopsis* (Hemiptera: Sternorrhyncha: Coccoidea: Pseudococcidae) was described by Tinsley from weed roots in a nest of the ant *Solenopsis geminata* Fabricius in New Mexico, U.S.A in 1898. This highly polyphagous mealybug attacks numerous crops, weeds, ornamentals and medicinal plants. It infests the leaves, fruit, branches, main stems, trunks and roots feeding on phloem sap and producing sugary honeydew (McKenzie, 1967 and Arif *et al.*, 2009). Large populations of mealybugs cause general weakening, defoliation and death of susceptible plants. Indirectly, it may also damage plants by serving as vectors of plant diseases. Moreover, the honeydew excreted by the mealybugs cause growth of sooty moulds and other secondary infections that decreases photosynthesis and reduces the marketability of plant products (Hodgson *et al.*, 2008, Abbas *et al.*, 2010, Wang *et al.*, 2010 and Vennila *et al.*, 2011).

The first record of *P. solenopsis* damaging a crop was made by Fuchs *et al.* (1991) who recorded *P. solenopsis* on cotton cultivated in Texas, U.S.A. The *P.*

solenopsis has been found on a relatively wide variety of host plants including species of economically important families such as Cucurbitaceae, Fabaceae, Solanceae and Malvaceae (Culik and Gullan, 2005, Afzal *et al.*, 2009, Wang *et al*., 2009 & 2010 and Zhu *et al*., 2011). Aheer *et al.* (2009) reported 22 host plants of *P. solenopsis,* besides cotton crop in Pakistan. Maximum prevalence was observed on China rose, *Hibiscus chinensis* followed by okra, *Abelmoschus esculentus* L. (Malvaceae) (Wang *et al*., 2010).

In Egypt, the first record of *P. solenopsis* infestation was on weed plants by Abd-Rabou *et al.* (2010). Ibrahim *et al.* (2015) recorded *P. solenopsis* for the first time on tomato plants at Qalyoubia Governorate. Nabil *et al.* (2015) registered *P. solenopsis* for the first time on four economical crops okra, *A. esculentus* , eggplant, *Solanum melongena* L. (Solanceae), maize, *Zea mays* L. (Poaceae) and nalta jute (meloukhia), *Corchorus olitorius* L. (Malvaceae) at Hihhya distract, Sharkia Governorate, Egypt.

This research represents an initial effort to study the biology of *P. solenopsis* because the information on its biology was scanty. Therefore, the present study on the biology was carried out. The information generated may be used for designing a comprehensive pest management program and prediction models for the cotton mealybug.

MATERIALS AND METHODS

Collection of insects:

The biological study on of *P. solenopsis* was conducted at Scale Insects and Mealybugs Research Department, Plant Protection Research Institute, Sharkia Branch, Agricultural Research Center. The study was conducted between July to October 2015. The using population collected from eggplant, *Solanum melongena* L. (Solanceae) at Hihhya distracts, Sharkia Governorate, Egypt.

Potato culture and mealybug rearing:

Potato tubers, *Solanum tuberosum* L. (Solanceae) were washed thoroughly in water and put on moistened plastic dishes 30 cm. Water was sprinkled daily to keep the plastic dishes moistened to encourage sprouting. After 28-30 days potatoes produced sprouts of 5-7 cm. Then the insects were transferred with the aid of camel hairbrush to the potatoes sprouts and reared under laboratory conditions 25 ± 1˚C, 65 ± 5% RH and a photoperiod 12 hrs. The mealybug females settled on potatoes sprouts started to eggs laying. The crawlers emerged out and started feeding and developed to adults. The newly adult females were separated and placed on a new potato sprouts kept under the same laboratory conditions with the help of fine camel hair brush. Biological studies were started from the egg stage which laying from the second generation females. A total of 260 eggs laid from different females but laid on the same day were observed and followed to study the biological aspects. The crawlers were observed daily in the morning by the aid of magnifying glasses (X 10) to determine the nymphal instars durations with checking for exuvia which were visible through the loose waxy filaments. The preoviposition, oviposition, postovipostion periods for female, Longevity, life cycle and generation periods were calculated. The eggs laid by females of *P. solenopsis* were examined under binocular microscope and counted for calculating fecundity. The number of males out of the total population that survived to adult stage and sex ratio were calculated. The longevity of males was observed.

Statistical analysis:

Data were statistically analyzed using COSTAT Computer Program (2005).

RESULTS AND DISCUSSION

Egg incubation periods

Data tabulated in Table (1) showed that the mean egg incubation periods of female and males ranged from 1 to 2 days with an average of 1.06 days. After that eggs hatching to immature stages *P. solenopsis* exhibited variation in males and females at immature stages. Our findings were agreed with the results of Kumar and Kontodimas (2012) who reported that egg development times (mean ± SE) ranged from 3.40±0.24, 2.10±0.33 and 1.10±0.24 days at 20, 25 and 30˚C, respectively.

Immature stages

Data presented in Table (1) showed that there were three nymphal instars were recorded for males and females but males had an additional stage that pupal stage. The duration of newly hatched nymphs first instar lasted for 3 to 8 days with an average of 6.15 ± 0.09 days in females compared with 5 to 7 days with an average of 5.91 ± 0.12 days in males. After moult, the second instar nymphs founded, the exuvium of the instar was seen near the posterior end of the abdomen the second instar nymphs were similar to that of first instar nymphs in general appearance and morphological features, except in size. The second nymphal instar for females ranged from 4 to 9 days with an average of 7.26 ± 0.11 days compared with 5 to 9 days with an average of 7.06 ± 0.17 days in males. The third nymphal instar for females ranged from 3 to 11 days with an average of 7.81 ± 0.16 days compared with 5 to 9 days with an average of 6.68 ± 0.16 days in males.

Table (1): Developmental durations (Mean ± SE) in days of *Phenacoccus solenopsis* stages reared on potato sprouts under laboratory conditions 25 ± 1˚C, 65 ± 5% RH and a photoperiod 12 hrs.

Biological parameters		Developmental durations in days		
		No.	**Range**	**Mean ± SE**
Female	Egg incubation period	226/ 260	1-2	1.06 ± 0.02
	Nymphs			
	1st instar	226/ 260	3-8	6.15 ± 0.09
	2nd instar	226/ 260	4-9	7.26 ± 0.11
	3rd instar	226/ 260	3-11	7.81 ± 0.16
	Adult			
	Preoviposition period	226/ 260	3-8	4.66 ± 0.09
	Oviposition period	226/ 260	4-16	10.55 ± 0.20
	Postoviposition period	226/ 260	1-8	3.69 ± 0.11
	Total average of eggs/female (fecundity)	226/ 260	93-456	267.0 ± 5
	Longevity	226/ 260	11-26	18.91 ± 0.22
	Life cycle	226/ 260	22-50	41.20 ± 0.46
	Generation	226/ 260	14-34	26.95 ± 0.37
Male	Egg incubation period	34/260	1-2	1.06 ± 0.04
	Nymphs			
	1st instar	34/260	5-7	5.91 ± 0.12
	2nd instar	34/260	5-9	7.06 ± 0.17
	3rd instar	34/260	5-9	6.68 ± 0.16
	Pupal stage	34/260	5-10	6.12 ± 0.21
	Longevity	34/260	1-5	2.97 ± 0.20

The male nymphs formed a white silken cocoon after their third moult, but this phenomenon was not founded in females. Male cocoons duration lasted for 5 to 10 days with an average of 6.12 ± 0.21 days. Results are in agreement with those Obtained by Akintola and Ande (2008) that studied *P. solenopsis* on *Hibiscus rosa-sinensis* and founded progressively increasing developmental periods of 6, 8 and 10 days for the 1st, 2nd and 3rd instars, respectively. Longer developmental duration of males compared to females was due to an additional of pupal stage.

Vennila *et al.* (2010) who reported that the developmental period from immature crawler to adult stage was greater for males compared with females probably due to the additional molt to the pupal stage in males.

Mature stages:

Data presented in Table (1) showed that female longevity ranged from 11 to 26 days with an average of 18.91 ± 0.22 days. Total life cycle lasted for 22 to 50 days with an average of 41.20 ±0.46 days. Observations on preoviposition, oviposition and postoviposition periods of *P. solenopsis* revealed that it varied from 3 to 8, 4 to 16 and 1 to 8 days with an average of 4.66 ± 0.09, 10.55 ± 0.20 and 3.69 ± 0.11 days, respectively. While, the male longevity ranged from 1 to 5 days with an average of 2.97 ± 0.20 days.

Data tabulated in Table (1) reported that the number of eggs laid by a single female (fecundity) during its entire life period ranged from 93 to 456 eggs with an average of 267 ± 5 eggs. The sex ratio of *P. solenopsis* in laboratory culture revealed that out of 260 third instar nymphs, 226 were females and 34 were males. Thus male to female ratio was 1: 6.65.

Our findings were agreed with the results of Charleston *et al.* (2010) who mentioned that the total life cycle of female was 30-48 days, which included 21 days adult longevity. Male life cycle was completed in 24-30 days including 3-5 days adult longevity. Hanchinal *et al.* (2010) reported that oviposition in *P. Solenopsis*, the number of eggs laid by a female varied greatly with the host on which it was reared. A mean of 226.1 eggs were laid by a single female when reared on potato sprout. The population of males was very low as compared to females. Vennila *et al.* (2010) who reported that males accounted for less than 5% of the population, and lived 1.5 ± 0.1 days. Adult males have inactive mouth parts and live only for 2-3 days in summer and 2-5 days in winter to copulate.

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ARABIC SUMMARY

دراسات بيولوجية على بق القطن الدقيقى *Phenacoccus solenopsis* Tinsley تحت الظروف المعملية

حسن أحمد نبيل

معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى- جيزة- مصر

أُجريت هذه الدراسة بمعمل قسم بحوث الحشرات القشرية والبق الدقيقى بمعهد بحوث وقاية النباتات فرع الشرقية على بق القطن الدقيقى *Phenacoccus solenopsis* Tinsley (Hemiptera: Sternorrhyncha: Coccoidea: Pseudococcidae) خلال الفترة من يوليو وحتى أكتوبر ٢٠١٥م لدراسة فترات الأطوار المختلفة للحشرة تحت الظروف المعملية ٢٥± ١م° و ٦٥ ± ٥ % رطوبة نسبية و ١٢ ساعة إضاءة لإستخدام تلك المعلومات اثناء التربية الموسعة وتصميم برامج المكافحة والتنبؤ للآفة.

من خلال تلك الدراسات وجد إن لكل من الذكور والإناث ثلاثة أعمار حورية غير أن الذكور تتميز بوجود طور العذراء الغير موجود فى الإناث.

وجد أن فترة حضانة البيض كانت ١.٠٦ يوم لكل من الذكور والإناث، كذلك فإن فترات الأعمار الحورية الأول والثانى والثالث وطول عمر الحشرة الكاملة ودورة الحياة والجيل للإناث كانت ٦.١٥ و ٧.٢٦ و ٧.٨١ و ١٨.٩١ و ٤١.٢٠ و ٢٦.٩٥ يوم على الترتيب. وأن فترات الأعمار الحورية الأول والثانى والثالث وطور العذراء وطول عمر الحشرة الكاملة للذكور كانت٥.٩١ و ٧.٠٦ و ٦.٦٨ و ٦.١٢ و ٢.٩٧ يوم على التوالى. وكانت النسبة الجنسية ١: ٦.٦٥ ذكر لكل أنثى.