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BIOLOGICAL STUDIES ON COTTON MEALYBUG *Phenacoccus solenopsis* TINSLEY UNDER LABORATORY CONDITIONS

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ABSTRACT: This study was carried out on cotton mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Sternorrhyncha: Coccoidea : Pseudococcidae) in Scale Insects and Mealybugs Department, Plant Protection Research Institute, Sharkia Branch. It was done during the period extended from July to November 2018 to study periods of the developmental stages of the tested insect under laboratory conditions 25 ± 1˚C, 65 ± 5% RH and a photoperiod 12 hrs., for the possible use of this information in mass rearing and designing prediction and control programs of this pest. Results showed that three nymphal instars were recorded for females with no pupal stage, while only two nymphal instars and a pupal stage were recorded for males. The developmental periods for first, second, third nymphal instars, adult female longevity, life cycle and generation were 6.41, 4.45, 7.09, 28.17, 46.12 and 29.76 days, respectively. The developmental periods for first, second, pupal stage and adult male longevity were 7.10, 8.49, 9.05 and 2.0 days, consecutively. The females showed dynamic patterns of fecundity with the number of crawlers produced per female ranging between 120 and 385, with a mean of 227.

Key words: Biological studies, cotton mealybug.

INTRODUCTION

The cotton mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Sternorrhyncha: Coccoidea: Pseudococcidae) was described by Tinsley from weed roots in a nest of the ant *Solenopsis geminata* Fabricius in New Mexico, USA in 1898. This highly polyphagous mealybug attacks numerous crops, weeds, ornamentals and medicinal plants. It infests the leaves, fruits, branches, main stems, trunks and roots feeding on phloem sap and producing sugary honeydew (**McKenzie, 1967; 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; Vennila *et al.*, 2011**).

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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, USA. 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 and 2010; Zhu *et al.*, 2011**). **Aheer *et al.* (2009)** reported 22 host plant of *P. solenopsis,* beside 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 *i.e.,* 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* as the information on its biology was scanty. 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

Biological study on *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 November 2018. The population used was 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 hair brush 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 laying eggs. 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 with neonate crawlers of the second generation. A total of 191 crawlers drawn 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 binocular microscope 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 longevity of males were studied.

Statistical Analysis

Data were statistically analysed using **COSTAT (2005)**.

RESULTS AND DISCUSSION

Immature Stages

Results presented in Table 1 show that three nymphal instars were recorded for females. On the other hand, males showed to have two nymphal instars and pupal stage. The duration of newly hatched nymphs first instar lasted for 6 to 8 days with an average of 6.41 ± 0.05 days in females compared with 6 to 9 days with an average of 7.10 ± 0.19 days in males. After moult, the second instar nymphs were found, the exuvium of the instar was seen near the posterior end of the abdomen and 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 3 to 5 days with an average of 4.45 ± 0.04 days compared with 8 to 11 days with an average of 8.49 ± 0.19 days in males. The third nymphal instar which was occurred in females only ranged from 4 to 10 days with an average of 7.09 ± 0.14 days. In males, second nymphal instar formed a white silken cocoon after their second moult, but this phenomenon was not found in females. Male cocoons duration lasted for 5 to 11 days with an average of 9.05 ± 0.37 days. These results were in agreement with those obtained by **Akintola and Ande (2008)** who studied *P. solenopsis* on *Hibiscus rosa-sinensis* and found progressive 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)** 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.

Table 1. Developmental durations (Mean ± SE) in days of *Phenacoccus solenopsis* stages reared on potato sprouts under laboratory conditions

Biological parameter		Developmental durations in days		
		No.	Range	Mean ± SE
Female	**Nymphs**			
	1st instar	140	6-8	6.41± 0.05
	2nd instar	140	3-5	4.45 ± 0.04
	3rd instar	140	4-10	7.09 ± 0.14
	Adult			
	Preoviposition period	140	6-18	11.81 ± 0.21
	Oviposition period	140	10-20	13.07 ± 0.17
	Postovipostion period	140	1-5	3.29 ± 0.06
	Total average of crawlers/female (fecundity)	140	120-385	227.0 ± 4.0
	Longevity	140	24-38	28.17 ± 0.19
	Life cycle	140	40-58	46.12 ± 0.21
	Generation	140	24-38	29.76 ± 0.18
Male	**Nymphs**			
	1st instar	51	6-9	7.10 ± 0.19
	2nd instar	51	8-11	8.49 ± 0.19
	Pupal stage (cocoon)	51	5-11	9.05 ± 0.37
	Longevity	51	1-3	2.0 ± 0.12

Mature Stages

Results presented in Table 1 show that female longevity ranged from 24 to 38 days with an average of 28.17 ± 0.19 days. Observations on preoviposition, oviposition and postoviposition periods of *P. solenopsis* revealed that it varied from 6 to 18, 10 to 20 and 1 to 5 days with an average of 11.81 ± 0.21, 13.07 ± 0.17 and 3.29 ± 0.06 days, respectively.

While, the male longevity ranged from 1 to 3 days with an average of 2.0 ± 0.12 days. Total life cycle of females lasted from 40 to 58 days with an average of 46.12 ±0.21 days.

Results in Table 1 report that the number of crawlers laid by a single female (fecundity) during its entire life period ranged from 120 to 385 crawlers with an average of 227.0 ± 4 crawlers/female.

These results are in agreement 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)** reported that females showed dynamic patterns of fecundity with the number of crawlers produced per female ranging between 128 and 812, with a mean of 344 ± 82. At the end of reproduction, adult females died in the next day with a maximum living of 6 days. Males were winged, delicate and non feeding with a maximum living period of 2 days and a mean of 1.5 ± 0.1 days.

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

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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 نوفمبر ٢٠١٨م لدراسة فترات الأطوار المختلفة للحشرة موضع الدراسة تحت الظروف المعملية ٢٥± ١م° و ٦٥ ± ٥% رطوبة نسبية و ١٢ ساعة إضاءة لإمكانية استخدام تلك المعلومات أثناء التربية الموسعة وتصميم برامج المكافحة والتنبؤ للآفة، من خلال تلك الدراسات وجد أن للإناث ثلاثة أعمار حورية مع غياب طور العذراء غير أن الذكور تتميز بوجود عمرين حوريين فقط بالإضافة إلى طور العذراء، وجد أن فترات الأعمار الحورية الأول، الثانى، الثالث، طول عمر الحشرة الكاملة، دورة الحياة والجيل للإناث كانت ٦,٤١ ، ٤,٤٥، ٧,٠٩ ، ٢٨,١٧ ، ٤٦,١٢ و٢٩,٧٦ يوماً على الترتيب، وأن فترات الأعمار الحورية الأول، الثانى، طور العذراء وطول عمر الحشرة الكاملة للذكور كانت ٧,١٠ ، ٨,٤٩، ٩,٠٥ و ٢,٠ يوم على التوالى، وأوضحت الدراسات أن الكفاءة التناسلية (عدد الحوريات لكل أنثى) تراوحت بين ١٢٠ إلى ٣٨٥ حورية لكل أنثى بمتوسط ٢٢٧ حورية لكل أنثى.

المحكمـــــون:

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