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FORAGING BEHAVIOR OF TWO APHID PARASITOIDS; *Aphidius matricariae* HALIDAY AND *Aphidius colemani* VIERECK (HYMENOPTERA: APHIDIIDAE)

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ABSTRACT

The effect of learning and experience status on the foraging behavior of aphid parasitoids *Aphidius matricariae* (Haliday) and *A. colemani* (Viereck) was studied. Direct observation showed that the experienced females remained for longer times on the leaves of potted cucumber plants (*Cucumis sativus*) than did their naïve counterparts. Also experienced female parasitoids attacked more aphids within a patch than did naïve females and parasitized more hosts. Moreover, experienced females super-parasitized more aphids than did naïve ones for both parasitoid species. Almost no difference was found between the foraging behavior of *A. matricariae* and *A. colemani*.

INTRODUCTION

Cotton aphid (*Aphis gossypii* Glov.) is a major insect pest infesting numerous plant species causing considerable damage. Several aphid parasitoids have been studied for their useful participation as biological control agents. *Aphidius matricariae* and *A. colemani* are endo-parasitoids on different aphid species. Learning and experience have been demonstrated at different stages of host foraging for many entomophagous insect species (Arthur, 1981). For parasitoids, the stage immediately preceding host finding has been called host habitat or host community location (Vinson, 1984). Different studies of insect foraging behavior have departed from classical mechanistic approach and focused on developing rules for decision making by individuals (Mangel and Clark, 1986).

The purpose of this study is to get detailed information on the foraging behavior of *A. matricariae* and *A. colemani* and to prove their importance as natural enemies of *A. gossypii*.

MATERIALS AND METHODS

Observations were carried out at the period of May and June 2010 in the laboratory of Plant Protection Department, Faculty of Agriculture, Al-Azhar University at a temperature of 24 ± 2°C and 65 ± 5% RH on leaves of potted cucumber plants (*Cucumis sativus*). At the beginning of every observation, ten adult aphids were placed on each potted cucumber plant leaf, and two days later the adults were removed and the remaining nymphs were used in the experiment as colonies. Each colony contained 20 to 30 nymphs. Continuous observations started immediately after the introduction of the parasitoid of both species.

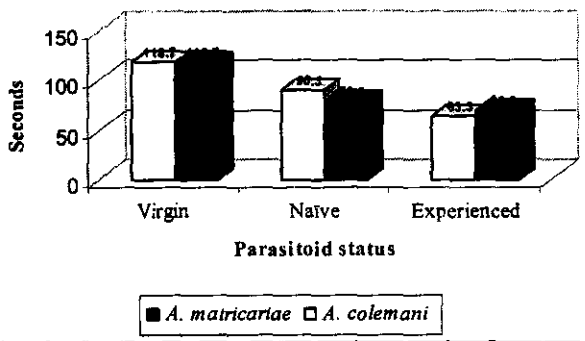
A muslin cage with front side of glass and wooden frame (width = 50 cm, height = 70 cm, and depth = 40 cm) was prepared for each parasitoid species where one potted cucumber plant was placed. Mummified aphids from each parasitoid stock culture on *A. gossypii* were taken and isolated in individual vials to await parasitoid emergence.

Experienced and inexperienced (naïve) female parasitoids were used. The experience consisted of five parasitizations (attacks) just before the experiment. The experiments were performed between 9 a.m. and 3 p.m. The effect of plant treatment and parasitoid experience were studied in blocks of five observations. The following parameters; latency time, first landing point and the time spent by the parasitoid on the leaf were recorded. Parasitized aphids were dissected and the number of parasitoid eggs was counted. When the parasitoid walked onto the stem of the plant or flew away to another part of the plant or the cage wall, the observation was terminated. For each combination 5 replicates were made. The observation was terminated also when the parasitoid had not left the vial for 10 minutes.

RESULTS AND DISCUSSION

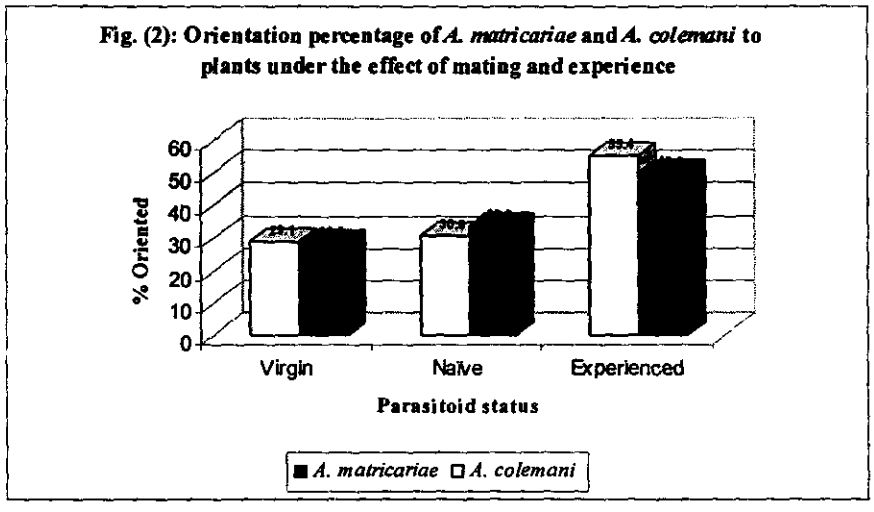
Latency Time:

Fig. (1): Latency time of *A. matricariae* and *A. colemani* under the effect of mating and experience



The time spent by the parasitoid from opening the vial till leaving it is called latency time. The obtained results as shown in figure (1) indicate that the mated female parasitoids left the vial faster than the virgin ones for both parasitoids. Latency time of virgin *A. matricariae* and *A. colemani* was 118.7 ± 3.3 and 118.8 ± 5.1 seconds, while it was 78.6 ± 3.7 and 90.3 ± 2.5 seconds, respectively for the naïve females. However the latency time for the experienced females of *A. matricariae* was 68.8 ± 3.9 and 63.3 ± 5.5 seconds for *A. colemani*. This finding is comparable with that of *A. colemani* studied by van Steenis *et al.* (1996) and for *A. matricariae* studied by El-Khawass (2000).

Parasitoid orientation to plants:



The ability of the parasitoid to be oriented by the host from a distance is called host location and defined by Weseloh (1992) as "the perception and orientation by parasitoids to their hosts from a distance by response to stimuli produced or induced by the host or its products".

Almost similar findings appear for both parasitoid species in figure (2) as regard their orientation behavior where experienced females showed higher percentage than either naïve or virgin females (49.9% ± 5.7 and 55.4% ± 3.3 for *A. matricariae and A. colemani*). However no significant differences were found between naïve and virgin ones where naïve and virgin females of *A. matricariae* were oriented by percentages of 33.6% ± 3.9 and 28.8% ± 4.5; respectively. Similarly naïve and virgin females of *A. colemani* were oriented by percentages of 30.8% ± 5.1 and 29.1% ± 5.5.

Numerous studies have shown that the parasitoid responsiveness to host-associated cues can be modified as a result of experience. These cues originate from host food plants (Lewis *et al.*, 1990; Mc Auslan *et al.*, 1990 and Tooker and Hanks, 2006). It is more likely that both parasitoid species use odors from *A. gossypii* colonies to find aphid-infested plants once in the habitat. Such effect was found for *Diaeretiella rapae* (Read *et al.*, 1970), *Ephedrus cerasicola* (Hagvar and Hofsvang, 1987), *Aphidius colemani* (van Steenis and El-Khawass, 1995) and *Aphidius matricariae* (El-Khawass, 2000). Also previous investigations by Bouchard and Cloutier (1984) revealed that the experienced *Aphidius nigripis* females showed a significantly higher response than did the naïve ones, while there were no significant differences between the response of naïve and experienced *Aphidius rhopalosiphi* females (Bundenberg, 1990). Schwörer and Völkl (2001) found that within a patch of host plants, *Aphidius ervi* females visited most host plants under standard conditions. Only parasitoids that had oviposition experience on the release plant successfully found new hosts after dispersal.

Time spent on cucumber leaf:

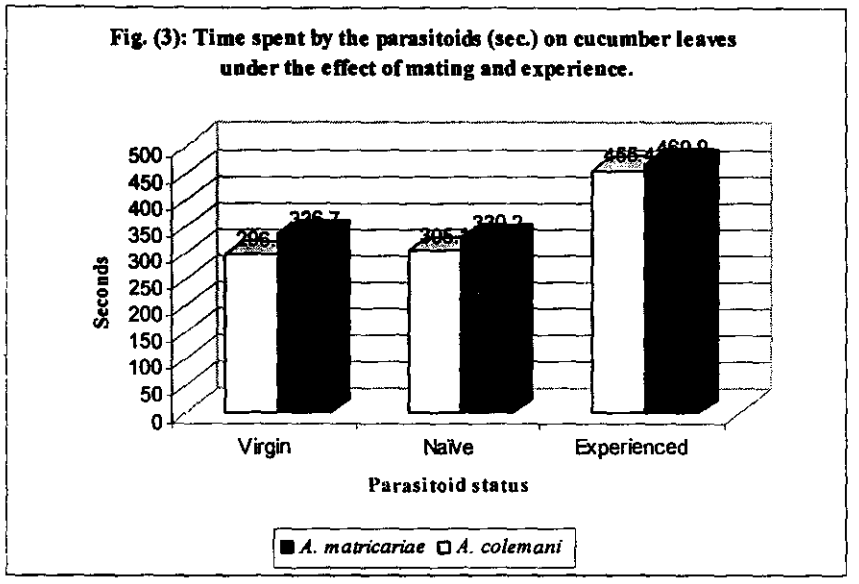


Figure (3) shows that the mated experienced female parasitoids remained for significantly longer time (469.9 ± 4.0 sec. and 455.4 ± 3.0 sec. for *A. matricariae* and *A. colemani*) than did the naïve and virgin ones. A similar increase in duration until the first escape attempt was found by El-Khawass (2000) which perhaps due to contact with host, arrestment by honeydew or detection of aphid kairomones (Bundenberg, 1990).

Parasitization:

Data in figure (4) show that the mated females either naïve or experienced attacked larger numbers of aphids where 60.0 ± 0.9, 82.0 ± 1.4 and 89.0 ± 2.0% of the aphids were parasitized by *A. matricariae* virgin, mated naïve and mated experienced females, respectively. Almost similar findings were found for *A. colemani* (68.0 ± 1.4, 85.0 ± 1.4 and 91.0 ± 1.0%). According to Tagawa (1987) the larger clutches of *Apanteles glomeratus* eggs were laid by mated than unmated females and suggested that it may be of advantage to virgins to have a larger number of patches from which male offspring can disperse, since they must disperse to search for other non-related females.

Superparasitism:

Dissection of the parasitized aphids showed that the rates of oviposition and superparasitism were slightly higher among mated (naïve or experienced) females of both parasitoid species than among virgin females (Table 1).

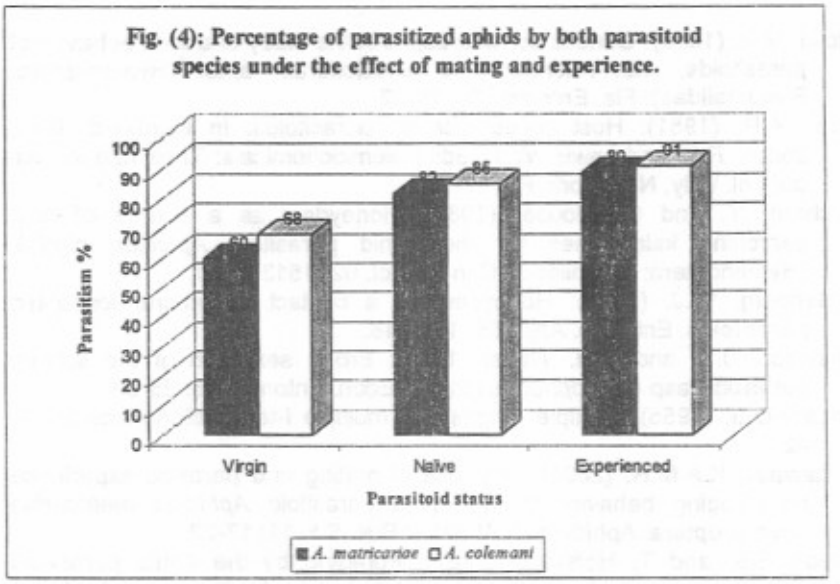


Fig. (4): Percentage of parasitized aphids by both parasitoid species under the effect of mating and experience.

Table (1): Percentage of parasitized aphids and number of eggs laid per host parasitized by different kinds of female parasitoids *A. matricariae* and *A. colemani*.

Kind of female parasitoid		% parasitized aphids	No. of eggs/host
A. matricariae	Virgin	60.0 ± 0.9 b	1.02
	Mated Naïve	82.0 ± 1.4 a	1.55
	Mated Experienced	89.0 ± 2.0 a	1.64
	Mean	77.0	1.40
A. colemani	Virgin	68.0 ± 1.4 b	0.80
	Mated Naïve	85.0 ± 1.4 a	1.12
	Mated Experienced	91.0 ± 1.0 a	1.60
	Mean	81.3	1.17

Different letters between raws indicate a significant difference (Duncan, 1955).

Michaud and Mackauer (1995) recorded differences between virgin and mated females of *Monoctonus paulensis* Ashmead with respect to the number of hosts attacked and rate of superparasitism. These results are attributed to a higher level of activity, where similar findings were reached by Antolin (1989) on *Muscidifurax raptor* and Donaldson and Walter (1991) on *Coccophagus atratus*.

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سلوك رعي نوعين من طفيليات المن *Aphidius matricariae* Haliday and *Aphidius colemani* Viereck (Hymenoptera: Aphidiidae)

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تمت دراسة تأثير حالة التعلم والخبرة التطفلية على سلوك الرعي لكل من نوعي طفيل المن *Aphidius matricariae* & *Aphidius colemani* وأوضحت الملاحظة المباشرة أن الإناث ذوات الخبرة التطفلية قد مكثت لفترة أطول على أوراق الخيار المزروع في قصاري عن مثيلاتها التي لم تتطفل على حشرات من البطيخ *Aphis gossypii* من قبل أو التي لم يتم تلقيحها من قبل الذكور. كما هاجمت إناث الطفيل ذوات الخبرة الت طفلية أفراد من حشرة المن أكثر من مثيلاتها عديمة الخبرة التطفلية أو تلك التي لم تلقح قط. علاوة على ذلك فإن تلك الإناث التي لديها خبرة التطفل تطفلت مرات عديدة على نفس فرد المن أكثر من الإناث عديمة خبرة التطفل أو التي لم تلقح من قبل. تشابهت هذه النتائج في كلا النوعين من طفيل المن من جنس Aphidius من حيث سلوك الرعي على أفراد من البطيخ على الخيار.

قام بتحكيم البحث

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