

Foraging behavior of *Aphidius colemani* (Hymenoptera: Aphidiidae) on three aphid species [*Aphis gossypii*, *Aphis craccivora* and *Rhopalosiphum maidis*] (Homoptera: Aphididae)

S. S. EL-Mezain*, I. L. Ibrahim and K. A. EL-Khawass

Plant protection department, faculty of agricultural, AL-Azhar university.

*Corresponding author E-mail: samy.salah@azhar.edu.eg (S. EL-Mezain)

ABSTRACT

The acceptance and suitability of three aphid species [*Aphis gossypii* Glover, *Aphis craccivora* and *Rhopalosiphum maidis* (Fitch)] (Homoptera: Aphididae) for the parasitoid *Aphidius colemani* Viereck (Hymenoptera: Aphidiidae) were studied and evaluated. Parasitoid female parasitized fewer *R. maidis* than the other two aphid species. Also, fewer offspring successfully completed development in *R. maidis* than in the other two host species, suggesting that *R. maidis* is a poor quality host for the mentioned parasitoid. No significant differences in sex ratios of emerging parasitoid adults between *A. colemani* reared on the three aphid species. Ovipositing *A. colemani* encountered *R. maidis* at a slower rate, also, parasitoid offspring died at a higher rate in *R. maidis* compared to *A. gossypii*. The results showed that oviposition behavior and offspring performance were correlated. The results of this research can be used for establishing integrated pest management (IPM) strategies against aphid species.

Keywords: development time, Aphid parasitoids, *Aphis gossypii*, sex ratios.

INTRODUCTION

Studies of host range can provide insight into the tradeoffs associated with specialization and into speciation via host-race formation (Futuyma & Moreno, 1988; Thompson & Pellmyr, 1991). Individuals with a broad host range have an advantage over those with a narrow host range because they can switch host species when one host becomes difficult to find. However, many species are highly specific in their use of hosts; thus the challenge is to explain why the host ranges of such species are not broader. Most theories concerning specialization in host use assume there are trade-offs between host range and host use efficiency (Via & Lande, 1985; Lynch & Gabriel, 1987). Specialists are often more efficient at host location or better able to cope with host defenses than generalists, but specialization may come at the cost of being poorly adapted to other host species. Because of such trade-offs, specialist parasites whose development is intimately tied to host physiology are more likely to have highly restricted host ranges.

Studies of host range and host use efficiency are also important for applied pest management. The success and safety of biological control introductions depend on an ability to predict post-introduction host use. Many pest populations are ephemeral; populations of natural enemies that can switch successfully to alternative host species may persist better and provide control when pest

populations resurge (e.g., DeBach & Rosen, 1991; Pike et al., 1999). On the other hand, knowledge of the behavioral and physiological bases of host use will help in assessing the potential for deleterious impacts on non-target species, an increasingly contentious issue in biological control (Simberloff & Stiling, 1996; Hopper, 2000).

Experimental studies of the trade-offs associated with the use of different host species, especially those focusing on trade-offs within a parasite species, are rare (Futuyma & Moreno, 1988) and this is particularly true for parasitic wasps (Godfray, 1994). Compared to many predators, parasitic wasps (parasitoids) have narrow host ranges, presumably because parasitoid development is often intimately associated with the physiology and immune responses of their hosts. This is thought to be especially true of parasitoids that allow their hosts to continue development (koinobionts) and develop internally (endoparasitoids) (Askew & Shaw, 1986; Strand, 1986). Yet, even among koinobiotic endoparasitoids, host range varies widely. Several species of aphelinid and braconid parasitoids, including *Aphidius colemani* Viereck (Hymenoptera: Braconidae), are known to attack as many as 60 species from several aphid genera (Sary, 1975, 1983; Kalina & Sary, 1976; Hopper et al., 1998; Takada, 1998). However, some extremely polyphagous species appear to be composed of distinct host races that rarely switch between host species in the field (Nemec & Sary, 1983; Sary, 1983; Cameron et al., 1984; Tardieux &

Rabasse, 1986, 1990; Powell & Wright, 1988; Messing & Rabasse, 1995; Atanassova et al., 1998; Takada & Tada, 2000). While much is known about the relationship between host use and offspring fitness within a host species (Godfray, 1994), less is known about the relationship between host use patterns and offspring performance across host species in the present work and the behavioral and developmental behavior of the parasitoid wasp, *A. colemani*, when exposed to three host aphid species.

MATERIALS AND METHODS

Rearing of aphids:

Rearing of Aphis gossypii Glover.

The cotton aphids were obtained from okra plants in the Farm of Agriculture Faculty, Al-Azhar University. The cotton aphid was colonized on cucumber at $25 \pm 1^\circ\text{C}$, $65 \pm 5\%$ R. H. and a photoperiod of 12L: 12D hours. Seedlings of cucumber were grown to the 4-5 leaf stage in a mixture of sand (33%), clay (33%) and compost (33%) in 25 cm pots.

Rearing of Aphis craccivora Koch.

The cowpea aphid, *A. craccivora* was the second host species used for rearing of the parasitoid under investigation. Its individuals were firstly collected from faba bean plants in Farm of Agriculture Faculty, Al-Azhar University. Stock culture of the aphid species was reared under the laboratory conditions ($23 \pm 2^\circ\text{C}$ and $65 \pm 5\%$ RH), on faba bean plants according to the following technique:-

Grains of faba bean were firstly soaked in water for 24-48 hours to accelerate germination.

Planting was made in plastic pots (22cm) filled with wet sawdust. A number of about 10 grains was distributed among the sawdust/pot.

As the germinated plants reached 2-3 cm, those were infested by 30-50 apterous adults of *A. craccivora* per pot.

Aphid nymphs were separated whenever needed for specific experiments on the investigated parasitoid.

Rearing of Rhopalosiphum maidis (Fitch):

The Corn leaf aphid *R. maidis* was the third host species used for rearing the parasitoid under investigation. Aphid's individuals were firstly collected from maize plants in the Farm of Agriculture Faculty, Al-Azhar University. The following technique was used to rear this aphid:

Grains of maize were firstly soaked in water for 12-24 hours to accelerate germination.

Planting was made in plastic pots (30cm) filled with wet sawdust. A number of about 30-50 grains was distributed among the sawdust/pot.

As the germinated plants reached 2-3 cm, those were infested by (30-50) apterous adults of *R. maidis* per pot.

Nymphs were separated whenever needed for specific experiments on the investigated parasitoid.

The three aphid species were identified in plant protection institute.

Rearing the parasitoid:

The parasitoids were separately reared on *A. gossypii* in glass cages (30 × 60 × 35 cm). Colonies of parasitoid wasps were replenished with field- collected individuals during spring and autumn. The aphids and parasitoids were reared on cucumber in the laboratory for at least three generations before using in experiments.

Used patterns among three aphid species

To measure differences in use of the three aphid species by *A. colemani*, exposed females from each subculture to each of the three aphid species. This experiment was conducted 6-8 generations after the *A. colemani* population was subcultured on each aphid species. Mummified aphids containing *A. colemani* from each subculture were isolated. As female wasps emerged, they were allowed to mate with a single male from their own subculture for 24 h. One-day-old; mated females from each of the three subcultures were put individually into cages with a plant infested with approximately 100 aphids of each of the three species. Each combination was replicated 6-10 times. Cages were clear plastic cylinders, 10 cm diameter pots containing either cucumber infested with *A. gossypii* while, faba bean infested with *A. craccivora* and the maize infested with *R. maidis*. The exposed aphids were held in plant growth chambers under a photoperiod of L12:D12 and at 25°C for 10 days (i.e., until mummies formed). The numbers of mummified aphids in each cage were counted, and after emergence, the adult wasp offspring were sexed and counted. Aphid age and size distribution at the time of parasitism was estimated from five additional cages for each of the three aphid species. The different ages of the three types of aphids were

separated to calculate the development period for each stage. Approximately 100 randomly selected aphids from each cage were categorized by nymphal stage. Different densities were made for the three aphid species; they were as follows (2, 5, 10, 25, 50 and 100). Antennal encounters and prickings have been calculated for each density separately for 8 hours per day. By directly observing whether an egg is laid at each encounter with a host, acceptance of the host was assessed by the Ovipositing female as well as progeny survival. Also, the relationship between oviposition and offspring survival among host species was measured, which is key to demonstrating adaptive host use. Host species influences offspring sex ratio was examined. Ovipositing females may allocate male and female differentially in different host species; alternatively, male and female may survive differently when developing in different host species. A female's pattern of oviposition may depend primarily on the host species she encounters, or she may exhibit a higher acceptance rate of the same host species in which she developed (Godfray, 1994). Data were subjected to ANOVA by using Costat program (1988) and significant difference among the treatments was compared by Duncan's (1955) multiple range test and L.S.D. test at probability level $P=0.05$ in all data obtained.

RESULTS

Table (1) shows the sex ratio of the parasitoid *Aphidius colemani* on three aphid species. There were no differences between the three aphid species were 1:1.2, 1:1.1 and 1:1.2 on *A. gossypii*, *A. craccivora* and *R. maidis* respectively.

Data in table (2) show the number of antennal encounters by the parasitoid ovipositor with different host densities of three aphid species. It is clear that higher density of the host, led to higher antennal encounters process on the three aphid species. But the highest number of antennal encounters was recorded on *Aphis gossypii* followed by *Aphis craccivora* and the lowest number was on *Rhopalosiphum maidis*. They were 129.3 ± 5.73 , 102.9 ± 7.48 and 84.6 ± 5.44 at density of 100 of tested aphids respectively.

Data presented in table (3) show the numbers of pricking done by the parasitoid ovipositor with different densities on three aphid species. Although growing the number of pricking by increasing the aphid densities. The perfect recorded rate of pricking were

75.6 ± 3.40 , 57.9 ± 4.01 and 42.6 ± 4.42 on *A. gossypii*, *A. craccivora* and *R. maidis*, respectively.

Data in table (4) show the parasitized aphids by the parasitoid, *A. colemani* at different densities of *A. gossypii*, *A. craccivora* and *R. maidis*. Female of parasitoids parasitized fewer *R. maidis* than the other two aphid species on the six different densities. The percentage of parasitism increased with the increase in the density of the three aphid species. The highest number of parasitized aphid was at density of 100. It was 55 ± 3.29 , 50.1 ± 1.66 and 38.6 ± 2.45 on *A. gossypii*, *A. craccivora* and *R. maidis* respectively.

DISCUSSION

The results show that population of *A. colemani* is poorly adapted to *R. maidis* compared to the other two aphid species. Females exposed to *R. maidis* produced fewer mummies and adult offspring than females exposed to the other two species. The second experiment showed that the difference in use of *A. gossypii* and *R. maidis* resulted from how fast the ovipositing females encountered each host species, how fast each host species was handled, how readily each host species was accepted for oviposition. Taking these effects together in consideration, it is obvious that *A. colemani* females to produce about twice more offspring on *A. gossypii* than on *R. maidis* over a fixed period of time, and this difference was in the experiments. Differences in leaf shape or its chemical components may affect the aphid distribution on cucumber vs. maize; this may in turn influence the foraging activity of *A. colemani* females. In one population of *A. colemani*, females showed a foraging preference for the host plant on which they had emerged (Storeck et al., 2000). Host plant species may also influence the development of parasitoids in different aphid species. Differences in resistance to parasitism between *A. gossypii* and *R. maidis* might be determined by the different effects of host plant species on aphid.

Previous studies showed that *A. colemani* females encounter the parasitized and unparasitized *A. gossypii* with similar frequency (van Steenis & El-Khawass 1995). Age of parasitoids can affect their host searching and oviposition behavior (Völkl & Mackauer 1990; Asadi et al. 2012; Nikbin et al. 2014; Pasandideh et al. 2015). In the field, several foraging parasitoids may visit a host patch simultaneously (He & Wang 2014), which may cause competition and interference among parasitoids and reduce their per capita

host search and attack efficiency (Hassell & Varley 1969). Obtained findings appear to agree with those of Hassell & Varley (1969). However, reproductive fitness of *A. colemani* was actually the highest when the parasitoid density was between intermediate and high. This could be attributed to the significantly positive interactions between parasitoid and host densities. This property should encourage aggregation of parasitoids on host patches of high density, leading to the collapse of host patches (Hassell & May 1973; Kidd & Jervis 2005; Hanan et al. 2017) and preventing pest outbreaks from these patches. In two studies, there was a positive association between host acceptance by the Ovipositing female and larval survivorship. In a study of *Asobara tabida*, a parasitoid of drosophiles. van Alphen & Janssen (1982) showed that ovipositing females were more likely to reject a host species in which larval survival was low. In a series of host choice tests using *Monoctonus paulensis*, an aphid parasitoid, ovipositing females were most likely to accept aphid species with the greatest likelihood of producing adult offspring (Chau & Mackauer, 2001). All evidence proves that mass release of *A. colemani* can be a good option for effective control of aphids when the pest density is high. The sex ratio of *A. colemani* is usually female-biased (Saleh et al., 2014). However, this is affected by environmental factors. In a temperature range of 15 ~ 25 °C, sex ratio is female-biased, whereas, at temperatures below 10 °C or above 30 °C, it is male-biased (Zamani et al. 2007). Body size of aphids is another factor affecting *A. colemani* sex allocation. For example, those attacking small aphids (first instar nymphs) produce offspring of a male-biased sex ratio and those parasitizing large aphids (third instar nymphs) have offspring of a female-biased sex ratio (Jarošik et al. 2003).

CONCLUSION

There are no differences in the sex ratio of the parasitoid when reared on three aphid species. The parasitoid can be reared on cotton or beans aphid successfully. The parasitoid can also be used in biological control to control most of species of aphids.

REFERENCES

- Asadi, R., Talebi, A.A., Khalghani, J., Fathipour, Y., Moharrampour, S., Askari Siahooei, M. 2012. Age-specific functional response of *Psyllaephagus zdeneki* (Hymenoptera: Encyrtidae), parasitoid of *Euphyllura pakistanica* (Hemiptera: Psyllidae). Journal of Crop Protection 1: 1-15.
- Askew, R.R., Shaw, M.R. 1986. Parasitoid communities: their size, structure and development. Insect Parasitoids (ed. by JK Waage & D Greathead), pp. 225–264. Academic Press, London.
- Atanassova, P., Brookes, C.P., Loxdale, H.D., Powell, W. 1998. Electrophoretic study of five aphid parasitoid species of the genus *Aphidius* (Hymenoptera: Braconidae), including evidence for reproductively isolated sympatric populations and a cryptic species. Bulletin of Entomological Research 88: 3–13.
- Cameron, P.J., Powell, W., Loxdale, H.D. 1984. Reservoirs for *Aphidius ervi* Haliday (Hymenoptera: Aphidiidae). Bulletin of Entomological Research 74: 647–656.
- Chau, A., Mackauer, M. 2001. Preference of the aphid parasitoid *Monoctonus paulensis* (Hymenoptera: Braconidae, Aphidiinae) for different aphid species: female choice and offspring survival. Biological Control 20: 30–38.
- Costat software. 1988. Microcomputer program analysis, Co Hort software, Berkely, CA, USA.
- DeBach, P., Rosen, D. 1991. Biological Control by Natural Enemies, 2nd edn. Cambridge University Press, Cambridge, UK.
- Duncan, D.B. 1955. Multiple range and multiple F tests, Biometrics, 11, 1-42.
- Futuyma, D.J. Moreno, G. 1988. The evolution of ecological specialization. Annual Review of Ecology and Systematics 19: 207–233.
- Godfray, H.C.J. 1994. Parasitoids: Behavioral and Evolutionary Ecology. Princeton University Press, Princeton.
- Hanan, A., He, X.Z., Wang, Q. 2017. Insight into the success of whitefly biological control using parasitoids: evidence from the *Eretmocerus warrae-Trialeurodes vaporariorum* system. Pest Management Science 73: 2294-2301.
- Hassell, M., Varley, G. 1969. New inductive population model for insect parasites and its bearing on biological control. Nature 223: 1133.
- Hassell, M.P., May, R.M. 1973. Stability in insect host-parasite models. Journal of Animal Ecology 42: 693-726.
- He, X.Z., Wang, Q. 2014. Demographic dynamics of *Platygaster demades* in response to host density. Biological Control 72: 46-53.
- Hopper, K.R. 2000. Research needs concerning non-target impacts of biological control introductions. Evaluating Indirect Ecological Effects of Biological Control (ed. by E Wajnberg, JK Scott & PC Quimby), pp. 39–56. CABI Bioscience, London.
- Hopper, K.R., Coutinot, D., Chen, K., Mercadier, G., Halbert, S.E., Kazmer, D.J., Miller, R.H.,

- Pike, K.S. Tanigoshi, L.K. 1998. Exploration for natural enemies to control *Diuraphis noxia* in the United States. A Response Model for an Introduced Pest – The Russian Wheat Aphid (ed. by SS Quissenbery & FB Peairs), pp. 166–182. Entomological Society of America, Lanham, MD.
- Jarošík, V., Holý, I., Lapchin, L., Havelka, J. 2003. Sex ratio in the aphid parasitoid *Aphidius colemani* (Hymenoptera: Braconidae) in relation to host size. Bulletin of Entomological Research 93: 255-258.
- Kalina, V., Stary, P. 1976. A review of the aphidophagous Aphelinidae (Hymenoptera, Chalcidoidea), their distribution and host range in Europe. Studia Entomologica Forestalia (Praha, Czechoslovakia) 2: 143–170.
- Kidd, N.A.C., Jervis, M.A. 2005. Population dynamics. pp. 435-523, In M. A. Jervis [ed.], Insects as natural enemies: a practical perspective. Springer, Dordrecht, the Netherlands.
- Lynch, M. Gabriel, W. 1987. Environmental tolerance. American Naturalist 129: 283–303.
- Messing, R.H., Rabasse, J.M. 1995. Oviposition behaviour of the polyphagous aphid parasitoid *Aphidius colemani* Viereck (Hymenoptera: Aphidiidae). Agriculture, Ecosystems and Environment 52: 13–17.
- Nemec, V., Stary, P. 1983. Elpho-morph differentiation in *Aphidius ervi* Hal. biotype on *Microlophium carnosum* (Bckt.) related to parasitization on *Acyrtosiphon pisum* (Harr.) (Hym., Aphidiidae) Zeitschrift für Angewandte Entomologie 95: 524– 530.
- Nikbin, R., Sahragard, A., Hosseini, M. 2014. Age-specific functional response of *Trichogramma brassicae* (Hymenoptera: Trichogrammatidae) parasitizing different egg densities of *Ephestia kuehniella* (Lepidoptera: Pyralidae). Journal of Agricultural Science and Technology 16: 1217-1227.
- Pasandideh, A., Talebi, A.A., Hajiqanbar, H., Tazerouni, Z. 2015. Host stage preference and age-specific functional response of *Praon volucre* (Hymenoptera: Braconidae, Aphidiinae) a parasitoid of *Acyrtosiphon pisum* (Hemiptera: Aphididae). Journal of Crop Protection 4: 563-575.
- Pike, K.S., Stary, P., Miller, T., Allison, D., Graf, G., Boydston, L., Miller, R., Gillespie, R. 1999. Host range and habitats of the aphid parasitoid *Diaretiella rapae* (Hymenoptera: Aphidiidae) in Washington State. Environmental Entomology 28: 61–71.
- Powell, W., Wright, A.F. 1988. The abilities of the aphid parasitoids *Aphidius ervi* Haliday and *A. rhopalosiphum* De Stefani Perez (Hymenoptera: Braconidae) to transfer between different known host species and the implications for the use of alternative hosts in pest control strategies. Bulletin of Entomological Research 78: 683–693.
- Saleh, A., Ali, S.A., El-Nagar, H.M. 2014. Development of the parasitoid *Aphidius colemani* Viereck on the mealy aphid, *Hyalopterus pruni* (Geoffroy) in relation to heat unit requirement. Egyptian Journal of Biological Pest Control 24: 297- 300.
- Simberloff, D., Stiling, P. 1996. How risky is biological control? Ecology 77: 1965–1974.
- Stary, P. 1975 *Aphidius colemani* Viereck: its taxonomy, distribution and host range (Hymenoptera, Aphidiidae). Acta Entomologica Bohemoslovaca 72: 156–163.
- Stary, P. 1983 Colour patterns of adults as evidence on *Aphidius ervi* biotypes in field environments (Hymenoptera, Aphidiidae). Acta Entomologica Bohemoslovaca 80: 377–384.
- Storeck, A., Poppy, G.M., van Emden, H.F., Powell, W. 2000. The role of plant chemical cues in determining host preference in the generalist aphid parasitoid *Aphidius colemani*. Entomologia Experimentalis et Applicata 97: 41–46.
- Strand, M.R. 1986. the physiological interactions of parasitoids with their hosts and their influence on reproductive strategies. Insect Parasitoids (ed. by JK Waage & D Greathead), pp. 97– 136. Academic Press, London.
- Takada, H., Tada, E. 2000. A comparison between two strains from Japan and Europe of *Aphidius ervi*. Entomologia Experimentalis et Applicata 97: 11–20.
- Takada, H. 1998. A review of *Aphidius colemani* (Hymenoptera: Braconidae; Aphidiinae) and closely related species indigenous to Japan. Applied Entomology and Zoology 33: 59–66.
- Tardieux, I. Rabasse, J.M. 1986. Host-parasite interrelationships in the case of *Aphidius colemani*. Ecology of Aphidophaga. (ed. by I Hodek), pp. 125–130. Academia, Praha, Czechoslovakia.
- Tardieux, I., Rabasse, J.M. 1990. Role of some epigenetic factors influencing the host suitability of *Myzus persicae* for the parasitoid *Aphidius colemani*. Entomologia Experimentalis et Applicata 54: 73–80.
- Thompson, J.N., Pellmyr, O. 1991. Evolution of oviposition behavior and host preference in Lepidoptera. Annual Review of Entomology 36: 65–89.
- van Steenis, M.J., El-Khawass, K.A.M.H. 1995. Behaviour of *Aphidius colemani* searching for *Aphis gossypii*: functional response and reaction to previously searched aphid colonies. Biocontrol Science and Technology 5: 339-348.

- Van Alphen, J.J.M., Janssen, A.R.M. 1982. Host selection by *Asobara tabida* Nees (Braconidae; Alysiinae), a larval parasitoid of fruit inhabiting *Drosophila* species. II. Host species selection. Netherlands Journal of Zoology 32: 215–231.
- Via. S., Lande, R. 1985. Genotype–environment interaction and the evolution of phenotypic plasticity. Evolution 39: 505–522.
- Völkl, W., Mackauer, M. 1990. Age-specific pattern of host discrimination by the aphid parasitoid *Ephedrus californicus* Baker (Hymenoptera: Aphidiidae). Canadian Entomologist 122: 349-361.
- Zamani, A.A., Talebi, A., Fathipour, Y., Baniamiri, V. 2007. Effect of temperature on life history of *Aphidius colemani* and *Aphidius matricariae* (Hymenoptera: Braconidae), two parasitoids of *Aphis gossypii* and *Myzus persicae* (Homoptera: Aphididae). Environmental Entomology 36: 263-271.

Table 1: Sex ratio of the newly emerged parasitoid, *Aphidius colemani* parasitized on *A. gossypii*, *A. craccivora* and *R. maidis*.

Sex	<i>A.gossypii</i>	<i>A.craccivora</i>	<i>R. maidis</i>
Male	45	48	44
Female	55	52	56
ratio	1:1.2	1:1.1	1:1.2

Table 2: Mean numbers of antennal encounters by the parasitoid ovipositor with different densities of host; *Aphis gossypii*, *Aphis craccivora* and *Rhopalosiphum maidis*.

Aphid spp Aphid density	<i>A.gossypii</i>	<i>A.craccivora</i>	<i>R. maidis</i>	LSD
2	9.6±4.64a	8.1±4.01a	6.3±2.21a	3.457
5	17.1±2.02a	12.3±4.11b	9.3±2.98c	2.896
10	32.7±3.30a	28.8±3.79b	24.3±2.98c	3.098
25	81±4.89a	60±4b	51.6±3.68c	3.878
50	100.2±5.32a	84.3±5.37b	70.5±6.81c	5.397
100	129.3±5.73a	102.9±7.48b	84.6±5.44c	5.769

*Means followed by the same letter in each row are not significantly different.

Table 3: Mean numbers of pricking by the parasitoid ovipositor with different densities of host; *A. gossypii*, *A. craccivora* and *R. maidis*.

Aphid spp Aphid density	<i>A.gossypii</i>	<i>A.craccivora</i>	<i>R. maidis</i>	LSD
2	5.7±2.98a	5.4±2.36a	3.6±1.89a	2.253
5	9±2a	8.4±3.09a	4.5±1.58b	2.125
10	9.3±2.21a	9 ±2.44a	7.5±2.12a	2.079
25	39.6±4.64a	26.1±3.47b	17.1±3.47c	3.585
50	55.5±3.53a	54±6.16a	37.8±6.03b	4.938
100	75.6±3.40a	57.9± 4.01b	42.6±4.42c	3.643

*Means followed by the same letter in each row are not significantly different.

Table 4: Mean numbers of parasitized aphids by the parasitoid, *A. colemani* at different densities of *A. gossypii*, *A. craccivora* and *R. maidis*.

Aphid spp Aphid density	<i>A.gossypii</i>	<i>A.craccivora</i>	<i>R. maidis</i>	LSD
2	1.5±0.52a	1.3±0.48a	1.1±0.56a	0.48
5	3.2±0.91a	2.5±0.70ab	2±0.66b	0.708
10	8.1±0.99a	6.9±0.73b	5.3±0.94c	0.826
25	18.9±1.19a	17.3±1.15b	13.1±1.91c	1.34
50	32.6±2.01a	29.6±1.71b	24.4±1.64c	1.64
100	55±3.29a	50.1±1.66b	38.6±2.45c	2.35

سلوك الرعي للمتطفل الحشري *Aphidius colemani* (Hymenoptera: Aphidiidae) على ثلاثة أنواع من المنّ (منّ القطن - منّ الفول - منّ الذرة)
(Homoptera: Aphididae)

سامي صلاح المزين*، خالد أحمد الخواص، إبراهيم لبيب إبراهيم.

قسم وقاية النبات، شعبة الحشرات الاقتصادية، كلية الزراعة، جامعة الأزهر، القاهرة، مصر.

* البريد الإلكتروني للباحث الرئيسي: samy.salah@azhar.edu.eg

الملخص العربي

تم قياس قبول وملاءمة ثلاثة أنواع من حشرات المنّ وهي منّ القطن، منّ الفول و منّ الذرة للمتطفل الحشري *Aphidius colemani* Viereck (Hymenoptera: Aphidiidae). وجد من التجارب أن أنثى الطفيل تفضلت على عدد أقل من حشرة منّ الذرة مقارنة بالنوعين الآخرين وأكمل عدد قليل من الطفيليات حياته على حشرة منّ الذرة مما يشير الى أن منّ الذرة عائل ذو نوعية رديئة للمتطفل الحشري *Aphidius colemani* ولم تكن هناك فروق ذات دلالة احصائية بين أنواع المنّ الثلاثة في النسبة الجنسية للأفراد البالغة من المتطفل. وكان معدل البحث عن العائل أبطأ في حشرة منّ الذرة مقارنة بالأنواع الأخرى وكذلك معدل الوخز ووضع البيض أقل وبالتالي نسبة تطفل اقل من النوعين الآخرين. وأظهرت النتائج ارتباط سلوك وضع البيض وأداء النسل الناتج. ويمكن استخدام نتائج هذا البحث لوضع استراتيجيات الإدارة المتكاملة للآفات (IPM) ضد أنواع المنّ.

الكلمات الاسترشادية: متطفل المنّ، منّ القطن، النسبة الجنسية، مدة التطور.