

Utilization of *Goniozus* sp. (Hym.: Bethyridae) as a Bio-control Agent against the Lesser Date Moth, *Batrachedra amydraula* (Meyrick) (Lep.: Batrachedridae) in Date Palm Orchards in Sultanate of Oman

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ABSTRACT

Goniozus sp. (Hym.: Bethyridae) was found to be the most common parasitoid of the lesser date moth, *Batrachedra amydraula* (Meyrick) (Lep.: Batrachedridae) in Sultanate of Oman. The parasitoid was reared successfully in laboratory on larvae of *Galleria mellonella* L. and released in three date palm orchards as a bio-control agent against this pest. Samples of *Batrachedra*-infested unripe date fruits, collected during the course of this study gave rise to 4 parasitoid species and 3 predator species. The ratio of *B. amydraula*: *Goniozus* sp. (B: G) was estimated in samples of infested unripe date-fruits collected during April and May 2007. The study revealed that the ratio of B : G in the *Goniozus*-released orchards ranged from 1: 1.1 to 1: 3.1, while this ratio ranged from 1: 0.1 to 1: 0.05 in the control orchards. Such results indicate that *Goniozus* sp. seems to be a promising bio-control agent and could be utilized within an IPM program against *B. amydraula* in date palm orchards in Sultanate of Oman.

Key Words: *Goniozus*, *Batrachedra amydraula*, Release, Date palm, Sultanate of Oman.

INTRODUCTION

The lesser date moth, *Batrachedra amydraula* Meyrick is one of the major insect pests of date palm fruits in Iraq (Al-Safi *et al.*, 1978), in Gulf area (Hammad *et al.* 1981; Abdul-Jabbar *et al.* 1982), in Yemen (El-Haidari, 1981), in Libya (Bitaw & Saad, 1990), in Israel (Navon *et al.* 1999) and in Egypt (Harhash *et al.* 2003). The insect infests the unripe fruits early in the season where the larvae bore into and feed on such fruits. The infested fruits remain attached to the fruit stalks by silken threads produced by the larvae for a while but they get dry later and fall causing considerable loss in fruit-yield reaches up to 75 % in heavy infestation (Eitam, 2001).

In Sultanate of Oman, *B. amydraula* was found to have three generations starting from February until June. At the end of the 3rd generation (in June), the larvae spin white cocoons and enter an aestivation as larvae inside such cocoons until the following February then complete their development to adults (Abd-Allah *et al.*, 1998).

A survey of natural enemies of *B. amydraula* in date palm orchards in Sultanate of Oman in 2005 revealed that the larvae were parasitized by two parasitoid species (*Goniozus* sp. and *Bracon* sp.); the most common and prevailing parasitoid was *Goniozus* sp. (unpublished). Eitam (2001) reported *Goniozus swirskiana* and *Bracon hebetor* attacking *B. amydraula* in Israel.

The present investigation is a trial to evaluate the release of *Goniozus* sp. as a bio-control agent for controlling *B. amydraula* in date palm orchards in Sultanate of Oman. Natural enemies of the insect obtained from samples of infested date fruits are given.

MATERIALS AND METHODS

Factitious hosts.

Trials were carried out for rearing *Goniozus* sp. on factitious hosts. The factitious hosts tested were; the cotton leafworm, *Spodoptera littoralis* (Boisd), the greater wax moth, *Galleria mellonella* (L.), the Mediterranean flour moth, *Ephestia kuehniella* Zeller and the rice moth, *Corcyra cephalonica* (Stainton).

Rearing of *G. mellonella*

Rearing of *G. mellonella* started from pupae and moths collected from infested honey bee hives. Moths were confined in ovipositional glass jars, 17 cm high and 10 cm diameter, covered with pieces of tissue paper. A piece of cotton-wool moistened with 20 % sugar solution was placed into each jar as food for moths. The jars were inspected daily for *G. mellonella* eggs which were laid on tissue paper-covers. 400–500 eggs were placed in similar glass jars containing an artificial diet consisted (in volume) of: 6 whole wheat flour, 1 honey, 1 glycerol, 1 powder milk, 1 dried yeast and 3 (ml) formaldehyde.

These ingredients were mixed thoroughly and distributed in three jars, covered with pieces of cotton-cloth and kept in an incubator at $27\pm 1^{\circ}\text{C}$ and 60–70% R.H. The emerged moths were collected daily and transferred to the ovipositional glass jars.

Rearing of *Goniozus* sp.

Goniozus sp. was obtained from samples of unripe date fruits infested with *B. amydraula* collected from date palm orchards in 2006. Larvae of *G. mellonella*, in the 3rd and 4th instars, were introduced to *Goniozus* females in glass vials, 10x2 cm, stoppered with pieces of cotton-wool (one larva/female).

The parasitoid female attacked and partially paralyzed the host larva within minutes but started to lay eggs on such a host 24–72 hours post paralyzation. The parasitized larvae were removed to similar glass vials and other larvae were introduced instead to the females. Parasitized larvae were kept until emergence of adult parasitoids. Rearing was carried out at $25\pm 2^{\circ}\text{C}$ and 60 – 70 % R.H.

Releasing of the parasitoid

Newly emerged females of *Goniozus* sp. were confined in glass vials, 10 cm high and 2 cm diameter, stopper with pieces of cotton-wool (one female/vial). The vial contained droplets of honey as food for the parasitoid females. The parasitoids were transferred to the date palm orchards in ice-box where the cotton-wool was removed to allow the parasitoid to fly. *Goniozus* sp. was released in 3 date palm orchards (89, 121 and 192 date palm trees) at a rate of one female / tree on March 24, April 10 and May 7, 2007. Two orchards were chosen as check where no control measures were applied against *B. amydraula*.

Sampling

Date palm trees were inspected weekly during March–June, 2007 (infestation period). Unripe date fruits infested with *B. amydraula* (brown in color) were picked, kept in paper bags and transferred to the laboratory. Such fruits were kept in glass jars, 17 cm high and 10 cm diameter (50–70 fruits / jar), covered with pieces of cotton-cloth. The jars were lined with tissue paper to absorb condensed water and for avoiding rotten of the fruits. Wet tissue paper was changed at 2–3 days intervals. The jars were inspected daily to collect different developmental stages of *B. amydraula* (larvae, pupae, moths) and adults of *Goniozus* as well as any other parasitoids or predators. Numbers of collected insects were calculated for each sample during the whole course of the study. Obtained natural enemies were sent to the Natural History Museum, UK for identification.

RESULTS AND DISCUSSION

Rearing of *Goniozus* on factitious host(s)

Goniozus sp. females did not accept or attack all larval instars of *E. kuehniella* or *C. cephalonica*. All females offered such hosts died within few days with no attempt to even attack them. As for the larvae of *S. littoralis*, the parasitoid female parasitized the 3rd instar larvae. The number of eggs deposited/larva varied from 1 to 6, with an average of 2.9. However, the parasitoid could not develop successfully as out of 114 eggs deposited by *Goniozus* females on 38 *Spodoptera* larvae, 79.8% of the progeny died in the 2nd or 3rd larval instars, 10.5% died during spinning cocoons and the rest died as adults inside cocoons. Also, the parasitized *S. littoralis* larvae died within 2–3 days and the body fluids exuded from such larvae.

In contrast, the female accepted and parasitized the 2nd and 3rd instar larvae of *G. mellonella*. The number of eggs deposited per *G. mellonella* larva reached 13 eggs and the total developmental period of the parasitoid ranged 13–15 days at 25°C .

Natural enemies of *B. amydraula*

Samples of infested unripe date fruits collected from the date palm orchards treated and untreated with *Goniozus* gave rise to four parasitoid species and three predator species.

The obtained parasitoid species, arranged in descending order according to numbers of individuals obtained were:

***Goniozus* sp.** (Hym. : Braconidae): Identified by Dr. A. Polaneszek.

***Bracon* sp.** (Hym. : Braconidae): Identified by Dr. D. Quicke.

***Apanteles* sp.** (Hym.: Braconidae): Identified by Dr. A. Polaneszek.

An unidentified eulophid parasitoid.

Obtained predators were: **An anthocorid species**: Identified by Mr. M. Webb.

An unidentified staphylinid (Coleoptera)

Chrysoperla carnea (Neuroptera: Chrysopidae).

It is noteworthy that the anthocorid predator was found in almost all samples of the infested date fruits collected during April and May 2007 from all date palm orchards. In contrast, only 3 individuals of the staphylinid and one *C. carnea* larva were obtained during the whole course of the study.

Evaluation of *Goniozus* sp. releases

Efficacy of *Goniozus* sp. released in the the 3 date palm orchards against the lesser date moth, *B. amydraula* was assessed depending on the ratio of *Batrachydra: Goniozus* (B:G) obtained from the samples of infested date fruits collected from treated and untreated date palm orchards. In April this ratio ranged from 1: 1.1 to 1: 1.5 in *Goniozus* treated orchards. The obtained ratio in the untreated orchards (control) was 1:0.1 – 1:0.3. In May, the ratio reached 1:2.2 - 1:3.1 in the treated orchards and 1: 0.03-1: 0.05 in the control ones (Table 1).

The parasitized larvae of *B. amydraula* in the samples of infested date fruits collected from date palm orchards gave rise to 2 – 3 adults of *Goniozus* sp.

Rearing *Goniozus* sp. on factitious hosts was successful on *G. mellonella* whereas the parasitoid female did not accept larvae of *E. kuehniella* or *C. cephalonica*. However, the parasitoid attacked and parasitized larvae of *S. littoralis* but its progeny could not develop on such larvae. Comparing with other *Goniozus* species, *G. legneri* could be reared on *E. kuehniella* (Sarhan, 1989 and Shoeb *et al.*, 2005); *G. nephantidis* was reared on *G. mellonella* and *C. cephalonica* (Chandrika and Shameer, 2003 and Venkatesan *et al.* 2004).

In this study when *Goniozus* sp. was released in different date palm orchards at the rate of one female/tree, it gave considerable success as a bio-control agent against *B. amydraula*. The ratio of *Batrachydra:Goniozus* (B:G) in April (fig. 1) was 1: 1.1 – 1: 1.5 increased to 1: 2.2 – 1: 3.1 in May (fig. 2). In the control, this ratio was 1: 0.1- 1: 0.3 in April and 1: 0.03 – 1: 0.05 in May.

These results could be interpreted as the populations of *Goniozus* sp. increased in the treated orchards during April-May on the expenses of *B. amydraula*. In the control orchards, however, the natural reduction of the population of *B. amydraula* in May was accompanied by much more natural reduction in the population of *Goniozus* sp. so that the B:G ratio reached the minimum (1: 0.03 - 1: 0.05). Similarly, Legner and Gordh (1992) reported that releasing *Goniozus legneri* against the navel orange worm; *Amyelois transitella* in 5 almond orchards in California, USA reduced the average density of this insect to 0.5 %. Also, Hearne *et al.* (1994) claimed that *G. natalensis* was found to be one of the most promising biological control agents against *Eldana saccharina* in sugar-cane fields in South Africa.

Table (1): Ratio of *B. amydraula: Goniozus* sp. (B:G) in infested unripe fruits collected form date palm orchards treated with *Goniozus* sp. during April and May 2007 in Sultanate of Oman .

Treatment	No. of emerged insects (April)			No. of emerged insects (May)		
	Ratio (B:G)	<i>Goniozus</i> sp.	<i>B. amydraula</i>	Ratio (B:G)	<i>Goniozus</i> sp.	<i>B. amydraula</i>
<i>Goniozus</i>	38	40	1 : 1.1	8	25	1 : 3.1
Treated Orchards	36	53	1 : 1.5	10	23	1 : 2.3
	43	58	1 : 1.3	5	11	1 : 2.2
Untreated Orchards	144	17	1 : 0.1	57	2	1 : 0.03
	138	41	1 : 0.3	37	2	1 : 0.05

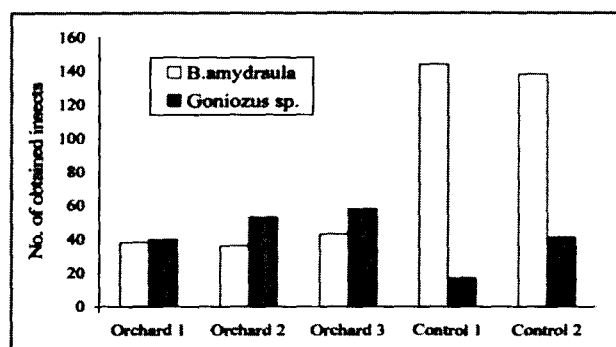


Fig.1. Numbers of *B. amydraula* and *Goniozus* sp. obtained from samples of infested unripe date fruits collected from 3 date palm orchards treated with *Goniozus* sp. and 2 control orchards (untreated) in April 2007 in Sultanate of Oman.

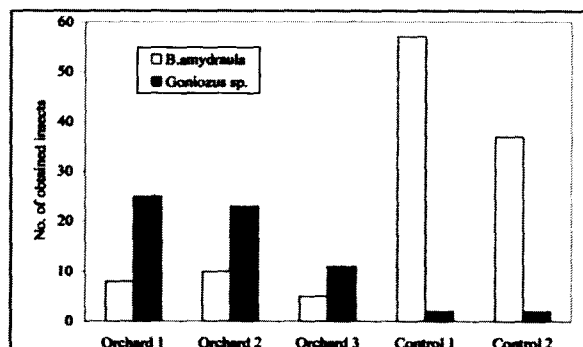


Fig.2. Numbers of *B. amydraula* and *Goniozus* sp. obtained from samples of infested unripe date fruits collected from 3 date palm orchards treated with *Goniozus* sp. and 2 control orchards (untreated) in May 2007 in Sultanate of Oman.

Although *Goniozus* sp. was released at a low rate (one female / tree), it caused considerable reduction in the population of *B. amydracula*. This result could be attributed, relatively, to low rates of infestation in the tested date palm orchards. We recommend that the rate of releasing *Goniozus* should be increased in relation to the level of infestation by *B. amydracula* in the treated orchards.

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الملخص العربي

إستخدام طفيل *Goniozus* sp. كعدو حيوي لمكافحة فراشة ثمار التمر الصغرى

Batrachedra amydracula (Meyrick) في مزارع النخيل بسلطنة عمان

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يتطفل الطفيل *Goniozus* sp. على يرقات فراشة ثمار التمر الصغرى *Batrachedra amydracula* بمزارع النخيل بسلطنة عمان. تم إكثار الطفيل بالمختبر على يرقات دودة الشمع الكبيرة وإطلاقه في مزارع النخيل لمكافحة هذه الآفة خلال عام ٢٠٠٧. تم إطلاق الطفيل بمعدل أنثى واحدة/نخلة ثلاثة مرات خلال الفترة من إبريل إلى أول يونيو. ولدراسة فعالية هذا الطفيل تم جمع عينات من التمور (غير الناضجة) أسبوعياً وتقدير نسبة أعداد كل من الطفيل ودودة ثمار التمر في كل عينة. أظهرت الدراسة أن هذه النسبة في المزارع التي أطلق فيها الطفيل (٣ مزارع) تراوحت من ١ : ١ : ١ إلى ١,٥ : ١ : ١ خلال شهر إبريل، ومن ١ : ٢,٢ : ١ إلى ٣,١ : ١ : ١ خلال شهر مايو أما في مزارع النخيل التي لم يطلق فيها الطفيل (مقارنة) فتراوحت هذه النسب من ١ : ٠,١ : ٠,٣ إلى ١ : ٠,٣ : ٠,٣ في شهر إبريل، ومن ١ : ٠,٣ : ٠,٣ إلى ١ : ٠,٥ : ٠,٥ في شهر مايو. بالتالي يمكن أن نوصى بإمكانية استخدام هذا الطفيل كوسيلة للمكافحة الحيوية لدودة ثمار التمر الصغرى في مزارع التمر بسلطنة عمان.