

## Role of Egg Parasitoids for Controlling the Pomegranate Butterfly, *Virachola livia* Klug (Lycanidae: Lepidoptera) in Sultanate of Oman

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### ABSTRACT

The pomegranate butterfly, *Virachola livia* Klug (Lycanidae: Lepidoptera) is the major insect pest infesting pomegranate fruits in Sultanate of Oman. The local egg parasitoid, *Telenomus* sp. was found to attack the eggs of the pest in pomegranate orchards at Jabal Al-Akhder province. Two egg parasitoids, *Trichogramma brassicae* Bezdenko and *T. evanescens* Westw. were imported and released in two pomegranate orchards in 2005 to assess the total action of the indigenous and such imported parasitoids against *V. livia*. The results showed that *Telenomus* sp. had superior role compared to *Trichogramma* spp. Percentages of parasitism on the host's eggs by *Telenomus* sp. ranged from 26.7 to 76.9%, with an average of 58.2 % in the first orchard and from 55 to 85% with an average of 70.4% in the second orchard. On the other hand, % parasitism with *T. brassicae* released in the first orchard ranged 0.0- 52.7%, with an average of 20.9% while in case of *T. evanescens* released in the 2<sup>nd</sup> orchard it ranged 0.0-15.4% with an average of 9.9%.

**Key Words:** Egg parasitoids, Pomegranate, *Virachola livia*, Sultanate of Oman.

### INTRODUCTION

Pomegranate is the major cash crop at Jabal Al-Akdher province, Sultanate of Oman. The fruits are severely infested by the pomegranate butterfly, *Virachola livia* Klug. This insect is a polyphagous pest having a wide range of host plants including plums, peaches, pears, citrus, guava and many legume trees (*Acacia* spp.). At Jabal Al-Akdher province, *V. livia* infests and over winters on pods of an *Acacia* sp. trees. The female deposits the eggs in the calyx of flowers and pomegranate fruits and occasionally, in the high population of the insect, on pomegranate leaves. The number of eggs deposited/fruit reaches as many as 11 eggs but mostly one larva develops/fruit. The neonate larva bores into the pomegranate fruit to feed on the ripening seeds until maturity making a hole, which could be recognized by the feces of the larva, from which the larva exits to pupate in soil. Besides consuming considerable part of the fruit, the damage increases by the growth of sooty mold inside the fruit that affects the quality of the crop. Chemical insecticides are the main tool for controlling this insect worldwide. However, some alternatives, other than chemicals, were applied including the pathogenic bacteria, *Bacillus thuringiensis* and the bio-insecticide, Spinosad (Temerak & Sayed, 2001), and fruit bagging (Hussein *et al.* 1994; Sayed, 2000 and Obeidat & Akkawi, 2002).

An IPM program has been carried out at Jabal Al-Akdhar to suppress the populations of this butterfly depends mainly on biological control by egg-parasitoids and spraying insecticides on the high infested trees only once in the season. The egg parasitoid, *Telenomus* sp. occurs naturally in pomegranate orchards having a considerable role in controlling this pest; parasitizing an average of 60% of the eggs (unpublished data). The egg parasitoid, *Trichogramma brassicae* Bezd. has been introduced from UK and *T. evanescens* from Egypt to be released as a biocontrol agent against such a pest.

The present investigation aimed to estimate the efficacy of the indigenous parasitoid, *Telenomus* sp. and two *Trichogramma* spp. for controlling the pomegranate butterfly, *V. livia* in Sultanate of Oman.

### MATERIALS AND METHODS

*Trichogramma evanescens* Westw. (imported from Egypt) and *T. brassicae* Bezdenko (imported from UK) were mass produced on eggs of the Angoumois grain moth, *Sitotroga cerealella* under laboratory conditions.

#### Rearing of *S. cerealella*

A mass production unit for *S. cerealella* was established in the General Directorate of Agriculture and Animal Research at Al-Rumais, Sultanate of Oman in 2004. *S. cerealella* was reared in aluminum cages, 90cm long, 90cm wide and 70 cm high, with five sides of plywood and with no bottom. The cage was based on a four-leg table 90 cm long, 90 cm wide and 110 cm high with no top. The bottom of the cage was surrounded by a transparent plastic funnel ending with a plastic jar, 20cm high and 12 cm diameter. The cage

contained 10 trays (85 cm long, 65 cm wide and 3 cm high) made of aluminum frames with all sides of wire-screen except the top which was opened to be filled with wheat. Each tray was filled with 6 Kg of wheat. The trays were kept, horizontally, on shelves and the wheat was infested by 6 gm of *S. cerealella* eggs/tray. Ten days later, the trays were transferred to the cage to be kept vertically. Moths of *S. cerealella* started to emerge one month post infestation and continued for 2-3 months. The moths dropped through the plastic funnel to the plastic jar and were collected daily to be confined in an oviposition cylinder. The oviposition cylinder was made of metal frame, 30cm long and 15 cm diameter, covered with fine wire-screen to allow the eggs to go through. Eggs were collected daily for re-infestation and/or for rearing *Trichogramma*. Rearing *S. cerealella* was carried out at  $24 \pm 1$  °C and 60 - 70% R.H.

#### **Rearing of *Trichogramma* spp.**

Eggs of *S. cerealella* were glued onto paper cards, 15X8 cm, and exposed to *Trichogramma* wasps in glass jar, 20cm high and 12cm diameter, covered with a piece of cotton-cloth. Exposure to *Trichogramma* was carried out by introducing 9 egg-cards / 3 cards containing parasitized eggs that just gave rise to adult parasitoids in the jar. The jars were kept for 5 days after which the introduced egg-cards were removed and kept either for release or for re-parasitisation. Rearing was carried out at  $25 \pm 1$  °C and 60-70%R.H.

#### **Releasing Technique**

The cards containing parasitized eggs were cut into small pieces (1000 parasitized eggs each). Each piece was kept in a carton-paper envelop (5X5 cm) with small holes to allow the wasps to exit and prevent predators to go inside. The envelopes were transferred to pomegranate orchards, in ice boxes, and hung on the trees. Rate of release was one envelop (1000wasps) per tree and the release started on May 15, 2005 and continued until the end of July (10 releases). Release of *T. evanescens* and *T. brassicae* was carried out weekly in two pomegranate orchards 10 km apart from each other. The first orchard, where *T. evanescens* was released, had 80 pomegranate trees and the second, where *T. brassicae* was released, had 67 trees.

#### **Estimating percentages of parasitism**

Fruits of pomegranate were examined carefully, weekly, in both orchards and the eggs were removed by a fine brush and kept in glass vials covered with pieces of cotton-wool. The eggs were transferred to laboratory and kept in small glass vials, 4cm high and 1cm diameter, plugged with cotton - wool (one egg / vial). The vials were checked daily for egg hatching and/or emerging of parasitoids. Percentages of parasitism by each parasitoid were estimated. The study was carried out from May 15 until August 9, 2005.

## **RESULTS AND DISCUSSION**

As presented in table (1) and illustrated in Fig. (1), the indigenous egg parasitoid, *Telenomus* sp. was found to have a superior role in controlling the pomegranate butterfly *V. livia*. Percentage of parasitism with this parasitoid on eggs collected from orchard 1 (where *T. brassicae* was released) ranged from 26.7 to 76.9% with an average of 58.2%. Percentage of parasitism by *T. brassicae* released in this orchard ranged from nil to 52.7% with an average of 20.9%. Percentage of parasitism by *Telenomus* sp. in orchard 2 (where *T. evanescens* was released) ranged from 55 to 85% with an average of 70.4%. However, percentage of parasitism by *T. evanescens* ranged from nil to 15.4% with an average of 9.9%. The total percentage of parasitism in orchard 1 (*Telenomus* sp. + *T. brassicae*) averaged 79.1% (ranged 41.0–95.3%) while in orchard 2 (*Telenomus* sp + *T. evanescens*) it averaged 80.3% (ranged 57.1- 93.3%).

This study indicated that the indigenous naturally occurring egg parasitoid, *Telenomus* sp. was found to have a considerable efficacy on the population of pomegranate butterfly *V. livia* in pomegranate orchards compared to the introduced *T. brassicae* or *T. evanescens*. Average % parasitism by *Telenomus* sp. was 58.2% in orchard 1 and 70.4% in orchard 2. In contrast, average % parasitism was 20.9% by *T. brassicae* and 9.9% by *T. evanescens*. This high performance of *Telenomus* sp. compared to both *Trichogramma* could be attributed to one or more of the following reasons: 1. *Telenomus* sp. is adapted to the host egg, *V. livia*, and to the climatic and environmental conditions prevailing in the Jable Al-Akdhar province; 2. there is an expected competition between *Telenomus* sp. and *Trichogramma* spp. on the host-eggs and this competition is most probably in favor of *Telenomus* which is almost two times larger in size than *Trichogramma* that makes the female more fecund with more flight activity searching for host-eggs; 3. both *T. brassicae* and *T. evanescens* were found to produce 2-6 parasitoid adults/egg of *V. livia* (superparasitism) that reduced the total number of eggs parasitized by female. *Telenomus* sp., in contrast, produced one adult/egg that increased the number of parasitised eggs; 4. *T. brassicae* and *T. evanescens* were reared on factitious host, *S. cerealella*

Table (1): % Parasitism by *Trichogramma evanescens*, *T. brassicae* and *Telenomus* sp. on *Virachola livia* eggs collected from two orchards of pomegranate treated with *Trichogramma* spp. in 2005.

Sampling date	Orchard No.	No. of eggs collected	%Parasitism by <i>Trichogramma</i> spp.	%Parasitism by <i>Telenomus</i> sp.	Total % parasitism
15.5.2005	1*	17	40.0	26.7	66.7
	2**	-	-	-	-
25.5.	1	103	2.8	55.5	58.3
	2	89	0.0	85.0	85.0
31.5.	1	73	0.0	41.0	41.0
	2	43	7.1	50.0	57.1
6.6.	1	59	14.9	74.5	89.4
	2	51	16.7	50.0	66.7
20.6.	1	47	5.1	76.9	82.0
	2	44	3.3	73.3	76.6
28.6.	1	71	21.2	71.2	92.4
	2	74	3.4	67.2	70.6
4.7.	1	96	18.1	62.7	80.8
	2	102	10.7	78.6	89.3
11.7.	1	95	52.7	41.8	94.5
	2	95	9.3	84.0	93.3
18.7.	1	96	26.3	52.6	78.9
	2	91	22.1	69.1	91.2
26.7.	1	104	20.0	70.8	90.8
	2	35	15.4	69.1	84.6
1.8.	1	44	28.6	66.7	95.3
	2	22	11.1	77.8	88.9

\* Treated with *T. brassicae*.

\*\* Treated with *T. evanescens*.

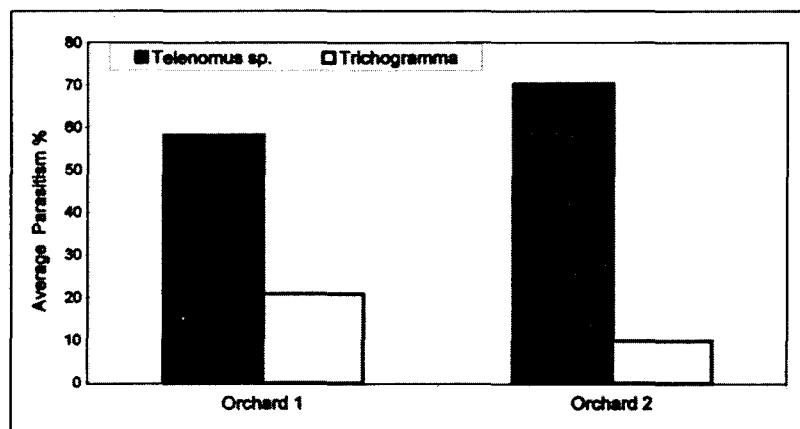


Fig.1. Average % Parasitism by *Telenomus* sp. and *Trichogramma* spp. in Pomegranate Orchards Treated with *Trichogramma evanescens* or *T. brassicae*

eggs for several generations which might affect the quality of female (Cerutti & Bigler 1991, Bigler 1994, Andow *et al.* 1995, O' Neil *et al.* 1998). However, Thakur & Pawar (1988) reported that 5 successive releases of *Trichogramma chilonis* against *V. livia* significantly reduced infestation on pomegranate fruits. Comparing *T. brassicae* with *T. evanescens*, it was evident that *T. brassicae* was much efficient (average % parasitism was 20.9%) than *T. evanescens* (average % parasitism was 9.9%). This fact could be attributed to two reasons: the 1<sup>st</sup> reason is that a population of *T. brassicae* has been established as the parasitoid has been imported and released annually in this province since 2003. What support this claim is that % parasitism by this species was 40 % on May, 15 just before releasing the parasitoid in the orchard. The 2<sup>nd</sup> reason is that *T. brassicae* could be more competitive to *Telenomus* sp. than *T. evanescens* as the total parasitism on eggs of *V. livia* (by *Telenomus* + *Trichogramma*) was almost similar in orchard 1 (79.1%) to that in orchard 2 (80.3%).

*T. evanescens* is expected to establish it self in pomegranate orchards at this province as this species was reported as the sole egg paraistoid of *V. livia* in pomegranate orchards in Egypt (Awadallah, et al. 1970). As a conclusion, despite the considerable natural role of the egg parasitoid, *Telenomus* sp. as a biological control agent against the pomegranate butterfly, *V. livia* in pomegranate orchards, the use of other egg parasitoids, i.e. *Trichogramma* spp. may help to increase the reduction of the population of the target pest. Similary, Hassan and Rost (1993) found that the release of a combination of *Trichogramma dendrolimi* and *T. embryophum* was found to increase effectiveness against *Cydia pomonella* by about 10% compared to the release of the same total number of *T. dendrolimi* alone.

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## الملخص العربي

### دور طفيليات البيض في مكافحة دودة ثمار الرمان *Virachola livia* في سلطنة عمان

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تعتبر دودة ثمار الرمان الآفة الرئيسية التي تصيب الرمان في سلطنة عمان وقد وجد أن طفيل البيض *Telenomus* sp. يتطفل على بيض هذه الآفة في مزارع الرمان. تم استيراد نوعين من طفيل التريكوجراما هي تريكوجراما إيفانيسنز *Trichogramma evanescens*، تريكوجراما براسيكي *T. brassicae* وإطلاقهما في مزرعتي رمان بمنطقة الجبل الاخضر لمكافحة دودة ثمار الرمان. وقد أوضحت النتائج المتحصل عليها أن الطفيل المحلى *Telenomus* sp. يقوم بدور كبير في مكافحة هذه الآفة حيث كان متوسط نسبة التطفل بهذا الطفيل على البيض ٥٨,٢% فى المزرعة الأولى، ٧٠,٤% فى المزرعة الثانية. من ناحية أخرى كان متوسط نسب التطفل بالطفيل *T. brassicae* (فى المزرعة الاولى) ٢٠,٩% بينما كان متوسط نسب التطفل بالطفيل *T. evanescens* (فى المزرعة الثانية) ٩,٩%.