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The Efficiency of The Parasitoid, *Trichogramma* sp. Against Some Date Pests

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ABSTRACT

The date palm tree and its fruits are attacked by several pests that are well adapted to the Egyptian environment that can cause a loss in yield ranged between 30-70%. To control these pests, chemical insecticides were intensively used. However, using chemical insecticides cannot be reliable and safe for long-term pest management solutions because of many serious problems, such as high economic cost, negative impact on the environment and human health, and some pests develop resistance towards them. Therefore, the present study was carried out to investigate the effectiveness of releasing the egg parasitoid, *Trichogramma evanescenes*, against some date palm fruits at Al Mansoureyah, Imbaba, Giza Governorate, Egypt during two successive growing season, 2018 and 2019. Two traditional chemicals were also used, Pyriban and sulfur. The results showed the successful release of the parasitoid as the high reduced infestation rate observed during the growing seasons 2018 and 2019 compared to conventional methods. So, *T. evanescenes* is a successful and reliable control method to be used on long- and short-term strategy.

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) cultivation in Egypt goes back thousands of years. The earliest evidence of its presence was provided by the drawings on ancient Egyptian tombs (Bekheet and El-Sharabasy, 2015). Egypt has been the world's largest producer of dates since 1974 and reports very high average yields as compared to other countries (Bekheet and El-Sharabasy, 2015). The date palm tree and its fruits are attacked by several pests that are well adapted to the Egyptian environment such as, the pomegranate butterfly *Deudorix* (*Virachola*) *livia* Klug (Lepidoptera: Lycaenidae), the greater date moth, *Arenipses sabella* Hampson (Lepidoptera: Pyralidae), the lesser date moth, *Batrachedra amydraula* Meyrick (Lepidoptera: Batrachedridae), the dried fruit moth, *Ephestia calidella* Guenée (Lepiodptera: Phycitidae), the spider mite, *Oligonychus afrasiaticus* Berlese (Trombidiformes: Tetranychidae), the palm frond borer *Phonapate frontalis* Fah. (Coleoptera: Bostrichidae), and *Parlatoria blanchardi*, date palm scale (Hemiptera: Diaspididae) (Bekheet and El-Sharabasy, 2015). These pests can cause a loss in yield ranged between 30-70%. To control these pests, several methods have been investigated, i.e., insecticides, mechanical control, biocide, and natural products (Bekheet

and El-Sharabasy, 2015; Gameel, 2017; and Latifian, 2017). The intensive use of traditional chemical insecticides has many serious problems, such as high economic cost, negative impact on the environment and human health, and some pests develop resistance towards them (El-Shafie *et al*., 2017 and Abdel-Samad *et al*., 2019). Therefore, chemical pesticides should not be relied upon as short-term solutions against date palm pests to avoid the risk of residues in fruits and to maintain the balance of the ecosystem (Ali and Aldosari, 2007 and Abdel-Samad *et al*., 2019). To significantly reduce or even eliminate pesticide usage completely in date palm plantation ecosystems, an integrated pest management (IPM) application is necessary (Latifian, 2012). Using predators and parasitoids to control pests is a control strategy well-established although it is still limited (Alrubeai *et al*., 2014 and Alrubeai, 2017). About 90 predators and parasitoids species were listed, indicating their potential role in date palm pest management (El-Shafie *et al*., 2017). *Trichogramma* species are among the most used groups of natural enemies because they are relatively easy to culture and, being egg parasitoids, they kill the host before crop damage occurs. Moreover, there are many factors that may influence the dispersal speed of *Trichogramma* such as wind speed, crop type and total leaf area of the crop (Hassan *et al*., 2018). The distance from the release point at which a sufficient level of parasitism is found varies from 5 to 50 m, depending on the *Trichogramma* species and the crop (Li, 1994; Wright *et al*., 2001; and Hassan *et al*., 2018). Accordingly, the present study aimed to survey the pests of date palm fruits Al Mansoureyah, Imbaba, Giza Governorate, Egypt. In addition, the dispersal capacity of *Trichogramma* sp. in the same district was also evaluated.

MATERIALS AND METHODS

Surveying and Detection of Target Pests:

Investigation of date palm trees was carried out to detect the levels of infestation with the pomegranate butterfly *Deudorix* (*Virachola*) *livia*, the greater date moth, *Arenipses sabella*, the lesser date moth, *Batrachedra amydraula*, and the dried fruit moth, *Ephestia calidella* from estimating the mean number of fallen date fruits randomly. From March to the middle of April, the lesser date moth *B. amydraula*, the pomegranate butterfly, *D. livia*, and the greater date moth *A. sabella*, started to emerge. During September and October, *E. calidella* larvae and moths attacked the ripened fruits. The release of the egg parasitoid and chemical treatments was conducted on these dates.

Tested Compounds:

Two traditional chemical insecticides were used, Pyriban® (Chlorpyrifos) and Sulfur. They were used at the recommended concentrations. Three cm of Pyriban® were dissolved in 1000 cm^3 of distilled water. The sulfur was used at the rate of one kilo/tree. The prepared concentration of Pyriban® was sprayed on leaves and fruits of the date palm. Leaves and fruits were dusted with sulfur.

The Free Release of The Egg Parasitoid, *Trichogramma evanescenes*:

The egg parasitoid was obtained from the mass rearing laboratory of *Trichogramma* sp., Plant protection research institute, Agricultural research center, Dokki, Giza, Egypt. The parasitoid was reared on eggs of the pink bollworm, *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae). The parasitized eggs of the host were glued onto paper cards (1.5×3.5 cm) each containing 1000 eggs approximately. The paper cards were hanged on date palm trees using strings and were released just before sunset. The rate of release was 10,000 eggs/feddan. The decrease in insect infestation percentage was recorded on monthly basis.

Experimental Design:

A ten-year-old orchard of date palm cultivar Barhy at Al-Mansouria village, Imbaba district, Giza Governorate, Egypt highly infested with *B. amydraula, A. sabella, D. livia,* and *E. calidella* during two successive growing seasons; 2018 and 2019, were selected for this study. The experimental area was divided into five plots. Each plot was about 820 m. Each plot contains 13 date palm trees, and they were divided into three replicates each replicate has ten date palm trees.

The parasitoid was released in two plots. In the first plot, the paper cards were hanged on each date palm tree. In the second plot, the paper cards were hanged on date palm trees one by one. Between each plot, an area of about 20 m width along the length of the experimental plot was left without releases to separate between the two treated plots. The third plot was sprayed with the prepared concentration of Pyriban. The fourth blot was dusted with sulfur. Between the third and fourth plots, an area of 20 m was left without and chemical treatment to separate between the treated plots. A fifth plot was left without any treatment as a check group. The observations were recorded on weekly intervals for newly infested date palm trees.

Statistical Analysis:

Percentage reduction in population was estimated using Henderson and Tilton (1955) equation. Results were then statistically analyzed using SPSS Statistical Package (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp). A one-way ANOVA was performed to compare the efficiency of the released parasitoid in reducing the infestation caused by the evaluated pests date palm farm. In addition, the efficacy of conventional insecticides in managing the treated insects. The significant difference among various treatments was set at $p< 05$.

RESULTS AND DISCUSSION

The Infestation of Surveyed Pests:

The total number of infected bunches and fallen fruits with *B. amydraula, A. sabella, D. livia,* and *E. calidella* were listed in tables (1 &2) and illustrated in figures (1&2) during the growing seasons of 2018 and 2019 starting from the mid of March till the end of October. Results showed that there was a gradual increase in the rate of infested fruits with *A. sabella* from May to July. The highest rate of infestation was detected in July. On the other hand, the rate of infested fruits with *B. amydraula* and *D. livia* was detected from May to August with a gradual increase manner. This was observed through the fallen fruits. Furthermore, the rate of infestation of fruits with *E. calidella* was observed from March to October. A gradual increase in the rate of infestation was observed through bunches and fallen fruits.

Results showed that all monitored pests caused great loss in date fruit yield. The obtained results were in accordance with Abdel Rahman (2007); Gameel (2017); and Abdel-Samad *et al*. (2019). It is noted that these pests were encountered as destructive pests in many regions inside Egypt (Abdel Rahman, 2007; Gameel *et al*., 2014; Gameel, 2017; Gameel *et al*., 2017; and Abdel-Samad *et al*., 2019).

Table 1: Mean number of fallen date fruits as a sign of infestation with *Arenipses sabella*, *Batrachedra amydraula*, *Deudorix livia*, and *Ephestia calidella* during the growing seasons of 2018**.**

Insects	Mean number of infested fallen fruits (± S. E.)							
	March	April	May	June	July	August	September	October
Arenipses sabella	3.54±0.5	4.85±0.05	5.06±0.2	8.70±0.55	10.45±0.33			
Batrachedra amydraula			12.88±0.33	21.06±0.25	29.33±0.05	38.6±0.33		
Deudorix livia			13.33±0.33	25.66±0.60	29.03±0.03	37.00±0.33		
Ephestia calidella	7.5±0.02	9.66±0.2	12.03±0.33	16.54±0.54	19.88±0.25	35.21±0.02	40.33±0.33	49.36±0.52

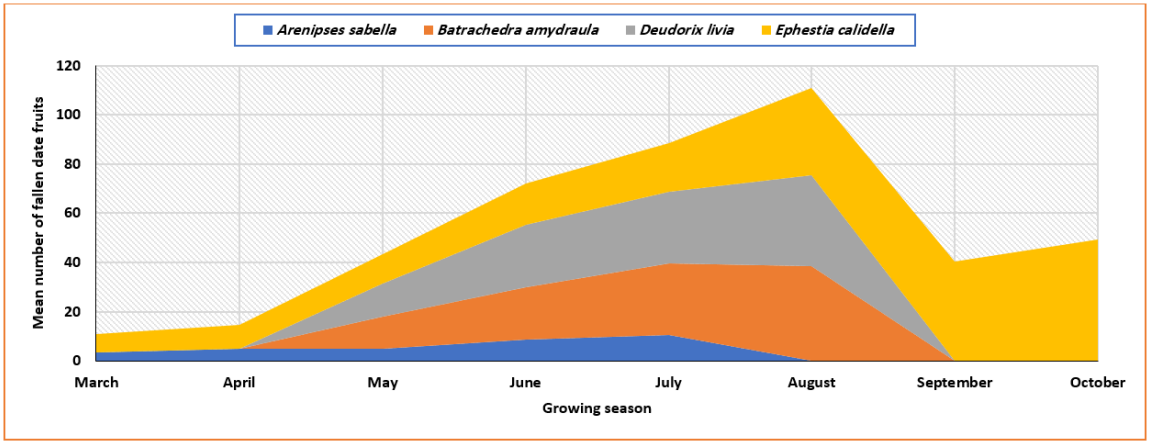

Fig. 1: Mean number of fallen date fruits as a sign of infestation with *Arenipses sabella*, *Batrachedra amydraula*, *Deudorix livia*, and *Ephestia calidella* during the growing seasons of 2018

Table 2: Mean number of fallen date fruits as a sign of infestation with *Arenipses sabella*, *Batrachedra amydraula*, *Deudorix livia*, and *Ephestia calidella* during the growing seasons of 2019

Insects	Mean number of infested fallen fruits (± S. E.)							
	March	April	May	June	July	August	September	October
Arenipses sabella	4.63±0.02	5.96±0.05	5.89±0.20	9.02±0.05	12.03±0.33			
Batrachedra amydraula			13.08±0.33	23.32±0.25	27.33±0.05	40.36±0.33		
Deudorix livia			14.50±0.25	26.75±0.33	31.02±0.13	40.04±0.04		
Ephestia calidella	8.02±0.05	10.66±0.2	15.03±0.33	18.54±0.54	22.88±0.25	37.21±0.02	44.33±0.33	56.36±0.52

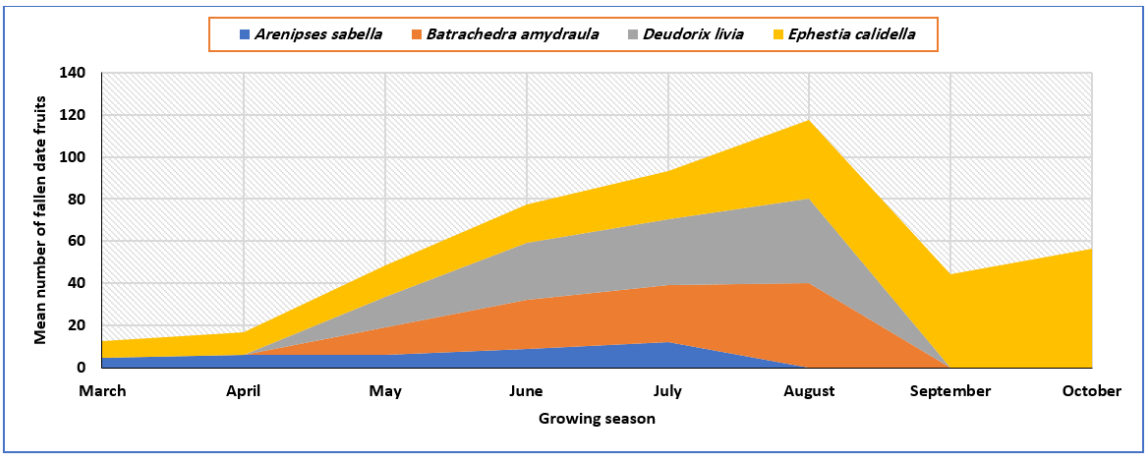

Fig. 2: Mean number of fallen date fruits as a sign of infestation with *Arenipses sabella*, *Batrachedra amydraula*, *Deudorix livia*, and *Ephestia calidella* during the growing seasons of 2019**.**

Efficacy of Tested Parasitoid and Chemical Insecticides:

Data in tables (3) and (4) showed the reduction percentage of the infestation rate of fruits by determined pests after application of chemical insecticides and the release of *T. evanescenes* in date palm farm during the growing seasons 2018 and 2019. Results showed that the infestation rate by *B. amydraula*, *A. sabella*, *D. livia*, and *E. calidella* was reduced by about 84.36, 85.87, 82.29 and 85.93 %, respectively, due to the parasitoid activity during the growing season 2018. During the growing season 2019 the infestation rate by *B. amydraula*, *A. sabella*, *D. livia*, and *E. calidella* was reduced by about 80.03, 81.17, 79.84 and 76.61 %, respectively. While treatment with pyriban and sulfur cause reduction percentage ranged from 73.7 to 83.2% and 79.33 to 82.67%, respectively during 2018 growing season. During 2019 growing season treatment with pyriban and sulfur caused a reduction percentage rate of 66.71 to 70.62% and 71.64 to 79.98%, respectively.

Although their effectiveness in controlling insect pests in date palm orchard, conventional insecticides adversely affect the environment and human and animal health (Abdel Rahman, 2007; Al-Khayri *et al*., 2015; Ali and Hama, 2016; and El-Shafie *et al*., 2017). Utilization of predators and parasitoids in pest control is a promising pest management tool however, it is still limited (Alrubeai, 2017; and Abdel-Samad *et al*., 2019). Consequently, *T. evanescens* was chosen to control the evaluated pests as it attacks different stages throughout the pest's life cycle, *i.e.* stops the continuousness of the pest life cycle (Abdel Rahman, 2007; Alrubeai, 2017; Gameel *et al*., 2017; Hassan *et al*., 2018; Abdel-Galil *et al*., 2018; and Abdel-Samad *et al*., 2019).

Table 3: Rate of infestation reduction after the release of *T. evanescenes* and application of Pyriban and sulfur against *Arenipses sabella*, *Batrachedra amydraula*, *Deudorix livia*, and *Ephestia calidella* during the growing seasons of 2018

Insects	%Reduction of infestation rate after treatment								
	T. evanescenes			Pyriban			Sulfur		
	Before	After	%reduction	Before	After	%reduction	Before	After	%reduction
Arenipses sabella	6.52	1.02	**84.36**	6.52	1.25	**80.80**	6.52	1.13	**82.67**
Batrachedra amydraula	25.47	3.60	**85.87**	25.47	4.83	**81.04**	25.47	4.21	**79.33**
Deudorix livia	26.26	4.65	**82.29**	26.26	5.25	**80.01**	26.26	4.99	**81.00**
Ephestia calidella	23.81	3.35	**85.93**	23.81	4.99	**79.03**	23.81	4.50	**81.10**

Table 4: Rate of infestation reduction after the release of *T. evanescenes* and application of Pyriban and sulfur against *Arenipses sabella*, *Batrachedra amydraula*, *Deudorix livia*, and *Ephestia calidella* during the growing seasons of 2019**.**

Insects	%Reduction of infestation rate after treatment								
	T. evanescenes			Pyriban			Sulfur		
	Before	After	%reduction	Before	After	%reduction	Before	After	%reduction
Arenipses sabella	7.51	1.50	**80.03**	7.51	2.25	**66.71**	7.51	2.13	**71.64**
Batrachedra amydraula	26.02	4.90	**81.17**	26.02	6.83	**73.75**	26.02	5.21	**79.98**
Deudorix livia	28.08	5.66	**79.84**	28.08	8.25	**70.62**	28.08	5.99	**78.67**
Ephestia calidella	26.63	6.23	**76.61**	26.63	7.99	**70.00**	26.63	5.50	**79.35**

Conclusion:

The obtained results showed the effectiveness of using *T. evanescens* in controlling and reducing the infestation with *B. amydraula*, *A. sabella*, *D. livia*, and *E. calidella* in date palm orchard compared to conventional methods. This can help farmers minimize the employment of chemical insecticides in pest management.

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ARABIC SUMMARY

كفاءة طفيل الترايكوجراما في مكافحة بعض آفات نخيل البلح

إيمان السيد الرهيوي، ناجي ناشد، وهبة محمود سيد البنا
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تتعرض أشجار النخيل وثمارها للهجوم من قبل العديد من الآفات التي تتكيف جيدًا مع البيئة المصرية والتي يمكن أن تسبب خسارة في المحصول تتراوح بين 30-70٪. ولمكافحة هذه الآفات، تم استخدام المبيدات الحشرية الكيميائية بشكل مكثف بالرغم من أن المبيدات الحشرية الكيميائية لا يمكن أن تكون حلاً موثوقًا وآمنًا لإدارة مكافحة الآفات على المدى الطويل بسبب العديد من المشاكل الخطيرة، مثل التكلفة الاقتصادية المرتفعة، والأثر السلبي على البيئة وصحة الإنسان، وبعض الآفات تطور مقاومة تجاهها. لذلك أجريت هذه الدراسة لمعرفة مدى فاعلية إطلاق طفيل البيض *Trichogramma evanescenes* ضد بعض آفات ثمار نخيل التمر في قرية المنصورية، إمبابة، محافظة الجيزة، مصر خلال موسمي زراعة متتاليين، 2018 و2019. وتم استخدم أيضا البيريبان والكبريت. أظهرت النتائج نجاح إطلاق الطفيل والذي دل عليه ارتفاع معدل الخفض بالإصابة بالآفات المعاملة خلال موسمي الزراعة 2018 و2019 مقارنة بالطرق التقليدية. لذلك، يعتبر استخدام طفيل *T. evanescenes* طريقة مكافحة ناجحة وموثوقة لاستخدامها في إستراتيجيات المكافحة على المدى القصير والمدى الطويل.