

## Effect of Releasing Different Rates of the Egg Parasitoid, *Trichogramma evanescens* West. on the Infestation Ratio with the greater Date Moth, *Arenipses sabella* Hampson

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### Abstract

Since the beginning of this century, numerous scientific studies have been conducted to elucidate the economic importance of the greater date moth, *Arenipses sabella*, in Middle Eastern date palm cultivation. This pest inflicts various injuries on date palms, leading to growth abnormalities and physiological disorders such as crown bending, dwarfing, and terminal shoot bud death. Newly emerged larvae invade the inflorescence, feeding on the flowers and leaving behind blackened areas amidst the healthy white inflorescence. The economic damage is particularly significant in the Saidi cultivar, where larval attacks on the bunch can result in the breaking of the bunch stalk and subsequent loss of date fruits. To combat this pest while aligning with sustainable and environmentally friendly practices, the application of biological control agents is essential. This study aims to assess the effect of different release rates of the egg parasitoid *Trichogramma evanescens* on infestation levels of the greater date moth, *A. sabella*. Data indicate that, in the absence of parasitoid releases, the economic loss in the Saidi variety due to infestation ranged from 12.45% to 16.05% in date palm orchards. Notably, the introduction of parasitoids significantly reduced economic infestation rates by *A. sabella*, achieving reductions between 48.64% and 60.13%. The most effective results were observed when 250 parasitoids were released per tree multiple times (twice or thrice), followed by single releases of 500 or 750 parasitoids. Conversely, the least reduction in bunch base damage occurred with the standard single release of 250 parasitoids per tree. Statistical analysis of the data collected over two successive seasons revealed that to reduce the economic damage caused by the greater date moth to 4.79%, it is necessary to release *T. evanescens* at a rate of 600 parasitoids per palm tree, divided into three batches monthly from mid-March to mid-May.

**Keywords:** Date palm, biological control, *Trichogramma evanescens*, the greater date moth, *Arenipses sabella*

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### Introduction

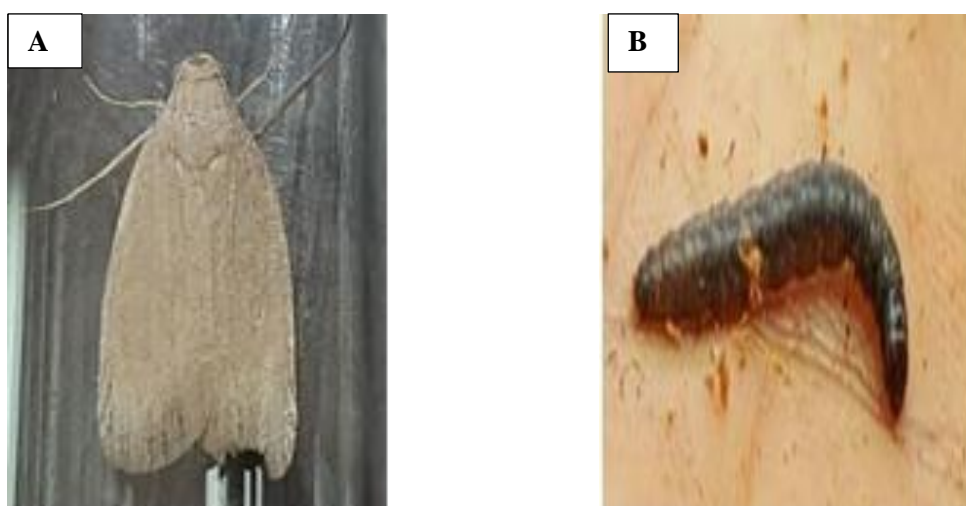
The greater date moth, *Arenipses sabella*, has emerged as a major pest affecting date palm trees in the New Valley and various Egyptian oases (Abdel-Rahman *et al.*, 2007; Imam, 2012; Mansour *et al.*, 2019; Ahmed and Gameel, 2021; Gameel and Ahmed, 2021). This pest is recognized as one of the earliest threats to date palms, with infestations reported as early as the last week of January, particularly affecting unopened spadices of male date palms (Gameel, 2017). Over 80% of inspected date palms have been found infested, leading to an average economic loss of approximately 10% for the Saidi variety. Additionally, direct losses can reach up to 45% in Tamr El Wadi fruit (dry

date) (Gameel *et al.*, 2017). Integrated pest management strategies have been employed to combat Lepidopteran pests, including *A. sabella*. Mechanical control has been highlighted as effective in reducing infestations in subsequent seasons (Abdel-Rahman, 2007). Starting from mid-March and at monthly intervals, releasing 3-4 cards of the egg parasitoid *Trichogramma evanescens* at a rate of one card per tree has demonstrated promising results against various lepidopteran pests. Gameel and Sayed (2009) recommended the application of alternative or traditional pesticides during the first and third weeks of November to lower the population density of *A. sabella* larvae before they overwinter as larvae or pupae, ultimately leading to fewer adult pests in the spring. *Trichogramma* spp. is recognized as a key egg parasitoid of several Lepidopteran pests. The effectiveness of *T. evanescens* has been demonstrated in Siwa Oasis, where it reduced infestations of six lepidopteran pests of date palm fruits by 97.8% (El-Dakroury *et al.*, 2002). Additionally, Mohammad *et al.* (2011) evaluated the efficacy of releasing different rates of *T. evanescens* and *Trichogramma principium* Sugonjaev & Sorokina to control the lesser date moth, *Batrachedra amydraula*. They found that all release rates of the two parasitoids significantly reduced infestation levels during both hababook and chemri stages, with *T. evanescens* achieving a control efficiency of 70.8% at the rate of three capsules per tree. Further studies by Gameel *et al.* (2014) indicated that a single release of 250 parasitoids per date palm effectively controlled both *A. sabella* and *B. amydraula* in El-Kharga Oasis. Moreover, Abdel-Samad *et al.* (2019) explored a combination of six parasitoids and predators, including *Trichogramma* sp., *Bracon* sp., *Goniozus* sp., *Chrysoperla* sp., *Coccinella* sp., and *Orius* sp., to manage various life stages of *A. sabella*, *Virachola livia*, and *B. amydraula* in El-Bahariya and Siwa oases. They recommended this combination of natural enemies as an integrated pest management strategy, especially in protected areas where pesticide use is prohibited. In light of these findings, Elrehewy *et al.* (2020) reported that *T. evanescens* serves as a reliable control method for both long- and short-term strategies when compared to traditional pesticides. To achieve sustainable development goals while preserving human and environmental health, the present study aims to evaluate the effect of different release rates of the egg parasitoid *T. evanescens* on the infestation levels of the greater date moth, *A. sabella*, under New Valley conditions.

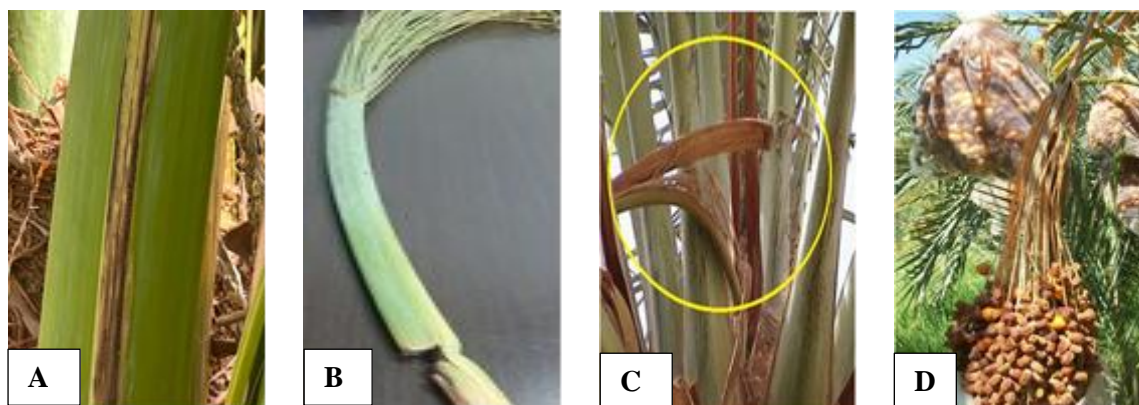
## Materials and methods

This work was conducted in El-Kharga Oasis, New Valley, to study the effect of releasing different regimes of the egg parasitoid *T. evanescens* on the infestation ratio of the greater date moth, *Arenipses sabella* (Figure 1), in 2020 and 2021. Twenty-four date palm farms cultivated with the Saidi cultivar (a semi-dry variety) were selected for this study. The treatments for releasing *T. evanescens* were applied as follows: a release of 250 parasitoids per tree was conducted once, twice, or three times at monthly intervals. Additionally, releases of 500 and 750 parasitoids per tree were done once, alongside a control treatment (without releasing the parasitoid). Each treatment was replicated in four groves. All treatments began in mid-March during the two successive seasons. Data were

recorded from ten date palms in each grove, where all bunches were inspected at two-week intervals from March until harvest time (Abdel-Rahman *et al.*, 2007). According to the criteria established by Gameel (2017), the nature of bunch infestation was classified as follows: 1) Surface infestation, which does not cause any yield losses and indicates the presence and activity of the pest (Figure 2A); 2) Cut bunch bases (Figure 2B), which occur when the larvae of the pest severely attack bunch stalks, leading to breakage under the heavy weight of date fruits (Figure 2C). This results in wilting and drying of the fruit dates (Figure 2D), representing the economic damage to the crop for the Saidi variety.



**Fig. (1):** Adult and larval stages of *Arenipsea sabella*. (A) Adult; (B) Larva



**Fig. (2):** Symptoms of infestation by the greater date moth, *Arenipsea sabella*: (A) Surface infestation; (B) Cut bunch base; (C) Broken bunch stalk; (D) Wilting and drying of fruit dates.

### Statistical analysis

The reductions in infestation ratios were estimated using Abbott's formula (1925). Data were statistically analyzed using the F-test, and means were compared according to Duncan's Multiple Range Test (Snedecor and Cochran, 1971).

## Results and discussions

### First season 2020

Regarding the economic damage caused by *Arenipses sabella*, data presented in Table 1 indicate that different releasing regimes resulted in a significant reduction in the degree of infestation, averaging 60.13%. The highest reductions in economic damage (76.66% and 72.08%) were achieved when releasing 250 parasitoids per tree either twice or three times at monthly intervals. In contrast, the lowest reduction ratio (36.57%) was observed when 250 parasitoids were released only once in mid-March.

**Table (1):** Average percentage reduction in *Arenipses sabella* infestation following the release of different *Trichogramma evanescens* regimens during the 2020 season.

Treatment	Economic damage		Surface damage		Total damage	
	Infestation %	Reduction %	Infestation %	Reduction %	Infestation %	Reduction %
250 parasitoid /tree once time	10.24	36.57 c	7.83	32.02 b	18.08	34.68 b
250 parasitoid /tree twice times	3.77	76.66 a	9.71	17.16 c	13.33	51.91 a
250 parasitoid /tree three times	4.52	72.08 a	8.46	26.44 b	12.98	53.09 a
500 parasitoid /tree once time	7.25	55.20 b	5.55	52.01 a	12.80	53.86 a
750 parasitoid /tree once time	6.45	60.13 b	6.22	46.07 a	12.66	54.28 a
Control	16.05		11.29			
Mean		60.13		34.74		49.57

Means within columns followed by the same letter (s) are not significantly different at 0.05 level of probability.

In the case of surface damage, the average reduction in infestation was 60.13%. The highest reduction percentages (52.01% and 46.07%) were recorded after releasing 500 and 750 parasitoids per tree once in mid-March, respectively. Regarding the impact of releasing *Trichogramma* parasitoids on total damage caused by the greater date moth to date palm bunches, significant reductions were observed, with no substantial differences between the various releasing regimes. However, the release of 250 parasitoids per tree yielded the lowest reduction value (34.68%).

### Second season 2021

Data presented in Table 2 indicate that different releasing regimes resulted in a significant decrease in the rate of infestations and economic damage caused by the greater date moth, averaging 48.64%. The maximum reductions in economic damage ratios (56.74%, 56.21%, and 55.58%) were recorded after releasing 250 parasitoids per tree twice, releasing 750 parasitoids per tree once, and releasing 250 parasitoids per tree three times, respectively. Conversely, the minimum effect (27.31%) was observed when 250 parasitoids per tree were released only once.

The highest reduction value (78.81%) in surface damage occurred after releasing 250 parasitoids per tree three times. In contrast, lower reduction values (55.57% and 53.38%) were noted after releasing 500 and 250 parasitoids per tree once, respectively. The greatest reduction in total damage to date palm bunches (65.98%) was achieved after releasing 250 parasitoids per tree three times, while the lowest reduction value (38.99%) was recorded after releasing 250 parasitoids per tree just once.

**Table (2):** Average percentage reduction in *Arenipses sabella* infestation following the release of different *Trichogramma evanescens* regimens during the 2021 season.

Treatment	Economic damage		Surface damage		Total damage	
	Infestation %	Reduction %	Infestation %	Reduction %	Infestation %	Reduction %
250 parasitoid /tree once time	9.11	27.31 c	4.82	53.38 d	13.93	38.99 e
250 parasitoid /tree twice times	5.45	56.74 a	2.96	71.66 b	8.41	63.43 b
250 parasitoid /tree three times	5.59	55.58 a	2.27	78.81 a	7.85	65.98 a
500 parasitoid /tree once time	6.62	47.33 b	4.61	55.57 d	11.23	51.01 d
750 parasitoid /tree once time	5.51	56.21 a	4.00	61.36 c	7.85	58.52 c
Control	12.45		10.18		22.64	
Mean		48.64		64.16		55.59

Means within columns followed by the same letter (s) are not significantly different at 0.05 level of probability

### Best releasing regime

Overall, the data obtained indicate that repeated releases of *T. evanescens* parasitoids at a rate of 250 parasitoids per tree, either twice or three times, were highly effective against infestations of *Arenipses sabella* across all assessed damage criteria, as recorded in Table 3 during the 2020 and 2021 seasons.

**Table (3):** Overall average percentage reduction in *Arenipses sabella* infestation following the release of different *Trichogramma evanescens* regimens during the 2020 and 2021 seasons.

Treatment	2020			2021		
	Reduction%			Reduction%		
	Economic damage	Surface damage	Total damage	Economic damage	Surface damage	Total damage
Usual release, 250 parasitoid /tree for one time	36.57 c	32.02 b	34.68 b	27.31 c	53.38 c	38.99 c
Repeated releasing 250 parasitoid /tree for twice or three times	74.37 a	21.81 c	52.50 a	56.16 a	75.23 a	64.70 a
Releasing than 500 or 750 parasitoid/tree for one time	57.67 b	49.04 a	54.08 a	51.77 b	58.46 b	54.77 b

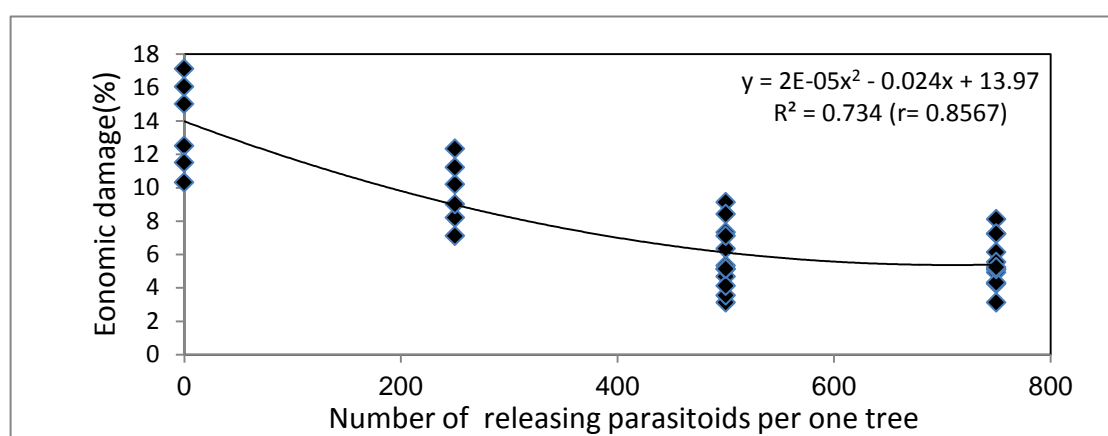
Means within columns followed by the same letter (s) are not significantly different at 0.05 level of probability.



The economic damage ratio decreased to 74.37% after repeatedly releasing 250 parasitoids per tree either twice or three times. In contrast, this ratio reached 36.57% when date palm farms employed the traditional release regime (250 parasitoids per tree once) in 2020. A similar trend was observed during the second season, where the highest reduction in economic damage (56.16%) was recorded after repeatedly releasing 250 parasitoids per tree twice or three times. Conversely, the lowest value (27.31%) was noted under the usual release regime (250 parasitoids per tree once) during the 2021 season.

### Estimate of the best release rate to reduce infestation levels

The relationships between infestation rates of *Arenipses sabella* and the number of releasing parasitoids per tree are summarized in Figure 3 for the 2020 and 2021 seasons.



**Fig. (3):** The relationship between the number of released *Trichogramma evanescens* parasitoids and the economic loss of the Saidi variety yield due to infestation by *Arenipses sabella* during the 2020 and 2021 seasons.

Testing the correlation between the infestation rate and the total number of *Trichogramma* parasitoids showed that polynomial equations best fit the data, yielding a significant correlation coefficient of 0.8567. Extrapolating the polynomial relationships between infestation rate (y-axis) and the number of parasitoids per tree (x-axis) during the 2020 and 2021 seasons indicated that using 600 parasitoids per tree would result in a minimum infestation rate of 4.79%.

### The results reveal several points worthy of discussion:

a) Integrated pest management is essential in date palm farms to combat the greater date moth, where the rate of economic damage ranged from 12.45% to 16.05% in control fields. This aligns with findings by Gameel (2017) and Gameel *et al.* (2017), who highlighted that *Arenipses sabella* is a key pest affecting date palms under New Valley conditions. Wakil *et al.* (2015) emphasized the need for future research to identify attractants for several significant date palm pests, particularly the rhinoceros beetle, *Oryctes agamemnon* (Burmeister), the greater date moth, *A. sabella*, and the date stone beetle, *Coccotrypes dactyliperda* F., which can cause substantial crop damage.

b) The highest reduction in economic damage was achieved by repeatedly releasing 250 parasitoids per tree either twice or three times, followed by releasing more than 500 or 750 parasitoids per tree just once. In contrast, the lowest reduction in cut bunch bases occurred with the traditional release of 250 parasitoids per tree once. This finding is consistent with Abdel-Rahman (2007), who noted that 3-4 monthly releases of the egg parasitoid *T. evanescens* resulted in satisfactory control of various lepidopterous pests affecting date palms. Additionally, Mohammad *et al.* (2011) reported a control efficiency of 70.8% against the lesser date moth, *Batrachedra amydraula*, using *T. evanescens* at a rate of three capsules per tree.

### Conclusion

In conclusion, to achieve a 4.79% reduction in economic damage (cut bunch bases) caused by *A. sabella*, *T. evanescens* parasitoids should be released at a rate of 600 parasitoids per palm tree, divided into three batches monthly from mid-March to mid-May. The advantages of this control method include its cost-effectiveness, environmental safety, and alignment with sustainable and green solutions.

### Acknowledgment

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## تأثير إطلاق معدلات مختلفة من طفيل الترايكوجراما. *Trichogramma evanescens* West على نسبة الإصابة بفراشة التمر الكبرى *Arenipses sabella* Hampson

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### الملخص العربي

منذ بداية هذا القرن، أُجريت العديد من الدراسات العلمية لتوضيح الأهمية الاقتصادية لفراشة التمر الكبرى *Arenipses sabella*، في زراعة النخيل في الشرق الأوسط. تتسبب هذا الآفة في إصابات متعددة لنخيل التمر، مما يؤدي إلى تشوهات في النمو واضطرابات فسيولوجية مثل انحناء التاج، والتقزم، وموت براعم النمو الطرفية. تغزو اليرقات الناشئة حديثاً النورات، حيث تتغذى على الأزهار وتترك وراءها مناطق سوداء بين الأزهار البيضاء السليمة. تكون الأضرار الاقتصادية ملحوظة بشكل خاص في صنف الصعيدي، حيث تؤدي هجمات اليرقات على العناقيد إلى كسر ساق العنقود وفقدان ثمار التمر. لمكافحة هذه الآفة بطريقة تتماشى مع الممارسات المستدامة والصدقية للبيئة، يُعتبر استخدام العوامل البيولوجية أمراً ضرورياً. تهدف هذه الدراسة إلى تقييم تأثير معدلات الإطلاق المختلفة من الطفيل البيضي (الترايكوجراما) *Trichogramma evanescens* على مستويات الإصابة بفراشة التمر الكبرى *A. sabella*. تشير البيانات إلى أنه في غياب إطلاق الطفيليات، تراوحت الخسارة الاقتصادية في صنف الصعيدي بسبب الإصابة بين ١٢.٤٥% و ١٦.٠٥% في بساتين النخيل. من الجدير بالذكر أن إدخال الطفيليات قلل بشكل كبير من معدلات الإصابة الاقتصادية بـ *A. sabella*، محققاً تخفيضات تتراوح بين ٤٨.٦٤% و ٦٠.١٣%. كانت النتائج الأكثر فعالية عندما تم إطلاق ٢٥٠ طفيلياً لكل شجرة عدة مرات (مرتين أو ثلاث مرات)، تليها الإطلاقات الفردية لـ ٥٠٠ أو ٧٥٠ طفيلياً. في المقابل، تم تسجيل أقل انخفاض في نسبة الإصابة الاقتصادية عند الإطلاق المعتاد (٢٥٠ طفيل/نخلة في المرة الواحدة).

الكلمات الدالة: نخيل التمر، مكافحة البيولوجية، *Trichogramma evanescens*، فراشة التمر الكبرى،

*Arenipses sabella*