Biological Control of Three Main-Insect Pests of Date Palm Fruits Using *Trichogramma Evanescens* (West.) Parasitoid in Date Palm Farms in the Dakhla Region, New Valley Governorate, Egypt.

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Abstract

Date palm crop in New Valley Governorate, Egypt are given great importance as a basic economic crop, which is affected by many pests that reduce the quantity and quality of the crop. Therefore, this research aimed to evaluate the effect of biological control of three important insect pests that affect date palm fruits in three date palm cultivars at El-Dakhla, New Valley Egypt using the parasitoid, *Trichogramma evanescens* West. .The effect of releasing *T. evanescens* on the infestation percentages of the three insects under study, as well as the reduction rate in the infestation % over two consecutive 2023 and 2024 years. The results showed that the percent of infestation with the three tested insects (*Aphomia sabella*, *Batrachedra amydraula* and *Deudorix livia)* was significantly decreased with increasing number of checks from the 1st to the 5th ,and number of parasitoid releases from the 1st to the 3rd, where it reached the lowest value in the 5th check and after the 3rd release in the three tested palm cultivars (Tamr El Wadi, Siwi and Sakkoti).On the contrary, the reduction percentages in the infestation by tested insects was increased with the increase of checks and parasitoid releases, reaching the highest value in the 5th check and after the 3rd release in the tested cultivars. Attention must be paid to biological control elements of date fruit insects to prevent the use of pesticides that harm humans and environment to obtain date fruits free from infestations and residues acceptable for the local market and export.

Keywords: Date palm pests, biological control, *Aphomia sabella*, *Batrachedra amydraula, Deudorix livia, Trichogramma*

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Introduction

The date palm is one of the most significant fruit plants in the world, and it is spread across the Arabian Gulf, Middle East, and North Africa (El-Lakwah *et al*., 2011; El-Shafei, 2011, 2015). It has a specific place in Egypt because it depends on income, which includes many people, whether farmers, palm workers, wholesalers, retailers, and exporters. (El-Lakwah *et al.*, 2012; El-Shafei *et al.*, 2019; Assous *et al.*, 2022 and El-Shafei *et al.*, 2024 a). Egypt occupies the first rank in date production, generating 1.8 million tons annually, representing 20% of global output, and expected to be 9 million tons annually, however the export rate does not reach 3%. (FAO, 2022). Pests, whether insect, animal, or disease, influence all portions of the

palm tree during the production period, storage, trade, and marketing (El-Lakwah *et al*., 2011b; Darwish *et al*., 2014; El-Shafei *et al*., 2020; El-Shafei & Attia, 2023; El-Shafei & Batt, 2024). Making them one of the most significant impediments to palm cultivation and reducing the amount of good production for marketing and export (El-Shafei *et al*., 2018; Zinhoum & El-Shafei, 2019; El-Shafei, 2020; El-Shafei *et al*., 2022; Mahmoud *et al*., 2022).New-Valley governorate is the largest governorate of Egypt, covering nearly a third of Egypt's land area and has over 4 million palm trees, which are the governorate's first monetary economic crop and the primary source of income for the province's residents. A significant number of lepidopterous species were known to infest date palms. The lepidopterous larvae, *Aphomia (Arenipses) sabella* (Hampson) (Lepidoptera: Pyralidae), *Batrachedra amydraula* Meyrick (Lepidoptera: Batrachedridae) and *Deudorix (Virachola) livia* (Klug) (Lepidoptera: Lycaenidae) are the most important insect pests that attack dates palm fruits in the field in the New-Valley Governorate and all palm growing areas in Egypt as well as Arab world throughout the production period (El-Shafei, 2018). During flowering, *A. sabella* initiates the invasion, followed by *B. amydraula* which attacks the newly formed date to cause it to fall. Pomegranate larvae, *D. livia* attack date fruit as soon as it starts to color, affecting the quantity and quality of the harvest (Gameel & Sayed 2009; Alrubeai1 *et al.*, 2014 and El-Shafei *et al.*, 2024 b). Greater date moth, *Aphomia sabella* is an insect of the early season, its infestations of spathes, fruit stalks, and bunches occurred in March and early April, with a high level of invasion towards the end of the month. When the insect larvae attacked later in the growth cycle, the bases of the bunches were shattered, which seriously damaged the quality of the dates' fruits. Such bunches are heavy enough to hold their fruits after infestation, which usually happens in August. They documented two generations annually (Abdel-Rahman *et al.*, 2007). In the New Valley, *A. sabella* became a crucial pest that infests date palms (Gameel & Sayed, 2009 and El Shafei *et al.*, 2023). In the New Valley, the most authentic early insect on date fruits is the lesser date moth, *B. amydraula* (Temerak *et al.*, 2007). Its larvae infest newly developed date fruits and can cause them to stop growing. When this insect's larvae were observed feeding on date flesh in May and June, the dates' color changed to reddish-brown and eventually dropped (Venezian and Blumberg, 1982). Three generations and separate peaks of *B. amydraula* were found in the New Valley Governorate between April and September. The most dangerous phase, which occurs in May, is followed by two moderate peaks in July and September (Saleh, 1974). In Egypt, pomegranate and date fruits are infested by the essential insect pest *D livia* (Sayed *et al.*, 2007). According to Abbes *et al.* (2020), this pest is spreading throughout the Gafsa oasis in Tunisia and may pose a threat to the region's date palm and pomegranate industries both economically. One of the most important methods used in the past to control these pests is the chemical control using pesticides, which were highly efficient in control, but due to the consciences in their use and harm to the environment and the natural enemies and their residues on the fruits and make them unsuitable for consumption or export, as well as the fact that the new valley

governorate is naturally isolated from the rest of the governorates of the Republic. Due to their negative effects on the environment and human health, the Egyptian Ministry of Agriculture banned the use of conventional pesticides in the New Valley Governorate in 1995. This encourages the employment of biological control methods including parasitoids, predators, pathogens and plant extracts. Trichogramma parasitoid, parasitizes lepidopterous insect eggs, is one of the most efficient biological control factors for managing insect pests of the order Lepidoptera, followed by the three pests studied. By controlling six lepidopterous date fruit insects in Siwa Oasis, *T. evanescens* raised the infestation reduction rate to 97.8% (El-Dakroury *et al.,* 2002). The purpose of this study was to assess the effectiveness of biological control utilizing the Trichogram parasitoid, *T. evanescens* on the reduction rates of infestation percentages of three date palm cultivars (Tamr El Wadi, Siwi and Sakkoti) planted in the Dakhla district of the New Valley Governorate by these three tested pests (*A. sabella, B. amydraula, D. livia* during two consecutive 2023 and 2024 years.

Materials and methods

This work was carried out on a private farm located at (25°53'04"N, 28°20'28"E) in Al-Dakhla Oasis, New Valley Governorate, Egypt, during two successive seasons (2023 and 2024). The date farm includes Tamr El Wady, Siwi, and Sakkoti cultivars, covering an area of 30 feddans. The age of the date palm trees ranged from 10 to 15 years, and all were in the economic fruition stage. Each feddan (1 feddan = 4200 m²) contains 80 palm trees, with a planting distance of 7 x 7 meters.

Field experiment

A part of the farm was designated for the release of the parasitoid, while another part, isolated from it but within the same area and under the same conditions, was used for the control. Three levels of parasitoid release were applied: the first in mid-March, as soon as infestation symptoms of *A. sabella* appeared; the second in mid-April; and the third in mid-May. Ten release cards, each containing 10 x 2000 = 20,000 parasitized eggs per feddan, were used. Each feddan contained 80 date palms planted at a spacing of 7 x 7 meters. The release cards were hung on the leaves of palm trees (1.5 to 2 meters high). Ten replicates were used for each cultivar and its control, with each replicate represented by one palm tree.

Parasitoid release

Each release card contains parasitized eggs of *T. evanescens* within an envelope, which protects the eggs from predators and the heat of the sun. The card is attached using a double-thread piece with a stapler. Each card contains eggs of three different ages, allowing the parasitoid to be released in three waves over three days. The parasitoid was also released before sunrise to avoid the heat (El-Dakroury *et al*., 2002). The release of *T. evanescens* followed a distribution of 10 cards per feddan, placed regularly on the palm trees. Every third palm tree received a card, while two palm trees

were left without cards in between. The egg parasitoid *T. evanescens* was obtained from the laboratory at El-Dakhla Oasis, New Valley Governorate, Egypt.

Infestation percentage & reduction rate

For the Greater Date Moth (*A. sabella*), the sample size consisted of all bunches on one date palm from each of the ten replicates, compared to ten replicates of the control. Infestation percentage was calculated by observing signs of larvae consuming the fruits of the flower strands. The infestation of *A. sabella* is shown in Fig. 1. For the Lesser Date Moth (*B. amydraula*), 100 randomly selected date fruits per date palms were inspected from ten replicates, compared to ten replicates of the control. Fruits with alive larvae of *B. amydraula*, symptoms of infestation, or dropped fruits showing webbing silk or feces were recorded and calculated as a percentage (Fig. 2). For the Pomegranate Butterfly (*D. livia*), the examination was done by checking every 100 dates for symptoms of infestation or the presence of larvae in each of the ten replicates (Fig. 3).

Inspection times

Inspections were conducted at two-week intervals: from the beginning of March to the end of April for *A. sabella*, from mid-April to mid-June for *B. amydraula*, and from the beginning of July to the end of August for *D. livia*. Five checks were performed for each of the three tested insects.

Fig. (1): The signs of *A. sabella* infestation on date palm flower strands

Fig. (2): The signs of *B. amydraula* infestation on date palm fruits

Fig. (3): The signs of *D. livia* infestation on date palm fruits

Statistical analysis

The obtained data on infestation percentages and reduction rates were analyzed using the method of Henderson & Tilton (1955).

Results and discussion

1. **Impact of releasing *Trichogramma evanescens* parasitoid on the infestation by *A. sabella*, *B. amydraula*, and *D. livia* in three date palm cultivars during 2023 and 2024**

The results in Table (1) and illustrated in Fig.4 show the effect of releasing *T. evanescens* parasitoid on the infestation percentages by the tested date fruit insect pests in the field: *A. sabella*, *B. amydraula*, and *D. livia* in three date palm cultivars: Tamr El Wadi, Siwi, and Sakkoti, cultivated in El-Dakhla during the 2023 season.

The obtained results revealed that the infestation percentages of the tested insects decreased as a result of releasing *T. evanescens* parasitoid on the tested palm cultivars,

with the increasing of the number of parasitoid releases and checks advanced, reaching the lowest infestation percentage in the fifth check after the third parasitoid release. The average infestation percentages recorded in the Tamr El Wadi cultivar were 29.70%, 24.50%, and 30.36% for *A. sabella*, *B. amydraula*, and *D. livia*, respectively. For the Siwi cultivar, the infestation percentages were 23.50%, 19.40%, and 25.50%, respectively, for the same insects. In the Sakkoti cultivar, the mean infestation percentages were 17.40%, 14.10%, and 20.00%, respectively.

The same trend was observed in the second season in 2024 (Table 2) and Fig. 5, with a decrease in infestation percentages as the number of checks and parasitoid releases increased. The mean infestation percentages for the tested insects in the 2024 season were as follows: 23.60%, 18.90%, and 23.50% in the Tamr El Wadi cultivar; 16.00%, 13.00%, and 18.60% in the Siwi cultivar; and 14.10%, 8.50%, and 13.62% in the Sakkoti cultivar for *A. sabella*, *B. amydraula*, and *D. livia*, respectively.

2. Effect of releasing *Trichogramma evanescens* parasitoid on the reduction rate of infestation by *A. sabella, B. amydraula,* and *D. livia* in three date palm cultivars during 2023 and 2024

Results in Table (3) show the effect of releasing *T. evanescens* parasitoid on the reduction percentage of infestation by the tested date fruit insect pests in the field (*A. sabella*, *B. amydraula*, and *D. livia*) in three date palm cultivars: Tamr El Wadi, Siwi, and Sakkoti, cultivated in El-Dakhla during the 2023 season.
The results indicated that the reduction rate of infestation by the tested insects increased as a result of releasing the *T. evanescens* parasitoid on the tested palm cultivars, with the reduction rate increasing as the number of parasitoid releases and checks advanced, reaching the highest reduction rate in the fifth check after the third parasitoid release. The mean reduction rates were 30.61%, 35.83%, and 27.22% in the Tamr El Wadi cultivar for *A. sabella*, *B. amydraula*, and *D. livia*, respectively. In the Siwi cultivar, the mean reduction rates were 34.47%, 30.88%, and 29.56% for the same insects. In the Sakkoti cultivar, the mean reduction rates were 39.39%, 40.11%, and 35.63%, respectively.
The same trend was observed in the 2024 season (Table 4), with an increase in the reduction rates as the number of checks and parasitoid releases increased. The mean reduction rates in the 2024 season were 45.88%, 54.14%, and 42.22% in the Tamr El Wadi cultivar; 54.80%, 45.55%, and 36.42% in the Siwi cultivar; and 50.70%, 58.95%, and 50.22% in the Sakkoti cultivar for *A. sabella*, *B. amydraula*, and *D. livia*, respectively.

Data in Table (5) indicate the effect of four factors (years, cultivars, insects, and inspection dates) on the reduction rate of infestation in date palms by *A. sabella*, *B. amydraula*, and *D. livia* during the 2023 and 2024 seasons.
After analyzing and comparing the data, it was revealed that there was a significant difference between the reduction rates of all tested factors: the two years of study, the three tested cultivars, the insects, and the inspection dates.
Additionally, Table (5) shows that the highest mean reduction rates recorded on the infestation during the two years of study and for the tested date cultivars were in the second year (2024), with the Sakkoti cultivar and *B. amydraula* showing the highest reduction rates in the fifth check.

The results of this research are consistent with several previous studies. Abdel-Rahman (2007) reported that releasing the egg parasitoid *T. evanescens* three to four months later led to satisfactory control of different lepidopterous pests affecting date palms. Furthermore, using *T. evanescens* at a rate of three capsules per tree achieved 70.8% control efficiency against *B. amydraula* in date palm plantations (Mohammad *et al*., 2011). Alrubeai *et al*. (2014) demonstrated that the percentage of *B. amydraula* infestations was reduced by 55.06% and 67.45%, respectively, when 500 and 1,000 parasitoids/palm tree were released. Ali and Mohammad (2014) mentioned that the egg parasitoid *T. evanescens* was used against *B. amydraula* in field settings from 2009 to 2013, with significant reductions in insect infestation compared to untreated fields. El-Rehewy *et al*. (2020) found that the successful release of the parasitoid led to a significantly lower infestation rate of date fruit insect pests in Giza Governorate during the 2018 and 2019 growth seasons. Therefore, *T. evanescens* is a reliable and effective control tool that can be applied in both short-term and long-term pest management strategies. Gameel *et al*. (2024) indicated that releasing *T. evanescens* parasitoid two or three times, at a rate of 250 parasitoids per palm tree, achieved the highest reduction in infestation by *A. sabella* in date palm farms.

Table (1): Mean infestation % of *A. sabella*, *B. amydraula*, and *D. livia* after releasing *T. evanescens* parasitoid in Tamr El Wadi, Siwi, and Sakkoti date palm cultivars in El-Dakhla, New Valley Governorate, Egypt.

Cultivars	Pests	Mean of infestation % with insects at five examinations in 2023					
		Inspection numbers					
		1	2	3	4	5	Mean
Tamr El Wadi	***A. sabella***	41.10	35.30	29.50	23.70	18.90	29.70
	B. amydraula	33.30	31.10	23.90	18.70	15.50	24.50
	D. livia	35.10	32.90	29.80	28.60	25.40	30.36
Siwi	***A. sabella***	33.10	29.90	22.70	17.50	14.30	23.50
	B. amydraula	28.00	26.80	18.60	14.40	9.20	19.40
	D. livia	29.90	27.70	24.50	24.30	21.10	25.50
Sakkoti	***A. sabella***	22.80	20.60	16.40	14.20	13.00	17.40
	B. amydraula	22.50	20.30	13.10	8.90	5.70	14.10
	D. livia	24.60	22.40	19.20	18.00	15.80	20.00

Table (2): Mean infestation % of *A. sabella*, *B. amydraula*, and *D. livia* after releasing *T. evanescens* parasitoid in Tamr El Wadi, Siwi, and Sakkoti date palm cultivars in El-Dakhla, New Valley Governorate, Egypt.

Cultivars	Pests	Mean of infestation % with insects at five examinations in 2024					
		Inspection numbers					
		1	2	3	4	5	Mean
Tamr El Wadi	*A. sabella*	35.00	25.80	23.60	18.40	15.20	23.60
	B. amydraula	28.10	22.90	16.70	14.50	12.30	18.90
	D. livia	28.70	25.50	23.30	21.10	18.90	23.50
Siwi	*A. sabella*	23.40	18.20	16.00	13.80	11.60	16.60
	B. amydraula	23.60	17.40	11.20	8.00	6.80	13.40
	D. livia	23.80	21.60	19.40	16.20	12.00	18.60
Sakkoti	*A. sabella*	21.30	15.10	12.90	11.70	9.50	14.10
	B. amydraula	17.90	12.70	6.50	3.30	2.10	8.50
	D. livia	18.30	16.00	13.80	12.60	7.40	13.62

Table (3): Mean reduction % in infestation by *A. sabella*, *B. amydraula*, and *D. livia* after releasing *T. evanescens* parasitoid in Tamr El Wadi, Siwi, and Sakkoti date palm cultivars in El-Dakhla, New Valley Governorate, Egypt.

Cultivars	Pests	Mean of reduction % in infestation of insects during 2023					
		Number of examinations					
		1	2	3	4	5	Mean
Tamr El Wadi	*A. sabella*	2.38	18.60	35.56	46.51	50.00	30.61
	B. amydraula	5.71	18.42	39.47	56.10	59.46	35.83
	D. livia	2.78	13.51	34.09	37.78	47.92	27.22
Siwi	*A. sabella*	2.86	14.63	38.74	55.09	61.02	34.47
	B. amydraula	6.67	16.13	40.00	45.45	46.15	30.88
	D. livia	0.00	15.63	38.46	41.46	52.27	29.56
Sakkoti	*A. sabella*	8.33	26.28	47.13	56.72	58.47	39.39
	B. amydraula	12.00	23.08	50.00	53.57	61.90	40.11
	D. livia	4.00	18.52	44.12	50.00	61.54	35.63

Table (4): Mean reduction % in infestation by *A. sabella*, *B. amydraula*, and *D. livia* after releasing *T. evanescens* parasitoid in Tamr El Wadi, Siwi, and Sakkoti date palm cultivars in El-Dakhla, New Valley Governorate, Egypt.

Cultivars	Pests	Mean of reduction % in infestation of insects during 2024					
		Number of examinations					
		1	2	3	4	5	Mean
Tamr El Wadi	***A. sabella***	14.63	43.18	51.06	53.85	66.67	45.88
	B. amydraula	37.84	42.11	60.00	64.10	66.67	54.14
	D. livia	18.08	32.95	45.84	52.85	61.38	42.22
Siwi	***A. sabella***	34.29	51.35	57.89	64.86	65.63	54.80
	B. amydraula	27.71	45.45	46.88	50.00	57.69	45.55
	D. livia	1.43	16.67	40.13	56.04	67.86	36.42
Sakkoti	***A. sabella***	16.00	42.31	58.62	65.63	70.97	50.70
	B. amydraula	26.09	55.56	66.67	71.43	75.00	58.95
	D. livia	20.12	34.07	54.55	62.58	79.81	50.22

Table (5): Factorial analysis for the significance of different studied factors

Factor	Level	Mean ± SE
Years	2023	33.74 ± 0.66 b
	2024	48.77 ± 1.04 a
$F_{1,80}$		134.68
P		<.0001
LSD		2.576
Cultivars	Tamr El Wadi	39.32 ± 1.84 b
	Siwi	38.61 ±1.78 b
	Sakkoti	45.83 ±1.62 a
$F_{2,80}$		12.62
P		<.0001
LSD		3.32
Insect infestation %	*A. sabella*	42.64 ±1.72 a
	B. amydruala	44.24 ±1.97 a
	V. livia	36.88 ±1.54 b
$F_{2,80}$		11.9300
P		<.0001
LSD		3.15
Inspections	1st check	13.38 ±2.78 e
	2nd check	29.36 ± 3.33 d
	3rd check	47.18 ± 2.21 c
	4th check	54.67 ± 2.08 b
	5th check	61.69 ± 2.13 a
$F_{2,80}$		185.12
P		<.0001
LSD		4.53

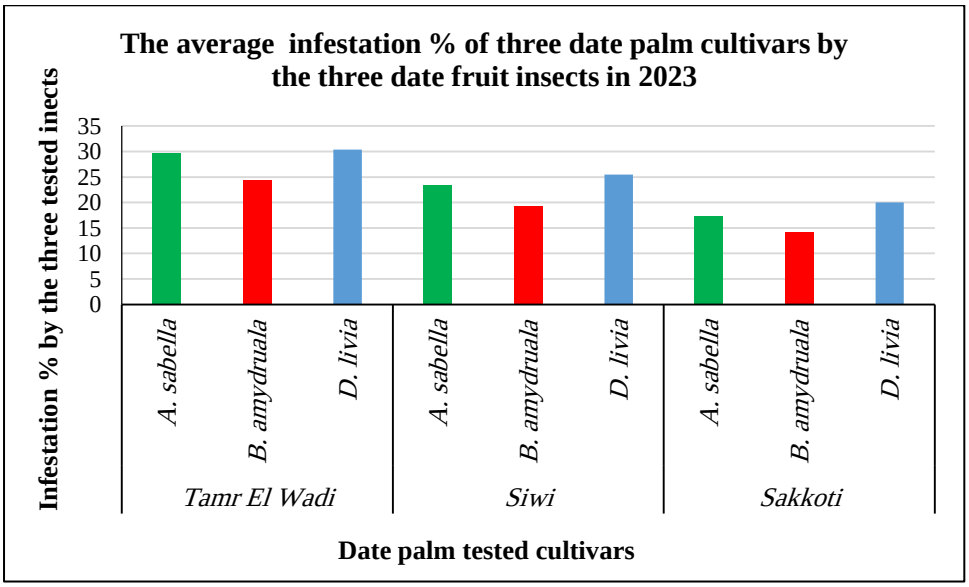

Fig. (4): The average infestation % of the three date palm cultivars by the three date fruit insects tested in 2023

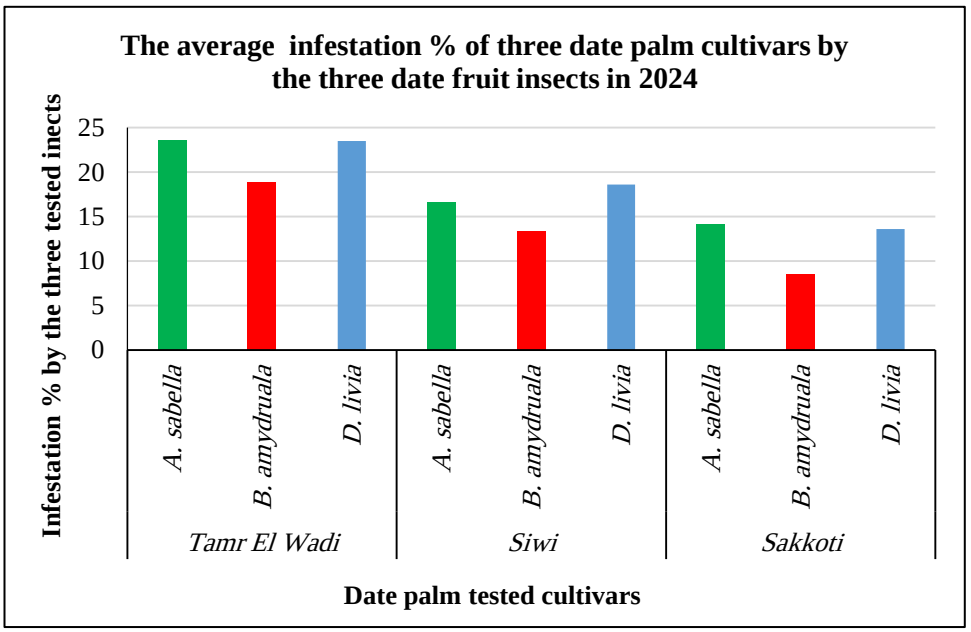

Fig. (5): The average infestation % of the three date palm cultivars by the three date fruit insects tested in 2024

Conclusions

Based on the findings of this study, it can be concluded that the biological control approach, involving the release of *Trichogramma* parasitoid eggs in date palm fields, significantly reduced the infestation of key insect pests (*A. sabella*, *B. amydraula*, and *D. livia*) on three date palm cultivars (Tamr El Wadi, Siwi, and Sakkoti) at three release timings (March, April, and May). The highest reduction in infestation rates was observed after five checks for each pest during the 2023 and 2024 growing seasons. Therefore, to minimize the use of chemical pesticides that can harm human health and the environment, and to produce high-quality date fruits free from insect infestations and pesticide residues for marketing and export, we recommend the adoption of biological control agents as a sustainable solution for managing date fruit pests.

References

Abbes, K., Zouba, A., Harbi, A., Ghrissi, N., Ksantini, M., & Chermiti, B. (2020). The pomegranate butterfly *Deudorix livia* (Lepidoptera: Lycaenidae): An emerging pest on dates in Tunisia. *EPPO Bulletin, 50*(1), 191–196.

Abdel-Rahman, G. A. (2007). Insect pest control in organic date palm production in Egypt. In *Proceedings of the 4th Symposium on Date Palm in Saudi Arabia* (pp. 1356-1360). Challenges of processing, marketing, and pest control. King Faisal University, Hofuf, Kingdom of Saudi Arabia.

Abdel-Rahman, G. A., Fouda, M. A., Mahmoud, H. I., El-Agamy, E. A., Imam, A. I., & Mansour, A. N. (2007). Observations on the greater date moth (*Arenipses sabella*) in Baharia Oasis, Egypt. *Egyptian Journal of Agricultural Research, 85*, 73-83.

Ali, A. S. A., & Mohammad, J. K. (2014). Potentials of utilizing biological measures for the management of the lesser date moth *Batrachedra amydraula* Meyr. in Iraq. *Proceedings of the Fifth International Date Palm Conference*, Abu Dhabi, UAE, 299-304.

Alrubeai, H. F., Hamad, B. S., Abdullatif, A. M., Ali, H. Z., & Abed, A. (2014). Efficacy of *Trichogramma evanescens* and *Bacillus thuringiensis* kurstaki to control lesser date moth *Batrachedra amydraula* Merck. *Journal of Agricultural Science and Technology, 4*, 281-284.

Assous, M. T. M., El-Shafei, W. K. M., Lewaa, L. M., & Salem, R. E. M. E. (2022). Efficiency of carbon dioxide and aluminum phosphide gasses on *Ephestia cautella* and *Oryzaephilus surinamensis* insects and microbial load on stored date fruits. *Egyptian Academic Journal of Biological Sciences, A. Entomology, 15*(1), 81-89. https://doi.org/10.21608/eajbsa.2022.225822

Darwish, A. A., El-Lakwah, F. A. M., El-Hosary, R. A., El-Banna, A. A., & El-Shafei, W. K. M. (2014). Effect of microwave on *Ephestia cautella* (Walker) (Lepidoptera: Pyralidae) as an alternative to methyl bromide. *Journal of Biological Chemistry and Environmental Science, 9*(4), 247-263.

El-Dakroury, M. S. I., Eweis, M. A., & Abul Fadl, H. A. A. (2002). Mass production and utilization of *Trichogramma evanescens* West. as a biocontrol agent against date fruit pests in Siwa Oasis, Egypt. *2nd International Conference, Plant Protection Research Institute*, Cairo, Egypt, 263-265.

El-Lakwah, F. A. M., El-Banna, A. A., El-Hosary, R. A., & El-Shafei, W. K. M. (2012). Improving pheromone traps efficacy for the depression of the red palm weevil *Rhynchophorus ferrugineus* (Oliv.) population on date palm plantations. *Egyptian Journal of Agricultural Research, 90*(1), 353-363. https://doi.org/10.21608/ejar.2012.159766

El-Lakwah, F. A. M., El-Banna, A. A., El-Hosary, R. A., & El-Shafei, W. K. M. (2011a). Impact of certain factors and agricultural practices on infestation of date palm trees by the red palm weevil *Rhynchophorus ferrugineus* (Oliv.). *Egyptian Journal of Agricultural Research, 89*(3), 1119-1127. https://doi.org/10.21608/EJAR.2011.177678

El-Lakwah, F. A. M., El-Banna, A. A., El-Hosary, R. A., & El-Shafei, W. K. M. (2011b). Population dynamics of the red palm weevil *Rhynchophorus ferrugineus* (Oliv.) on date palm plantations in 6th October Governorate. *Egyptian Journal of Agricultural Research, 89*(3), 1105-1118. https://doi.org/10.21608/ejar.2011.177676

Elrehewy, E., Nashed, N., & El-Banna, H. (2020). The efficiency of the parasitoid *Trichogramma* sp. against some date pests. *Egyptian Academic Journal of Biological Sciences, F. Toxicology & Pest Control, 12*(2), 269-275. https://doi.org/10.21608/eajbsf.2020.133370

El-Shafei, W. K. M., Ahmed, E. F. S., & Abdel Hafez, M. M. (2024b). The effect of different methods and quantities of pollination on the infestation percentage by two early date fruit insect pests in date palm farms in New Valley Governorate, Egypt. *Current Science International, 13*(3), 294-304. https://doi.org/10.36632/csi/2024.13.3.24

El-Shafei, W. K. M., Zinhoum, R. A., & El-Deeb, S. E. (2020). Modified atmosphere enriched with argon gas as an alternative measure for controlling four stored date pests. *Egyptian Academic Journal of Biological Sciences (A. Entomology), 13*(2), 57-65. https://doi.org/10.21608/eajbsa.2020.80069

El-Shafei, W. K. M., Tarek, E. A., Sary El Sahhar, & Haifa A. Almohammad. (2023). Changes in the content of certain oxidative defense enzymes and pigments in leaves of some date palm cultivars due to infestation by the red palm weevil in Egypt. *American-Eurasian Journal of Agricultural & Environmental Sciences, 23*(3), 93-98. https://doi.org/10.5829/idosi.aejaes.2023.93.98

El-Shafei, W. K. M. (2020). Comparison between using phosphine and/or carbon dioxide for controlling *Plodia interpunctella* and *Oryzaephilus surinamensis* in stored date fruits. *Middle East Journal of Applied Sciences, 10*(4), 657-664. https://doi.org/10.36632/mejas/2020.10.4.56

El-Shafei, W. K. M. (2015). Studies on efficiency of certain methyl bromide alternatives against *Ephestia cautella* (Walker) (Lepidoptera: Pyralidae). Ph.D. thesis, Benha University, Egypt, 195.

El-Shafei, W. K. M., & Attia, S. A. (2023). Ecological and toxicological studies on date palm scale *Fiorinia phoenicis* Balachowsky (Hemiptera-Diaspididae) infesting three date palm cultivars with reference to anatomical and chemical analysis of palm cultivars leaflets at Giza Governorate, Egypt. *Academic Journal of Entomology, 16*(2), 70-83. https://doi.org/10.5829/idosi.aje.2023.70.83

El-Shafei, W. K. M., & Batt, M. A. (2024). Evaluation of specific pheromone trap designs and components to improve their effectiveness in reducing the red palm weevil population in Egyptian palm farms. *Menoufia Journal of Plant Protection, 9*(1), 45-59. https://doi.org/10.21608/MJAPAM.2024.261543.1029

El-Shafei, W. K. M., Mesallam, T., & Batt, M. A. (2024a). Population density and host preference of the date stone beetle, *Coccotrypes dactyliperda* (Coleoptera, Curculionidae, Scolytinae) in date palm farms as well as the efficacy of some trap attractants in Sharkia Governorate, Egypt. *Middle East Journal of Agriculture Research, 13*(2), 269-287. https://doi.org/10.36632/mejar/2024.13.2.16

El-Shafei, W. K. M., Mahmoud, R. H., & El-Deeb, S. E. (2019). Impact of controlled atmosphere of different three gases for controlling the stored dates mite, *Tyrophagus putrescentiae* (Schrank) (Acari: Acaridida). *Academic Journal of Entomology, 12*(2), 49-56. https://doi.org/10.5829/idosi.aje.2019.49.56

El-Shafei, W. K. M. (2011). Ecological studies on the red palm weevil, *Rhynchophorus ferrugineus* (Oliv.) (Curculionidae: Coleoptera). M.Sc. thesis, Faculty of Agriculture, Benha University, Egypt, 180.

El-Shafei, W. K. M., Mahmoud, R. H., & Mohamed, S. S. A. (2022). Efficacy of some entomopathogens against *Ephestia cautella* (Walker) (Lepidoptera: Pyralidae) in stored date fruits. *Egyptian Journal of Biological Pest Control, 32*(1), 1-7. https://doi.org/10.1186/s41938-022-00546-2

El-Shafei, W. K. M., Zinhoum, R. A., & Hussain, H. B. H. (2018). Biology and control of Indian meal moth, *Plodia interpunctella* (Hubner) (Lepidoptera: Pyralidae) infesting stored date, almond, and peanut fruits. *Journal of Plant Protection and Pathology, Mansoura University, 9*(9), 595-600. https://doi.org/10.21608/jppp.2018.43888

El-Shafei, W. K. M. (2018). Population density of some insect pests infesting fallen soft dates and their associated natural enemies in Giza Governorate, Egypt. *Journal of Plant Protection and Pathology, 9*(12), 815-821. https://doi.org/10.21608/jppp.2018.44072

FAO. (2022). Data for crop production in 2020. http://www.fao.org/faostat/en/#data

Gameel, S. M. M., & Sayed, A. A. (2009). Control of the greater date moth, *Arenipses sabella* Hampson (Pyralidae: Lepidoptera) at the New Valley, Egypt. *Egyptian Journal of Agricultural Research, 87*, 1323-1328.

Gameel, S. M. M., Tolba, E. F., & Gameel, A. S. (2024). Effect of releasing different rates of the egg parasitoid, *Trichogramma evanescens* West. on the infestation ratio with the greater date moth, *Arenipses sabella* Hampson. *Egyptian International Journal of Palms, 4*(2), 38-47.

Henderson, C. F., & Tilton, E. W. (1955). Tests with acaricides against the brown wheat mite. *Journal of Economic Entomology, 48*, 157–161.

Mahmoud, R. H., Abdel-Khalik, A. R., & El-Shafei, W. K. M. (2022). Comparison between two physical methods to control the stored dates fruit mites, *Tyrophagus putrescentiae* (Schrank) and *Rhizoglyphus robini* Claparede (Astigmata: Acaridae). *Egyptian Academic Journal of Biological Sciences, B. Zoology, 14*(1), 149-158. https://doi.org/10.21608/eajbsz.2022.228058

Mohammad, J. K., Ali, A. A., Al-Jassani, R. F., & El-Bouhssini, M. (2011). The use of the egg parasitoids *Trichogramma evanescens* Westwood and *T. principium* Sugonjaev & Sorkina for the biological control of the date lesser moth *Batrachedra amydraula* Meyrick. *Anbar Journal of Agricultural Sciences, 9*, 292-303.

Saleh, M. R. A. (1974). Ecological, biological, and control studies on pests infesting date bunches in the New Valley. Ph.D. thesis, Faculty of Agriculture, Ain Shams University, 170 pp.

Sayed, A. A., Temerak, S. A., Bekheit, H. K., & Gameel, S. M. M. (2007). Actinomycete natural metabolites to combat *Virachola livia* inhabited date palm trees at Dakhla Oasis, New Valley, Egypt. *Egyptian Journal of Agricultural Research, 85*, 1-7.

Temerak, S. A., Sayed, A. A., Bekheit, H. K., & Gameel, S. M. M. (2007). Actinomycete natural metabolites to combat *Batrachedra amydraula* Meyrick and *Cadra* spp at Kharga Oasis, New Valley, Egypt. *Egyptian Journal of Agricultural Research, 85*, 9-17.

Venezian, A., & Blumberg, D. (1982). Penology, damage, and control of the lesser date moth *Batrachedra amydraula*, in date palms in Israel. *Alon Hanotea, 36*, 785-788.

Zinhoum, R. A., & El-Shafei, W. K. M. (2019). Control of one of the vital stored date insects, *Plodia interpunctella* (Hübner) (Lepidoptera: Pyralidae), by using ozone gas. *Egyptian Academic Journal of Biological Sciences, F. Toxicology & Pest Control, 11*(3), 149-156. https://doi.org/10.21608/eajbsf.2019.74450

المكافحة الحيوية لثلاث آفات حشرية أساسية لثمار نخيل التمر باستخدام طفيل الترايكوجراما فى مزارع النخيل بمنطقة الداخلة بمحافظة الوادي الجديد، مصر.

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الملخص العربي

نظراً للأهمية الكبرى لمحصول نخيل التمر كمحصول اقتصادي أساسي في محافظة الوادي الجديد بمصر، فإنه يتعرض للإصابة بالعديد من الآفات الحشرية التي تقلل من كمية ونوعية المحصول. لذلك يهدف هذا البحث إلى تقييم تأثير المكافحة الحيوية لثلاثة من أهم الآفات الحشرية التي تصيب ثمار نخيل التمر في إحدى مزارع نخيل التمر التي تحتوي على ثلاثة أصناف نخيل مزروعة في منطقة الداخلة بالوادي الجديد بمصر باستخدام طفيل البيض الترايكوجراما. تم دراسة تأثير إطلاق طفيل الترايكوجراما بمعدل ١٠ كروت لكل فدان (فدان=٤٢٠٠ م^{٢}) شهريًا خلال موسم النمو من مارس إلى مايو على نسب الإصابة للحشرات الثلاث قيد الدراسة، وكذلك معدل الخفض في نسبة الإصابة على مدى عامين متتاليين ٢٠٢٣ و ٢٠٢٤.أظهرت النتائج أن نسب الإصابة بالحشرات الثلاث المختبرة (دودة الطلع ودودة الحميرة وابى دقيق الرمان) انخفضت مع زيادة عدد مرات الفحص من الأولى إلى الخامسة، وعدد مرات إطلاق الطفيل من الأولى إلى الثالثة، حيث بلغت أقل نسبة للاصابة في الفحصة الخامسة وبعد الإطلاق الثالث في أصناف النخيل الثلاثة المختبرة (تمر الوادي، السيوي، السكوتي). وعلى العكس من ذلك، ارتفع معدل الخفض في نسبة الإصابة بالحشرات الثلاثة المختبرة مع زيادة عدد مرات الفحص وعدد إطلاقات الطفيل، حيث بلغت أعلى قيمة خفض في الفحصة الخامسة وبعد الإطلاق الثالث في أصناف النخيل الثلاثة المختبرة. لذلك يجب الاهتمام بالمكافحة الحيوية بكافة عناصرها للآفات الحشرية للتمور وذلك لمنع استخدام المبيدات الكيميائية الملوثة للبيئة والمضرة بالإنسان، والحصول على ثمار تمور جيدة خالية من الإصابات الحشرية ومتبقيات المبيدات وجاهزة للتسويق والتصدير.

الكلمات الدالة: آفات نخيل التمر، المكافحة الحيوية، ***Aphomia sabella***، ***Batrachedra amydraula***، ***Deudorix livia***، ***Trichogramma***.