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Ecological Studies on *Prays Oleae* (Lepidoptera: Yponomeutidae) on Olive Trees and Evaluation of the Egg Parasitoid, *Trichogramma evanescens* West (Hymenoptera: Trichogrammatidae) for its Management in Middle Egypt

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Abstract: One of the harmful pests having a devastating impact on olive trees is the olive moth, *Prays oleae*. In the present study, the seasonal fluctuation of P. oleae had three peaks during the spring, summer and fall at Beni-Suef Governorate in two subsequent seasons of investigation (2021 and 2022). During the two research seasons, the summer had the highest activity levels. During the two-year investigation, the percentage of relative humidity and daily and nighttime temperatures had significant impacts on this pest. During the two-year trial (2021-2022), *Trichogramma evanescens* was determined as a biocontrol agent for managing this pest. The release of this parasitoid was efficient in controlling P. oleae on olive.

Key words: Seasonal population · Olive moth · *Prays oleae* · *Trichogramma evanescens* · Beni-Suef Governorate

INTRODUCTION

The olive tree (*Oleae uropaea* L.) is a long-standing and essential traditional crop in the Mediterranean region. Since 4800 B.C., the olive tree is thought to have originated and been grown in the Mediterranean region [1].

The olive moth, *Prays oleae* Bern; the black scale, *Saissetia oleae* Bern; and the olive fruit fly, *Bactrocera oleae* Gmelin, were recognized as the three most significant olive pests in the Mediterranean region [2]. Due to improvements in olive pest management programmes, *P.oleae*'s significance has diminished overall, although regional relevance has persisted [3].

P. oleae has three yearly generations and the larval stages target various olive tree sections, which can result in fruit loss and harm to blossoms, leaves and other plant parts. As a result, the olive moth lowers tree growth, decreases fruit laydown and lowers the quality of the fruit and oil, leading to significant losses in olive yield [3].

In Egypt's historic and newly constructed and managed olive fields, the olive moth, *P. oleae*, has impulsively emerged as a major pest, resulting in considerable immediate crop loss and cosmetic damage [4-6]. *P. oleae*, the olive moth that caused the damage, caused production in current cultivars to drop from 50% to 60%. [7-9].

Relying basically on pesticides for management of P.oleae caused the appearance of many problems, such as insect resistance to these pesticides, as well as hazards for the environment and severe harm for natural enemies [10, 11].

So developing safe control methods for pest management is a very important matter. One strategy employed in integrated pest management programmes for this insect is the use of natural enemies [10].

The present study goals to monitor the seasonality of P. oleae at Beni-Suef Governorate. Detection the impact of daily, night temperatures and relative humidity on the pest population density.

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Moreover, estimation of the backlog of field releases of *T. evanescens* for controlling this pest under field conditions in Egypt.

MATERIALS AND METHODS

Seasonal Population Dynamics of the Olive Moth, *P.oleae* on Olive Trees: To perform this investigation, two feddans cultivated with olive trees for about five years old were selected. Estimation of the population dynamics were carried out for subsequent two seasons 2021 and 2022 extending from 15th January to 31th December in Naser District, Beni-Suef Governorate. Samples of olive twigs were collected from the olive orchard that was divided into four regions as it replicated. In each region, At biweekly intervals, twenty-five twig samples were randomly selected from the four directions of the olive trees and placed inside paper bags to be investigated in the laboratory. On each sample, the number of *P. oleae* larvae was determined and recorded.

The Effect of Weather Factors on *P.oleae*: The influence of weather factors on the pest during the two seasons of investigation (2021 and 2022) was studied by using meteorological parameters, including biweekly means maximum and minimum temperatures, as well as relative humidity, have been collected measured at the Central Laboratory for Agricultural Climate in Dokki, Giza.

Field Release of the Egg Parasitoid, *Trichogramma Evanescens* for Controlling *P.oleae*: The field trial was held in the Naser District of the Beni-Suef Governorate. Field trials were conducted on a plot of land planted with olive trees (approximately 2400 m^2). The experiment was conducted across two research seasons (2021 and 2022). T.evanescens was obtained at the trichogramma laboratory in Beni-Suef Governorate, Egypt. *T.evanescens* was raised on eggs of the grain moth, *Sitotroga cerealella (Oliv.) (Lep.:Gelichiidae),* in a controlled climatic condition of 25±2°C, 70% R.H. and a photoperiod of 16:8 L:D.

Data Analysis: One - way Anova was used to analyse the data. The statistical programme SPSS - V.20 was used to analyse correlation and partial regression coefficients.

RESULTS

The Seasonal Abundance of the Olive Moth (Prays Oleae) Population: Figures 1 and 2 depict the seasonal population abundance of olive moth larvae in 2021 and 2022. During the spring, summer and fall seasons, *P. oleae* reached three peaks. The peaks of the first season were on 15th May (with 3.75 larvae/25 twigs at maximum temperature of 36.7°C, minimum temperature of 20.8°C, R. H. = 31.8%), 1st August (with 7.75 larvae/25 twigs at maximum temperature of 36.8°C, minimum temperature of 26.3°C, R. H. = 39.2%) and 15th October (with 2 larvae/25 twigs at maximum temperature of 32°C. For the second season the peaks were recorded on 1st June (with 3.25 larvae/ 25 twigs at means of max. T. = 35.1°C, min. T=18.9°C, R. H. = 35%), 1st Aug. (with 6.25 larvae/ 25 twigs at means of max. T. = 37.6°C, min. T=24.7°C, R. H. = 38.6%) and15th Oct. (with 1.5 larvae/ 25 twigs at means of max. T. = 32.9°C, min. T=20.7°C, R. H. = 49.1%). The month of August had the largest population during the two research seasons.

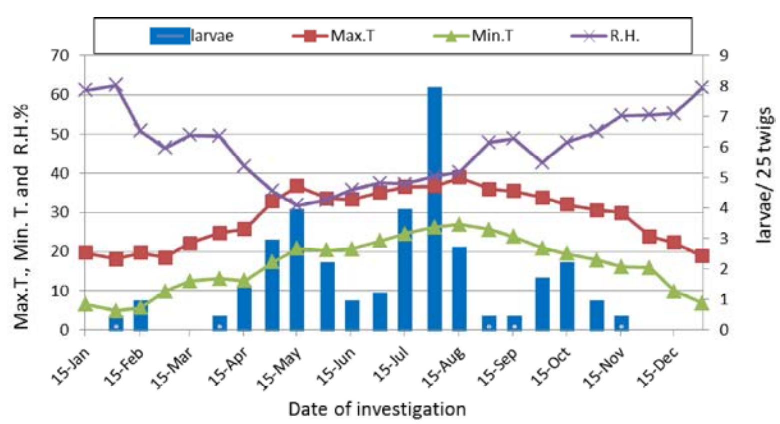

Fig. 1: Seasonal population density of *Prays oleae* larvae per 25 olive twigs and the corresponding biweekly means of maximum (Max. T.), minimum (Min. T.) temperatures (°C) and relative humidity (R.H.%) during the 1st season, 2021 from Jan. 15th to Dec. 31th at Naser, Beni-Suef Governorate, Egypt.

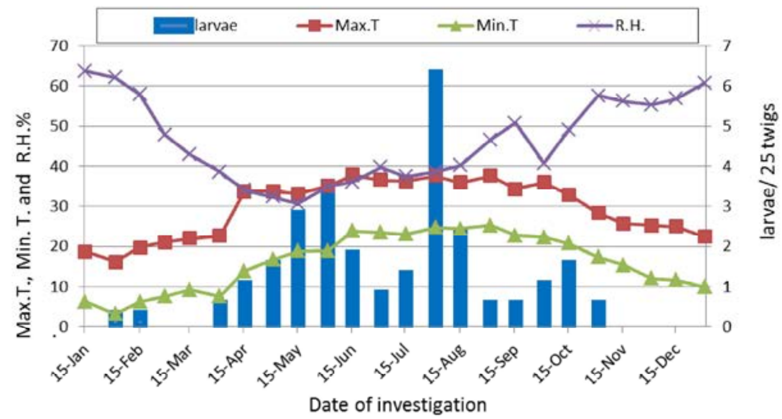

Fig. 2: Seasonal population density of *Prays oleae* larvae per 25 olive twigs and the corresponding biweekly means of maximum (Max. T.), minimum (Min. T.) temperatures (°C) and relative humidity (R.H.%) during the 2nd season, 2022 from Jan. 15th to Dec.31th at Naser, Beni-Suef Governorate, Egypt.

Table 1: Examination of the correlation and partial regression between the biweekly average count of *Prays oleae* larvae found on 25 olive twigs and the corresponding mean values of maximum and minimum temperatures, as well as the relative humidity (%R.H.) in Naser, Beni-Suef Governorate, Egypt, over two consecutive seasons in 2021 and 2022 (the study period spanned from January 15th to December 31st).

			Partial Regression Analysis			The Variance Analysis	
Seasons	The factors	R	B	SE	T	F	E.V. %
1st season	MAX. T. (X_1)	0.65	0.11	±0.18	0.58	4.86*	42.2
	MIN. T. (X_2)		-0.02	±0.17	-0.14		
	R.H.% (X_3)		-0.07	±0.05	-1.42		
2nd season	MAX. T. (X_1)	0.64	-0.02	±0.2	-0.08	4.69*	41.3
	MIN. T. (X_2)		0.08	±0.17	0.48		
	R.H.% (X_3)		-0.06	±0.05	-1.27		

* Significant at probability level 0.05
(R= correlation, B= coefficient value, SE = standard error, T= t-value, F= F- test and E.V. = percentage of explained variance)

Weather Conditions' Impact on the Prevalence of the *P. Oleae* Population: Regarding the effect of the three Climate variables, i.e., maximum and minimum temperatures and relative humidity, on the building up of P.oleae population on olive trees, The collected findings are shown in Table (1), data clearly reveal that the number of *P.oleae* larvae was substantially associated with both season's temperature and relative humidity ($P > 0.05$).

For the duration of the first year of research, a positive correlation was shown between maximum temperature and the numbers of larvae of P.oleae, whereas it was correlated negatively with minimum temperature and relative humidity. That is, for every one degree increase in maximum temperature, the mean population of *P. oleae* grew by 0.11 larvae/25 twigs, but fell by 0.02 and 0.07 larvae/25 twigs for every one degree increase in minimum temperature, or 1% for R.H.%, respectively. During the second year of research, *P. oleae* population activity was positively connected with minimum temperature but negatively correlated with the other two parameters. As a result, the mean population of *P. oleae* rose 0.02 larvae / 25 twigs for every one degree increase in minimum temperature but dropped 0.08 and 0.06 larvae/ 25 twigs for every 1°C increase in maximum temperature or 1% increase in R.H.%, respectively.

The values of explained variance recorded 42.2% and 41.3%, respectively, for the two years. The unexplained variance is thought to be caused by the effects of additional, unaccounted factors like total rainfall or wind speed, which combined with the experimental error, affect the population dynamics of *P. oleae* during the two seasons of assessment.

Field Release of *Trichogramma Evanescens* for Management *P.oleae* on Olive Trees: During the two seasons of investigation to control the olive moth, the effect of releasing *T.evanescens* on olive trees was evaluated in the field, as illustrated in Fig. 3 and 4. In this instance, after Trichogramma release, the mean number of larvae lowered from 1.32 to 0.25 and from 1.07 to 0.26 /25 twigs during the two years of investigations, respectively.

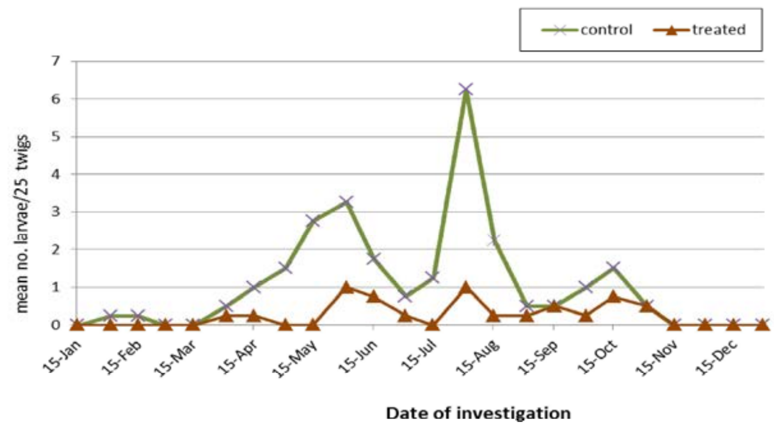

Fig. 3: Biweekly mean numbers of *Prays oleae* larvae per 25 olive twigs from control and treated areas by releasing *Trichogramma evanescens* during the 1st season, 2021 from Jan. 15th to Dec. 31th at Naser, Beni-Suef Governorate, Egypt.

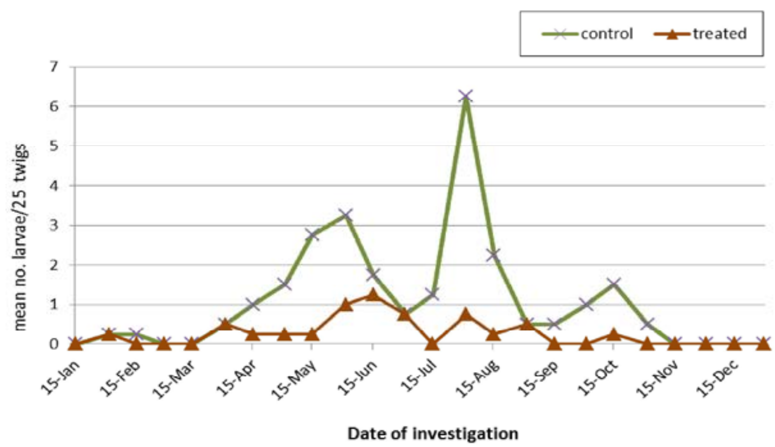

Fig. 4: Biweekly mean numbers of *Prays oleae* larvae per 25 olive twigs from control and treated areas by releasing *Trichogramma evanescens* during the 2nd season, 2022 from Jan. 15th to Dec. 31th at Naser, Beni-Suef Governorate, Egypt.

DISCUSSION

The Seasonal Population of Olive Moth, *Prays oleae*: The findings indicated the seasonal variability of *P.oleae* on olive trees in Beni-Suef Governorate across two consecutive seasons, 2021 and 2022, from 1st January to31st December. The results showed that the pest had three peaks across the two seasons. For the two seasons of research, the largest peak was reported during the summer, while the lowest peak was recorded during the autumn.

These findings were comparable to Bento *et al.* [12] who noted that the peaks of *P. oleae* in Northeastern Portuga were end of April/beginning of June; July and beginning of October/beginning of November.

Additionally, Kaplan and Alaserhat [13] discovered that In the Mardin province, the olive moth, *P. oleae*, had three yearly peaks in early May, the second week of June and early October. The pest was discovered to be present in the province of Mardin from April to November, with three generations per year.

The Effect of Maximum and Minimum Temperatures, as Well as Relative Humidity, on the Population Fluctuation of *P. Oleae*: Olive moth larval population density, *P. oleae* was significantly correlated at $P > 0.05$ with temperatures and relative humidity of the two seasons.

These results agreed with Villa *et al.* [14] who demonstrated that the weather factors (temperatures and humidity which were very important factors) had great effect on the population fluctuation of *P. oleae* larvae on olive. Low relative humidity (R.H.) and high temperatures had negative effect on larvae of this pest.

Effectiveness of *Trichogramma evanescens* in the Management of Olive Moth: During the research seasons on olive orchards in Beni-Suef Governorate, *Trichogramma evanescens* played a significant effect in reducing the population of olive moth.

Mesbah *et al.* [9] released the parasitoid *T. evanescens* in Wady El-Natroon region, Egypt, to control the olive moth, P. oleae, which gave infestation reductions of 52.48 and 53.66% in both seasons of 2016 and 2017, respectively.

CONCLUSIONS

P.oleae has three peaks annually. During the two-year study, daily and nighttime temperatures, alongside the percentage of relative humidity, had a significant impact on this pest. *T.evanescens* was successful in controlling *P.oleae* on olive.

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