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Research Article
Population Fluctuations of the Major Lepidopteran Insect Pests of Date Palm at Al-Wahat Al-Baharia Region, Egypt

[1]Ahmed Abd El-Maged, [2]Sayed-Ashraf Elarnaouty, [2]Ezz El Shazly, [1]Sherif El Sharabasy and [2,3]Samy Sayed

[1]Central Laboratory of Date Palm Research and Development, Plant Protection Research Institute, Agricultural Research Center, Giza 12311, Egypt
[2]Department of Economic, Entomology and Pesticides, Faculty of Agriculture, Cairo University, Giza 12613, Egypt
[3]Department of Science and Technology, University College-Ranyah, Taif University, Ranyah 21975, Saudi Arabia

Abstract

Background and Objective: Several insect pests infest the date palm and its fruit in the field and storage causing economic damage and affecting the tree productivity from one year to another and from one location to another due to the pest's status in the field. Therefore, this study aimed to estimate the seasonal fluctuation of the important insect pests, *Arenipses sabella*, *Batrachedra amydraula* and *Ephestia* sp. during the 3 successive years in the date palm fields at Al-Wahat Al-Bahareia region in Egypt. **Materials and Methods:** Three light traps were used to capture insects for 3 years, 2018, 2019 and 2020. The survey was done every 2 weeks for the three above-mentioned insects. Each year was divided into five periods according to the production of date palms. Also, the correlation coefficient was estimated between the population fluctuations and meteorological data. **Results:** In all three seasons, the number of all these insects increased gradually from the beginning of January till the fruiting period (end of July). Then, the numbers decreased gradually starting from August till the end of the year. The correlation coefficient for all estimated pests was more than R = 0.7 except for *Ephestia* sp. with the humidity (R = 0.6049). **Conclusion:** All studied lepidopteran insects are presented during the whole year and fluctuated with the highest peak at the fruiting period. Moreover, the increase in temperature and decrease in humidity is correlated with the high numbers of these insects. This study could help control these pests with different methods according to their estimated populations of them.

Key words: Date palm, Lepidoptera, *Arenipses sabella*, *Batrachedra amydraula*, *Ephestia* sp.

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Corresponding Author: Samy Sayed, Department of Economic, Entomology and Pesticides, Faculty of Agriculture, Cairo University, Giza 12613, Egypt

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The date palm, *Phoenix dactylifera* L. (Fam: Arecaceae) is known as one of the oldest fruit trees in Egypt and the Arab region. The major production of dates is situated in North Africa and the Arabian Gulf. The top date palm producing countries include Egypt[1]. The date palm and its fruit are infested with several insect pests in the field and storage causing economic losses. The fluctuation in the tree productivity from 1 year to another and from one location to another is due to the pest's status in the field[2].

Palm trees are infested by many insect pests. The most economic and serious insect pest for date palm is the greater date moth, *Arenipses sabella* Hampson (Lepidoptera: Pyralidae) where it attacks unripe, ripe and fallen date fruits and its high infestation rate, that might reach 55% of bunches and 100% of trees during the season[3]. It is attacking date palm during harvest and storage periods[4], inflorescences, bunch stalk, green and ripening fruits[5]. The *A. sabella* was recorded in many groves of date palm at EL-Baharia Oasis, Egypt, from March to June[6]. It attacks various date palm cultivars in many countries such as Egypt, Saudi Arabia, Iraq, Libya, Palestine, Iran and India[2].

From the significant insect pests of date palm fruits, the lesser date moth, *Batrachedra amydraula* Meyrick (Lepidoptera: Momphidae) is considered an important insect pest due to the high losses during the season that might exceed 19% of the fruits drying. It is recorded in many regions throughout the world where it damages fruits in fields and stores[7-9]. Their larvae attack and damage young fruits from April to July[10].

Ephestia cautella (Walker) (Lepidoptera: Pyralidae) is a very important insect pest in a warm climate that damages date fruits in both orchard and storage[11]. It causes considerable loss to dates held in storage with a considerable infestation rate[3]. Under ordinary storage conditions, four or five overlapping generations of *E. cautella* happened within each year[12]. *E. cautella* was recorded in different regions of Egypt such as Siwa and the New Valley regions[13].

Accordingly, this study aimed to estimate the seasonal fluctuation of the important insect pests, *A. sabella*, *B. amydraula* and *Ephestia* sp., during the three successive years within the date palm field at the important region in Egypt (Al-Wahat Al-Bahareia) which is cultivated with a large number of date palm.

MATERIALS AND METHODS

Study area: The location of the survey at Al-Wahat Al-Baharia, Giza, Egypt, which is located at 28°35'58"N, 28°87'47"E.

Field survey: Three light traps (20 W Biolab design-USA, manufactured in Egypt) were placed in three farms where the distance between every two traps was about 1 km. Each trap consisted of a plastic body and managed as Y shape, then, placed on the funnel. Neon lights were placed in a specific place in the plastic sheets. The galvanized steel cap was used as a cover on the top of the trap. These traps were used to capture male and female moths. Potassium cyanide was used as a killing agent with the rate of 5 g/killing jar/2 weeks. The collected insects were examined every two weeks in the laboratory and identified. The collection was carried out for 3 years of 2018, 2019 and 2020. Each year was divided into five periods according to the production of date palm and as follow: January and February as pre-flowering period, March and April as flowering and pollination period, May to July as fruiting period, August till October as pre-harvest and harvest period and November and December as post-harvest period. Therefore, to estimate the number of collected moths, each collection period (twice monthly) was considered as a replicate. Also, the meteorological data (temperature and humidity) were obtained every 2 weeks from weather stations at the same region of study area.

Data analysis: One-way ANOVA was conducted for numbers of moths (individuals/2 weeks) (%). Means were compared by Duncan's test ($p = 0.05$). To correlate the number of moths and both temperature and relative humidity (%), a linear regression equation was used. All data analysis was done using SPSS program version 23.

RESULTS AND DISCUSSION

The data of the presence of the three major lepidopteran insect pests, *A. sabella*, *B. amydraula* and *Ephestia* sp., were presented in Table 1 (season 2018), Table 2 (season 2019) and Table 3 (season 2020). In season 2018, the number of all these insects increased gradually from the beginning of January till the fruiting period (end of July). Then, the numbers decreased gradually starting from August till the end of the year. One-way ANOVA indicated that there are significant differences ($p<0.001$) for the three collected species during the five periods of the survey. The maximum numbers were obtained at the fruiting period (11.33 for *A. sabella* and 10 for *B. amydraula* and 10.78 individuals/trap/2 weeks for *Ephestia* sp.) while the lowest numbers were obtained at the beginning (1.85 for *A. sabella* and 1.08 for *B. amydraula* and 0.08 individuals/trap/2 weeks for and *Ephestia* sp.) and also at the end of the year (2.06 for *A. Sabella* and 2.93 for *B. amydraula* and 4.67 individuals/trap/2 weeks for and *Ephestia* sp.). In seasons of 2019 and 2020, the same trends

Table 1: Population fluctuations of the major lepidopteran insect pests during the annual periods of date palm in 2018

	Insect pests		
Periods	*Arenipses sabella*	*Batrachedra amydraula*	*Ephestia* sp.
Pre-flowering	1.58±0.83^{c}	1.08±0.57^{c}	0.08±0.08^{d}
Flowering and pollination	9.60±0.56^{ab}	9.07±0.92^{ab}	6.33±1.04^{c}
Fruiting	11.33±0.58^{a}	10.0±0.54^{a}	10.87±0.60^{a}
Pre-harvest and harvest	9.06±0.49^{b}	7.78±0.57^{b}	8.39±0.47^{b}
Post-harvest	2.06±0.70^{c}	2.93±0.63^{c}	4.67±0.66^{c}
df	4.67	4.67	4.67
F	47.614	32.238	34.056
P	<0.001	<0.001	<0.001

All data are expressed as Mean±SE. The values carrying different superscript letters in the same column are significantly different at p<0.05

Table 2: Population fluctuations of the major lepidopteran insect pests during the annual periods of date palm in 2019

	Insect pests		
Periods	*Arenipses sabella*	*Batrachedra amydraula*	*Ephestia* sp.
Pre-flowering	2.00±0.94^{c}	1.42±0.69^{d}	0.17±0.17^{d}
Flowering and pollination	10.47±0.55^{ab}	10.07±0.69^{ab}	7.31±1.04^{c}
fruiting	11.60±0.55^{a}	11.00±0.54^{a}	11.87±0.60^{a}
Pre-harvest and harvest	9.44±0.43^{b}	8.78±0.57^{b}	9.44±0.47^{b}
Post-harvest	2.80±0.71^{c}	3.93±0.63^{c}	5.53±0.70^{c}
df	4.67	4.67	4.67
F	49.388	34.168	38.631
P	<0.001	<0.001	<0.001

All data are expressed as Mean±SE. The values carrying different superscript letters in the same column are significantly different at p<0.05

Table 3: Population fluctuations of the major lepidopteran insect pests during the annual periods of date palm in 2020

	Insect pests		
Periods	*Arenipses sabella*	*Batrachedra amydraula*	*Ephestia* sp.
Pre-flowering	2.42±1.06^{b}	1.92±0.79^{d}	0.42±0.26^{d}
Flowering and pollination	11.13±0.51^{a}	11.00±0.93^{ab}	8.33±1.04^{c}
fruiting	11.53±0.56^{a}	12.00±0.54^{a}	12.87±0.60^{a}
Pre-harvest and harvest	9.72±0.42^{a}	9.83±0.59^{b}	10.44±0.47^{b}
Post-harvest	3.20±0.68^{b}	5.07±0.68^{c}	6.47±0.69^{c}
df	4.67	4.67	4.67
F	46.514	33.214	43.515
P	<0.001	<0.001	<0.001

All data are expressed as Mean±SE. The values carrying different superscript letters in the same column are significantly different at p<0.05

were occurred as in 2018 for all collected species. This study revealed that the highest peak of the population of all estimated moth species was in July. In this regard, In Egypt, from April until the harvest time, *A. sabella* caused infestation rates on various varieties of the date palm with a range of 61-96% during two successive seasons[14] of 2015 and 2016. Another investigation on *B. amydraula* was shown on the date palm tree during the observational period and its peak level was observed at the end of July, 2014 while it declined sharply in the following weeks to reach the lowest level at the beginning of August, 2014[15]. The population of *B. amydraula* in 2014 started at the beginning of March and ended in mid-September while in 2015, however, the population started again in March but ended in mid-November[16]. In contrast, in UAE, the highest trap catches for *B. amydraula* were observed on April[1]. These differences in populations in different regions may be due to the difference in the temperature of locations throughout the world. According to *A. sabella*, infestations of the date palm with this pest were observed from February to August particularly during April, 1999-2014[17]. Current observations stated that *Ephestia* moths were found in very low numbers in the field during the pre-flowering period. These results may be because this pest is considered as a main stored date pest in Egypt and the surrounding countries[18].

The combined data for the three successive years was used to evaluate the correlation coefficient between the number of each moth species and both temperature degrees and humidity (%). The obtained results of the statistical analysis indicated that the correlation coefficient between the number of *A. sabella* and both temperature degrees and humidity (%) were R = 0.8013 and R = 0.7548, respectively in

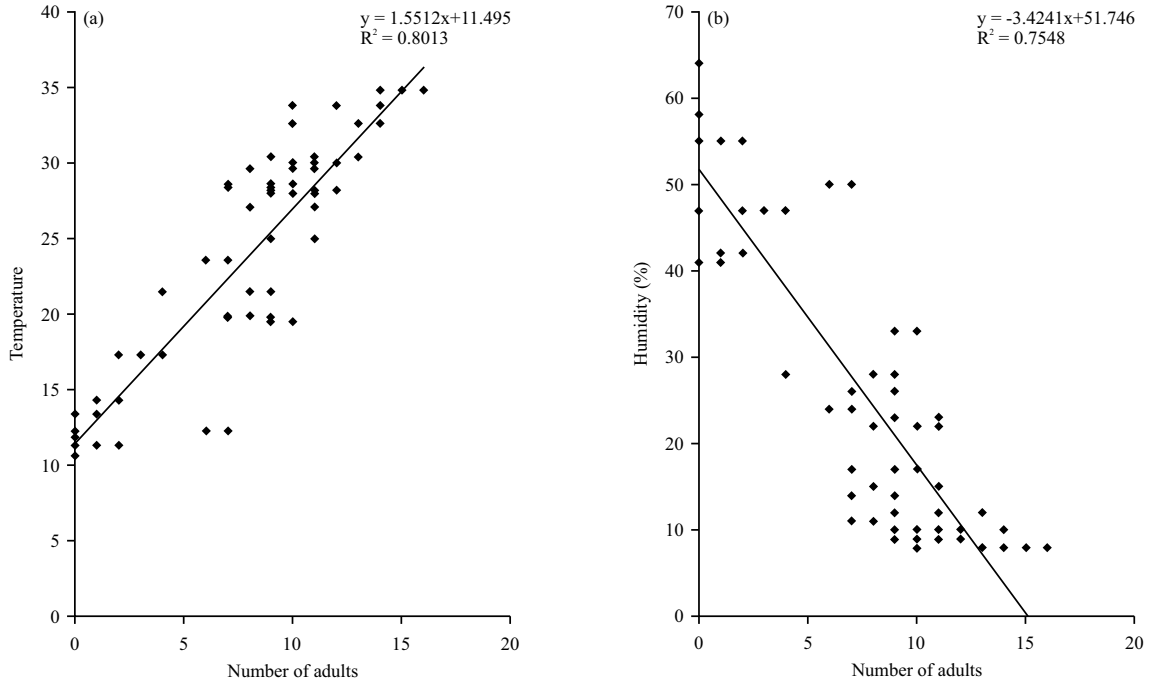

Fig. 1(a-b): Correlation coefficient between weather conditions and *Arenipses sabella* population during the three successive years (2018-2020), (a) Temperature and (b) Humidity

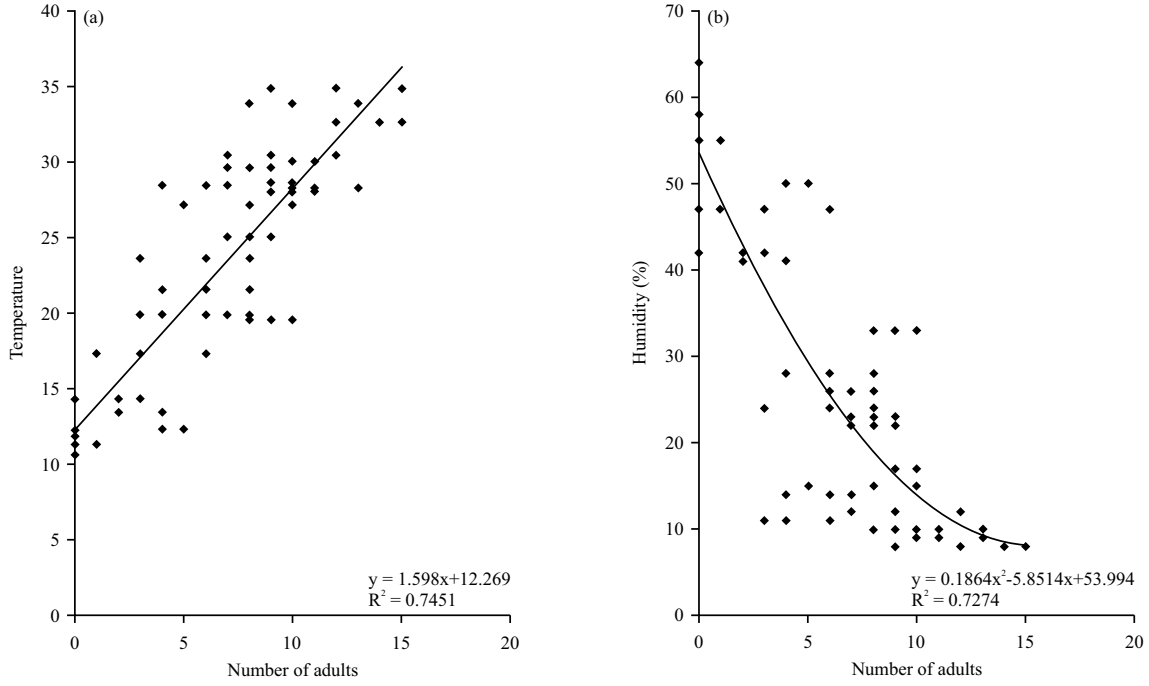

Fig. 2(a-b): Correlation coefficient between weather conditions and *Batrachedra amydraula* population during the three successive years (2018-2020), (a) Temperature and (b) Humidity

Fig. 1a and b. Meanwhile, the correlation coefficient between the number of *B. amydraula* and both temperature degrees and humidity (%) were R = 0.7451 and R = 0.7251, respectively in Fig. 2a and b. Also, the correlation coefficient between the number of *Ephestia* sp. and both of temperature degrees and humidity (%) were R = 0.7326 and R = 0.6049, respectively in Fig. 3a and b. The correlation coefficient for all estimated pests were more than 0.7 except for *Ephestia* sp., with the humidity.

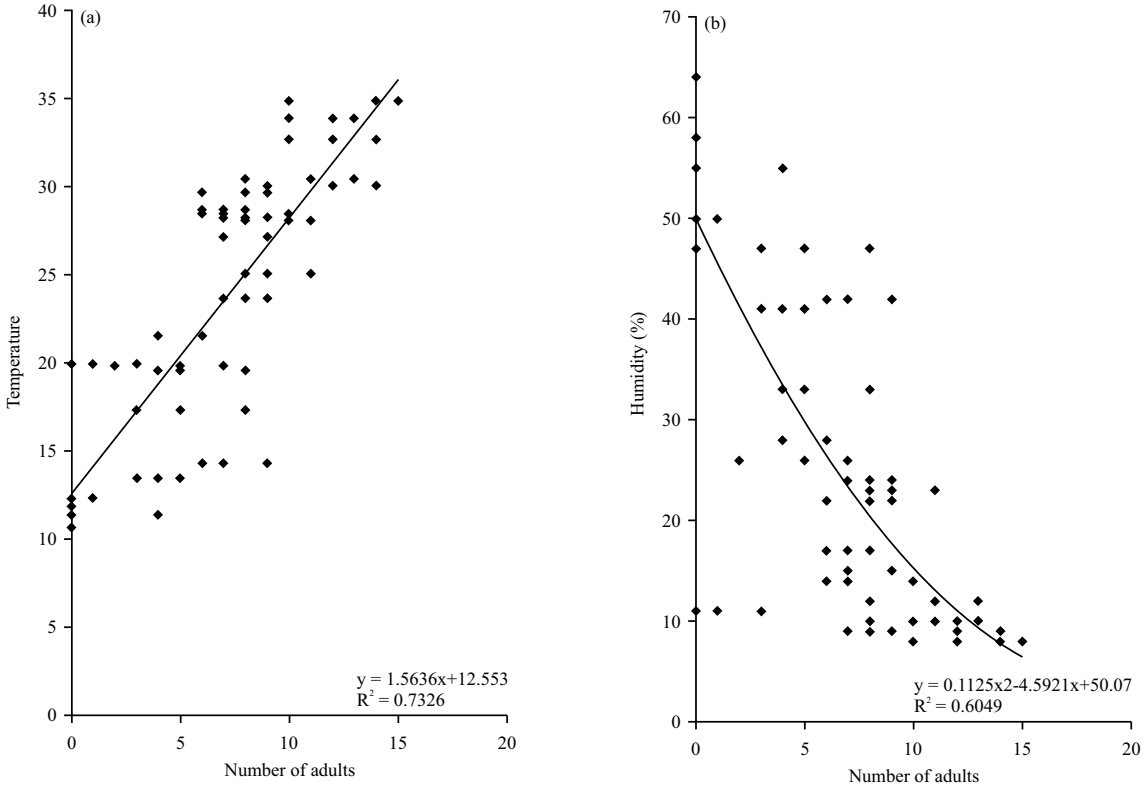

Fig. 3(a-b): Correlation coefficient between weather conditions and *Ephestia* sp. population during the three successive years (2018-2020), (a) Temperature and (b) Humidity

In this regard, the males of *Ephestia cautella* are more susceptible to low humidity (%) than those females and investigations on the use of humidity to control other insect pests of stored products, across a wide range of biogeography's are recommended[19]. For the other two pests, there was a clear correlation with humidity and temperature. This result coincided with the previous result where the percentages of the infested date palm with *B. amydraula* were ranged from 42.1-73.2% when the temperature with a range of 25-40°C and humidity was 34%. Meanwhile, with the temperature ranging from 17-34°C and humidity was 45%, the percentages of infested date palms were ranged from[20] 1.7-5.7%. In contrast, the scatter plot shows a strong negative correlation (r = -0.61695) between the adult numbers of *B. amydraula* captured in pheromone sticky traps in a date palm farm and the average daily temperature (°C) at Al-Ain, UAE in 2014 and 2015[21].

CONCLUSION

All three studied lepidopteran insects are presented during the whole year and fluctuated with the highest peak at the fruiting period. Moreover, the increase in temperature and decrease in humidity is correlated with the high numbers of these insects.

SIGNIFICANCE STATEMENTS

This study could help control these pests with different methods according to their estimated populations of them. Also, temperature and relative humidity during storage may offer good protection for dates.

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