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STUDIES ON THE POPULATION FLUCTUATIONS OF THE PEACH FRUIT FLY, *Bactrocera zonata* IN MANGO AND CITRUS ORCHARDS AND ITS FIELD CONTROL IN SHARKIA GOVERNORATE, EGYPT

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ABSTRACT

The peach fruit fly (PFF), Bactrocera zonata (Saunders), is one of the most destructive pest species in the world. The objective of this study is to manage the pest in the field while elucidating the frequency and abundance of flies on mango and citrus orchards utilizing Jackson sticky traps during 2021/2022 and 2022/2023 seasons in relation to the prevailing weather parameters. The results revealed that population increase of peach fruit fly starts from April onwards and the maximum population is recorded during May-October with a major peak in August.

The highest activity rate of peach fly was recording during 2021/2022 season than 2022/2023 season for both citrus and mango orchards. The highest population was recorded on the mango orchard reached (376 and 360 insects) in August 2021/2022 and 2022/2023 seasons, respectively. In the citrus orchard, the highest fly activity rate was recorded (242 and 235 insects) during the November, 2021/2022 and October, 2022/2023 seasons, respectively. Data showed that, Spinosad plus alpha-1 was recorded the higher reduction in the mean numbers of captured flies through three weeks of treatment. In the first farm, (Al-Saada Island), the percent reduction in the mean numbers of captured flies treated with spinosad plus alpha-1, alpha-1, indoxacarb plus alpha-1 plus clorfenapyr and spinosad was recorded 82.46, 79.62, 70.14 and 69.43%, respectively. While the second farm (Al-Qurain) were 83.28, 74.92, 67.80 and 60.37%, respectively.

Conclusively, *Bactrocera zonata* (Saunders), often known as the peach fruit fly (PFF), is a highly destructive insect found worldwide, particularly of fruit. We advise that control operations start in April and continue until the fruits are fully ripe, taking into account the recommended safety periods. *Due*

to the insect's great ability to develop resistance to insecticides we recommend that, not using insecticides alone more than once and using them in mixtures.
Keyword: *Bactrocera zonata*, Seasonal population fluctuations, Jackson traps, chemical control

INTRODUCTION

The peach fruit fly, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae), is one of the most serious polyphagous of fruit orchards in the world. it attacks a wide range of fruit species with over 50 host plants, including peach, guava, mango, apricot, fig, citrus and some vegetables as a secondary pest **(Fletcher, 1987; Pena *et al*., 1998; Khan and Naveed, 2017 and Saeed *et al*., 2022)**. Females of peach fruit flies lay their eggs in the fruits while the maggots devour the pulp. Also, it is considered as one of the most destructive fruit pests in temperate, tropical and subtropical countries due to the losses caused by fruit larvae as they feed and live in the fruits of host plants (**Joomaya and Price 2000, Hashem *et al*. 2001; Sharma *et al*., 2017 and Khan *et al*., 2023)** Fruit fly control has been a major challenge for farmers, because they are unable to control fruit flies' defense mechanisms (**Nadeem *et al*., 2014**).

Monitoring pest population round the year is one of the most important basic information in formulating integrated pest management IPM concept for sustainable agriculture. In 1999, the first traps were set up and showed high capture rates in Egypt (**El-Minshawy *et al*., 1999**). In October 2000, *B. zonata* was detected in North Sinai and different localities in Egypt such as Kalubia Governorate (**Hashem *et al*., 2001**) and El-Behera (**Draz *et al*., 2002**). The peach fruit fly, can be monitored by different kinds of traps (Jackson or Steiner traps, though Jackson traps are preferable) baited with the male lure methyl eugenol (O-methyl eugenol), which attracts male flies at very low concentrations (**Qureshi *et al*., 1993**). The seasonal fluctuation of peach fruit flies is one of the main factors that can help greatly on determining the correct time for control operations (**Laskar and Chatterjee 2010 and Abdelgaleil *et al*., 2019**).

In order to reduce the fruit fly populations to low levels, chemical control using malathion bait sprays has been considered as the most common method used worldwide (**Romoser and Ferro, 1994 and Rosseler *et al*., 2000**). Bait spray technique depends on the use of a mixture of protein bait plus an insecticide, which is applied as a spot at an approximate rate of about 40-50 ml /per tree. This technique reduces markedly the amount of insecticide sprayed into the environment, as compared to cover spray application (**Prokopy *et al*., 2003**). *B. zonata* has previously been found to be resistant to a variety of organophosphate

and pyrethroid pesticides in several regions of Pakistan's Punjab province (**Nadeem *et al*., 2014 and Khan and Akram, 2018**).

Therefore, this study aims to clarify the occurrence and abundant of peach fruit flies on mango and citrus trees by using Jackson sticky traps in relation to the prevailing weather factors through the two years 2021-2023 of the study, in addition to control the pest under field conditions.

MATERIALS AND METHODS

1. Seasonal population fluctuations

1. Field study site

The field experiments were carried out on mango (*Mangifera indica*) and citrus (*Citrus* spp.) orchards at Belbies region, Sharkia Governorate, Egypt from May 2021/2022 until May 2022/2023. The area of orchard was 12 feddans devided to 7 feddans /mango and 5 feddans /citrus (1 feddan = 4,200 m^2).

1.2. Jackson traps

Position and distribution for capture population fluctuation of peach fruit fly adult were monitored by using sex pheromone (Methyl eugenol at 98% concentration) to attract adult males. Jackson traps are baited with capsules of attractant males. Methyl eugenol was obtained from Agriculture Directorate, Zagazig, Egypt. Pheromone capsule of each trap was exchanged every 14 days at the summer season and every 1-1.5 month during the winter season. Jackson traps were distributed in area of 12 feddan, 2:1 trap in the mango orchard and one trap in the citrus orchard, respectively. The traps were placed on the farm at a height 1.5 m (**El-Gendy, 2012**).

1.3. Seasonal fluctuation studies

Seasonal fluctuations of adult peach fruit flies were studied by recording the average numbers of adult males captured from Jackson's traps weekly. On the other hand, weekly means of climatic factors [Average air temperature (°C) and Average relative humidity (RH %)], calculated 7 days earlier from corresponding sampling dates, were obtained from Central Laboratory for Agricultural Climate (CLAC), Doki, Giza. The weekly average of male peach fruit flies captured with pheromone traps was calculated to reveal their abundance and rearing periods throughout the year during the four seasons of the year (winter - spring - summer - autumn). The relationships between climatic factors and population densities were studied. Simple correlation and partial regression were analyzed using COSTAT (2008) statistical software computer program.

2. Chemical control of peach fruit fly under field conditions

2.1. Field control site and insecticides used

This experiment was carried out in mango orchards on two farms of the orchards, both farms located at Al-Saada Island (next to the city of Zagazig) and Al-Qurain, Sharqia Governorate, Egypt. Each farm had an area of 20 feddans. Five feddans were used for the four treatments plus control, so that each feddan had four replicates (29 tree /replicate). The main mango varieties were (Alphonse, Zebda, Ewais, and kate) and the varieties of citrus were (Navel orange and Valencia orange). Readings were recorded weekly for 3 weeks in all treatments and control. Spinosad and alpha-1 (Alpha-cypermethrin 7% + acetamiprid 3%) were tested at half the recommended dose, 480 and 437.5 mg/L, respectively. Also, spinosad plus alpha- 1 were tested at quarter the recommended dose. Furthermore, a mixture of both indoxacarb, alpha-1 at quarter the recommended dose and clorfenapyr at the recommended dose (144mg/L).

2.2. Bait application technique (BAT)

The current investigation used the partial spray application utilizing bait application technique (BAT) to reduce *B. zonata* population using a combination of pesticides once in the field. Based on the toxicity experiments conducted on the peach fly in the laboratory using pesticides and mixtures, the best toxicity results were applied in the field. The pesticide or combination was mixed with water (the carrier) plus hydrolysed protein (food attractant), to create BAT solutions at the ratio of (0.5:18.5:1). Compared to full cover sprays, this technique is less harmful to non-target insects and the environment. Moreover, it produces very little chemical residue and very little drift. In orchards, a knapsack sprayer is used to partially spray the solution at a rate of 40 milliliters over the trunk of the tree containing leaves.

2.3 Monitor the insect population

Jackson sticky traps were employed to assess the percent reduction of fly population (**Harris *et al*., 1971**). One trap per five feddans was hung on fruit trees, and the traps were 1.5 meters above the branches. The bait for the traps was strips of cotton soaked in methyl eugenol. Weekly counts were conducted on captured male flies for three weeks.

2.4.*Statistical analysis*

The obtained data were statistically analyzed through COSTAT (2008). When F-test was significant, means were separated using Tukey's HSD Test at the 0.05 level of significance.

RESULTS AND DISCUSSION

1. Seasonal population fluctuation of peach fruit fly infesting mango and citrus orchards

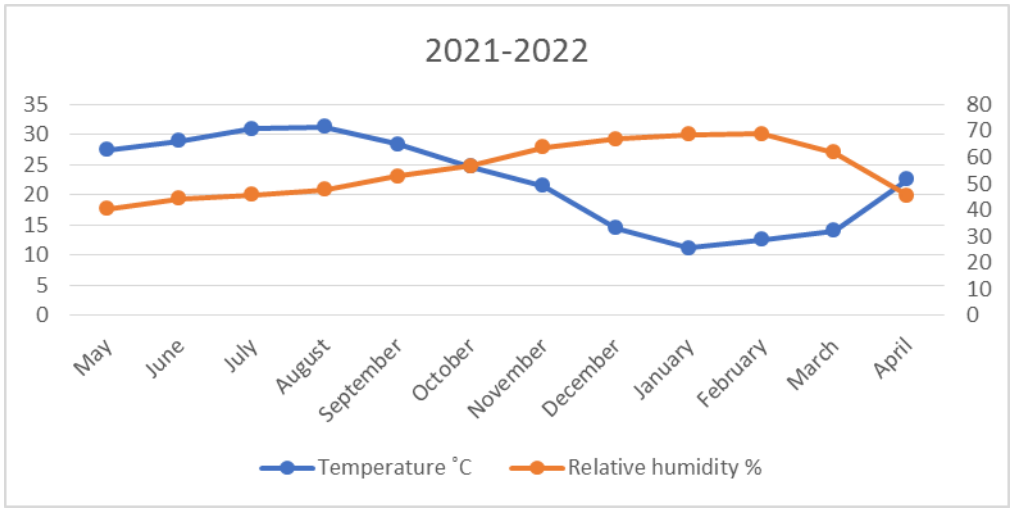
Seasonal population fluctuation of peach fruit fly in mango and citrus orchards during two growing 2021/2022 & 2022/2023 seasons at Belbies region, Sharkia Governorate, Egypt were recorded. The collected insects were recorded monthly in **Tables (1-2)** beside the meteorological data obtained during the period of study. **Figures (1-2)** illustrate the relation between the monthly mean number of attracted flies /trap, and the prevailing monthly means of temperature °C and R.H. % in two successive seasons. This study showed that peach fly populations were found overall the year, except for short periods during the cold winter season. Perhaps the reason for this is the low temperature, which is considered unsuitable for laying eggs or the growth of immature stages, thus prolonging the periods of the immature stage and reducing the number of adults. In the same way, the hot summer and reach extreme temperatures, which are not suitable for insect activity, so the death rate of flies increases and the population decreases (**Tables 1-2** & **Figures 1-2**).

In the mango crop during the 2021/2022 season, the population of peach fly/trap began to increase during May, recording 134±5.26 insects. The months progressed, the population increased reaching its maximum during August, recording 376±9.47 insects. Then, the population decreased during September and October and reaching its lowest limits during the month of February recorded 14±3.79 insects and then the population increased again (**Table 1 and Figure 1**). In another way, in the citrus crop during the 2021/2022 growing season, the peach fly/trap population began to increase during August, recording 154±5.85 insects, as the increase continued as the months progressed until the population reached its maximum during November, recording 242±4.93 insects, then it decreased after that and reached the lowest limits during the month of March recorded 36±3.65 insects and then increased again (**Table 1 and Figure 1**). A temperature of 31.29°C and a relative humidity of 47.8% were recorded at the highest fly activity rate during the month of August on the mango crop (376 ± 9.47 insects), while a temperature of 21.48°C and a humidity of 63.66% were recorded at the highest fly activity rate during the month of November (242 ± 4.93 insects) on the citrus crop during the 2021/2022 growing season (**Table 1 and Figure 1**).

Table (1): Mean numbers of monthly attracted *B. zonata* flies using Jackson traps baited with methyl-eugenol suspended in Sharkia Governorate during, 2021/2022.

Date of inspection (Months)		Mean of attracted flies/trap/month (Mean ± S.D)		Mean of Temperature ˚C	Mean of R.H.%
		Mango	Citrus		
1	May 2021	134 ±5.26 ^{d}	132±5.73^{de}	27.46	40.35
2	June 2021	161 ±6.99 ^{c}	89 ±2.5^{ef}	28.96	44.23
3	July 2021	٢٧٩ ±5.73 ^{a}	95 ±2.22^{ef}	30.99	45.8
4	August 2021	٣٧٦ ±9.47 ^{a}	154 ±5.85^{d}	31.29	47.8
5	September 2021	298 ±6.45 ^{a}	192 ±3.56 ^{b}	28.43	52.7
6	October 2021	235 ±5.31 ^{b}	229 ±6.75^{a}	24.66	56.71
7	November 2021	124 ±4.82 ^{d}	242 ±4.93^{b}	21.48	63.66
8	December 2021	٤٧ ±4.03 ^{e}	150 ±1.73 ^{c}	14.45	66.79
9	January 2022	33 ±3.59 ^{ef}	79 ±7.89^{f}	11.14	68.59
10	February 2022	14 ±3.79^{f}	47 ±2.75 ^{g}	12.6	68.94
11	March 2022	36 ±3.05 ^{ef}	24 ±3.65 ^{g}	14.05	61.81
12	April 2022	57±4.03 ^{e}	86 ±4.65^{ef}	22.6	45.53

The same letter (s) on top of averages indicates that the difference among them was not statistically significant, while different letters indicate significantly different values (Tukey's honestly significant difference test at $P \leq 0.05$, $n = 3$).



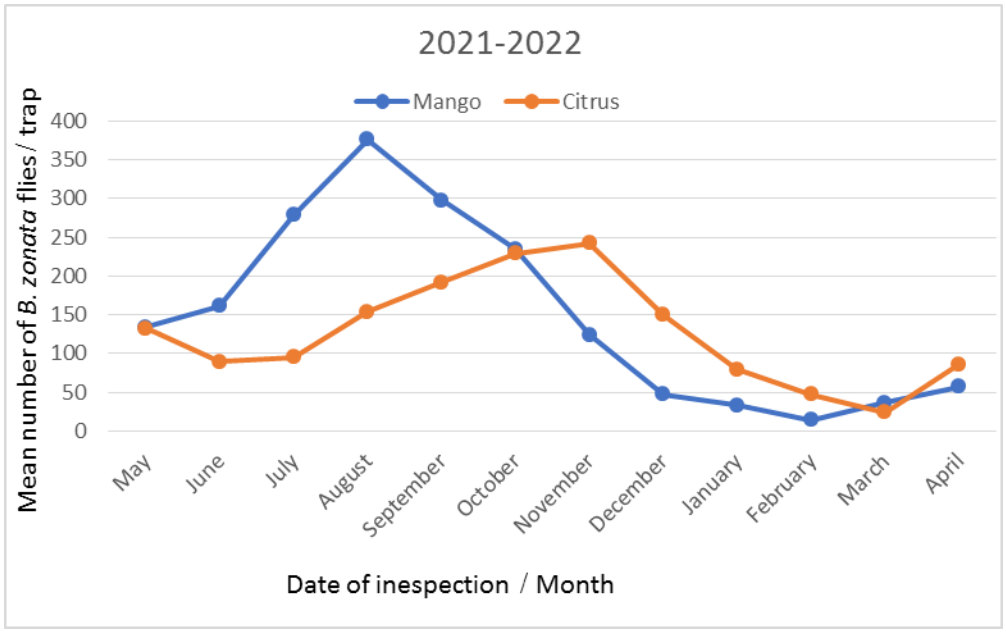
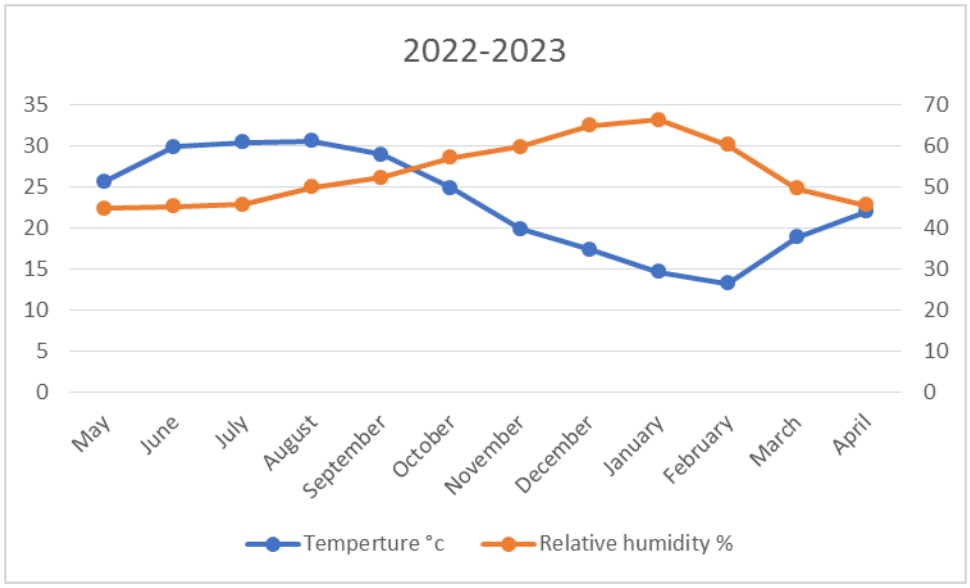


Fig. (1): Mean numbers of Monthly attracted *B. zonata* flies using Jackson traps baited with methyl-eugenol suspended on (mango – citrus) orchards in Sharkia Governorate during, 2021/2022.

Table (2): Mean numbers of monthly attracted *B. zonata* flies using Jackson traps baited with methyl-eugenol suspended in Sharkia Governorate during, 2022/2023.

Date of inspection (Months)		Mean of attracted flies/trap/month (Mean ± S.D)		Mean of temperature ˚C	Mean of R.H.%
		Mango	Citrus		
1	May 2022	151 ±3.70^{e}	148 ±4.28^{de}	25.63	44.74
2	June 2022	179 ±7.72^{d}	105 ±2.22^{ef}	29.84	45.16
3	July 2022	312 ±5.09^{a}	95 ±2.5^{fg}	30.38	45.64
4	August 2022	360 ±7.31^{ab}	165 ±2.92^{d}	30.57	49.86
5	September 2022	263 ±5.74^{b}	208 ±4.43^{b}	28.9	52.13
6	October 2022	230 ±9.81^{c}	235 ±4.35^{a}	24.83	57.1
7	November 2022	148 ±5.59^{e}	217 ±4.62^{c}	19.87	59.63
8	December 2022	65 ±3.77^{f}	170 ±5.57^{c}	17.33	64.92
9	January 2023	47 ±2.22f^{g}	90 ±5.07^{fg}	14.61	66.21
10	February 2023	19 ±2.98^{g}	59 ±3.3^{h}	13.21	60.12
11	March 2023	43 ±2.30^{g}	96 ±2.77^{gh}	18.79	49.56
12	April 2023	69 ±4.65^{f}	120 ±6.27^{c}	21.99	45.44

The same letter on top of averages indicates that the difference among them was not statistically significant, while different letters indicate significantly different values (Tukey's honestly significant difference test at $P \leq 0.05$, $n = 3$).



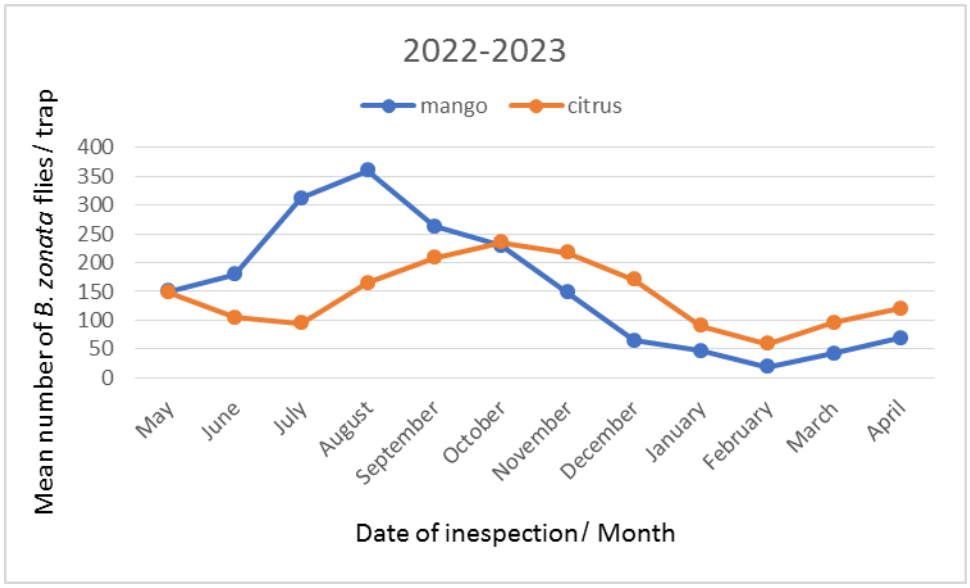


Fig. (2): Mean number of Monthly attracted *B. zonata* flies/trap by using Jackson traps baited with methyl-eugenol suspended on (Mango – Citrus) orchards in Sharkia Governorate during, 2022/2023.

In the mango orchards during the 2022/2023 season, the peach fly/trap population began to increase during May, recording 151±3.70 insects. The increase continued as the months progressed until the population reached its maximum during August, recording 360±7.31insects. Then, the population decreased during the months of December and January and reaching its lowest limits during February recorded 19 ±2.98 insects, and then increased again (**Table 2 and Figure 2**). In the citrus orchards during the 2022/2023 season, the peach fly/trap population began to increase during June, recording 179±7.72 insects, as the increase continued as the months progressed until the population reached its maximum during August, recording 360±7.3 insects then, it decreased after that and reached the lowest limits during February recorded 19±2.98 insects and then increased again (**Table 2 and Figure 2**). A temperature of 30.57 ˚C and a humidity of 49.86% were recorded at the highest fly activity rate during August on the mango orchards (360 ±7.31 insects), while a temperature of 24.83 ˚C and a humidity of 57.1% were recorded at the highest fly activity rate during the month of October (235 ±4.35 insects) on the citrus crop during the 2022/2023 season (**Table 2 and Figure 2**).

The highest activity rate of peach fly during the 2021/2022 season was higher than that during the 2022/2023 growing season for both citrus and mango crops. The highest fly activity rate was recorded during August on the mango orchard (376 ± 9.47 insects) during 2021/2022 season, while the highest fly activity rate was recorded during August on the mango orchards (360 ± 7.31 insects) during 2022/2023 season. In the citrus orchard, the highest fly activity rate was recorded during November (242 ± 4.93 insects) during 2021/2022 season while, the highest rate was recorded during October (235 ± 4.35 insects) during 2022/2023 season (**Table 1-2 and Figure 1-2**). The population activity of PFF along tested periods was in discrepancy, not only from year to year, but also from a host to another. Abiotic factors (temperature and RH) play a role in population activity, where there was a relationship between population density of peach fruit fly and abiotic factors and this contributes to the drawing of a future plan control this insect-pest based on a calendar date associated degrees-day, leading to reduce the risk of pesticides and success of management.

2. Monitoring of peach fruit fly*:*

The data in **Figures (1-2)** revealed that the appearance of peach fruit fly, *B. zonata* in the field was relatively appearance through none out-break and decline phases of population growth of peach fruit fly. The actual appearance of peach fruit fly on mango was occurred in the building and out-break phases of PFF through the fruiting maturity from June to October, while, the actual

appearance on citrus was occurred in the same phases through August to December and from March to May.

3. Effect of weather factors on trap catches of peach fruit fly

Data in **Table (3)** demonstrated that the population density of peach fruit fly was directly proportional to mean temperature, while it was inversely proportional to relative humidity, and this was in corresponding with statistical analysis on each of mango (r = 0. 86***, & 0.89***) and (r= -0.55 ns, & -0.43 ns) for T ˚C and RH% during 2021 and 2022 seasons, respectively, while in Citrus orchards, it was (r = 0. 0.35*, & 0.31*) and (r= -0.006ns & 0.197 ns) for T ˚C and RH% during 2021 and 2022 seasons, respectively. Multiple regressions between trapped peach fruit fly and both of mean temperature and relative humidity explained that 88 and 90 % of total variance in population density of peach fruit fly in mango orchard was related to these tested factors, while it was 84 and 89 % of total variance in the population density in Citrus orchard through 2021 and 2022 seasons, respectively.

The highest fruit fly population was recorded in August and the lowest was in February. The population increase of peach fruit fly starts from April onwards and the maximum population is recorded during May-October with a major peak in August (**Tables 1-2**). The population declines slowly from November to December after which it is a few existent up to March (**Figs.1-2**). In December-March a few fruits fly was captured in the trap. This is because of low temperature and relative humidity and no alternative host available in the surroundings (**Khan *et al*., 2017**). Temperature plays a dominant role in the rate of development of immature stages of *B. zonata* and consequently determines the timing of population increase (**Fletcher, 1989; Sharma *et al*., 2015; Khan *et al*., 2021; and Rasool *et al*., 2023**).

These results are consistent with previous research where **(Ali *et al*., 2011)** reported that during warm of (May- August), the flies (*B. zonata*) were more active in as compared to that of cold weather period (December, January and February) months, In Egypt. Also, **(Draz *et al*., 2016)** reported that the fruit fly, *B. zonata* was very active in warm months (June-August) and it causes severe damage to a wide range of fruits such as guava, peach, mango, and apricot in kafr El.shikh Governorate, Egypt. Furthermore, **(Sarwar *et al*., 2014)** observed that population increase of peach fruit fly starts from April onwards and the maximum population is recorded, during June-August with a major peak in July. According to research conducted by (**Rasool *et al*., 2023**), the fruit flies *B. zonata* and *B. dorsalis* showed a greatest decrease in population intensity between August and February, followed by an increase in

population between March and July. June saw the peak number of adult flies emerge, depending on the host fruit's development and the weather. From the Co-efficient of correlation (r) value it was clearly observed that fruit fly population mostly varies with temperature, relative humidity and host availability. The present results mentioned that all abiotic factors studied (temperature and relative humidity) can clearly contribute significantly toward increasing or decreasing fruit flies trapped with the help of sex attractant. The population of the fruit fly, *B. zonata* was positively correlated with the temperature (**Draz *et al*., 2002; Rajitha and Shashidhar, 2006; Nripendra and Hirak, 2010; El-Gendy and Nassar, 2014; and Khan and Naveed, 2017**), whereas relative humidity (R.H.) and rainfall were found to have a negative correlation with *B. zonata* abundance (**Khan and Naveed, 2017; Khan *et al*., 2021; Khuhro, 2021; and Kausar *et al*., 2022**). According to **(Sood *et al*., 2023)** stated that, temperature showed positive correlation with trap catches.

The present results demonstrated clearly the seasonal fluctuation of peach fruit fly in this area of Egypt, where, the Adult of peach fruit fly was active through both of 2021 and 2022 seasons in Mango and Citrus orchards, especially during building and out-breaks phases of population growth of peach fruit fly through fruiting period. peach fruit fly reached to high levels in autumn with harvest period, where the highest peak occurred in August and November on mango and citrus orchards, respectively. These results are in agreement with **(Noman *et al*., 2021 and Murtaza *et al*., 2021)**, they indicated a positive and significant correlation between the species of fruit flies and mean temperature in mango and citrus orchards at all locations. It's visible that the kind of host plant effects on population level of peach fruit fly, where the population density of PFF on Citrus was less than recorded on Mango orchards, these results are in harmony with (**Draz *et al*., 2002**) who reported that the number of captured male flies of peach fruit fly on citrus was fewer than that on mango trees.

The present results revealed clearly that population density of peach fruit fly in the first season were less than in the second ones, also its appearance in the field. We suggest that the discrepancy is due to unstable of effective factors, and it may be attribute to two main effective factors on peach fruit fly activity, temperature and host fruits. Where, the population activity of peach fruit fly was related with both of mean temperatures and relative humidity, where the developmental insect is temperature dependent. On the other hand, the results of statistical analysis revealed a significant positive correlation between trapped males and mean temperature. The statistical analysis revealed a negative correlation between trapped males and relative humidity, and this result is in agreement with (**Ghanim,**

2009) on *B. zonata* in the second season of his study and (**Ravi, 2005**) on both *B. zonata* and *B.dorsalis*. Its evidence clearly depending on weather conditions, the population dynamic of peach fruit fly may vary from year to year, so from host to another. These results are in agreement with (**Ghanim, 2009**) and (**Papadopoulos *et al*., 2001**).

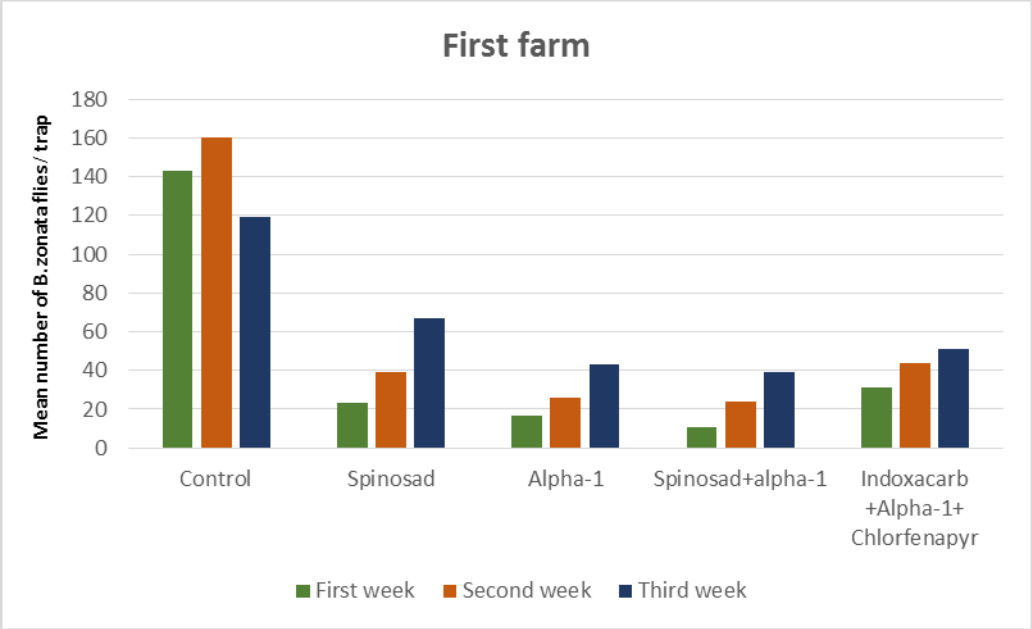
Also, the present results mentioned that abiotc factors studied (temperature and relative humidity) can clearly contribute significantly toward increasing or decreasing fruit flies trapped with the help of sex attractant. The previous results are agreeable with that obtained in our study which indicated a positive and significant correlation between the fly populations and both maximum and minimum temperatures, however, negative and insignificant correlation is shown with the relative humidity. Our results were found to be in remarkable variation to that reported by (**Sanjeev *et al*., 2008**) the population of fruit flies, *B. zonata* and *B. dorsalis* in Jammu and Kashmir in India showed a positive correlation between fruit fly and some abiotic factors (humidity and rain). Also, (**Hasyim *et al*. 2008**) recorded the number of flies captured with cue- lure baited traps correlated positively with humidity and rainfall. Finally, it is necessary to have basic information on the incidence of the pest in relation to weather parameters which help in determining appropriate time of action and suitable method for control.

4- Chemical control of peach fruit fly under field conditions

Data in **Table (4)** and **Fig. (3)** cleared the mean captured numbers of flies/trap of *B. zonata* /weeks for three weeks using Jackson sticky traps with methyl eugenol in the two farms at Sharkia governorate, Egypt. In the two farms, the mean numbers of captured flies through three weeks showed major reduction in all four treatments compared with control and the mean numbers of captured flies were increasing over time.

In the first farm (Al-Saada Island) Spinosad plus Alpha-1, Alpha-1, Indoxacarb plus Alpha-1 plus clorfenapyr and spinosad decreased the mean numbers of captured flies through three weeks to 74, 86, 126 and 129 insects, respectively compared with 422 in control. The percent reduction in the mean numbers of captured flies recorded 82.46, 79.62, 70.14 and 69.43 insects, respectively. In the second farm, Al-Qurain, spinosad plus Alpha-1, Alpha-1, spinosad and indoxacarb plus Alpha-1plus clorfenapyr decreased the mean numbers of captured flies through three weeks to 54, 81, 104 and 128 respectively compared with 323 in control. The percent reduction in the mean numbers of captured flies recorded 83.28, 74.92, 67.80 and 60.37, respectively. Data showed that Spinosad plus Alpha-1 recorded the higher reduction in the mean numbers of captured flies through three weeks of treatment, this may be due to

the mature produced a potentiation effect. Therefore, mixing pesticides reduces the possibility of resistance occurring, increases the toxic effect, and reduces the recommended doses for control, which reduces environmental pollution. It is noted that although spinosad is recommended in control the peach fly, it did not achieve sufficient effectiveness during the field experiment, as it ranked third and fourth in both farms, which indicates that the insect has acquired resistance to spinosad. In the past, field strains of *B. zonata* from a few locations in Punjab were also noted to be spinosad-sensitive (**Nadeem *et al*., 2014**). However, the widespread use of spinosad in baits or cover sprays has been associated to spinosad resistance in *Bactrocera* spp., according to reports from other nations (**Hsu and Feng, 2006; Jin *et al*., 2016 and Khan and Akram., 2018**). Identifying pesticide resistance is essential to developing an effective insect pest management strategy. (**Khan *et al*., 2013**). Many kinds of efforts have been made to lower the amount of the main insecticide used in the control program and lower the likelihood of a rapid development of resistance. These include employing insecticide formulations that are appropriate, utilizing mixes of pesticides with various modes of action, and restricting the percentage of the spray regions that are treated (**Lord., 2007**). Several examples exist of the effective use of pesticide mixtures to manage resistance. For example, Lambda-cyhalothrin and spinosad were shown to be vulnerable to low resistance of *B. zonata* populations (1.00-fold to 9.57-fold and 1.20-fold to 9.95-fold), according to investigations by (**Nadeem *et al*, 2014**). When LC_{25} of spinosad, LC_{25} of lemongrass, and LC25 of sesame oil were combined, a larger percentage of fatalities was seen than when each ingredient was used alone. (**Negm *et al*., 2022**). The following rationales support the use of pesticide mixtures consisting of various chemical types in agriculture: A combination of toxicants may be able to effectively manage a complex of pests with varying susceptibilities to the separate components of the mixture. Insects that are resistant to one or more insecticides may also be sensitive to a combination of toxicants. Combinations may also show synergistic effects (**Abd El-Mageed and Shalaby, 2011 and Khan *et al*., 2013**). According to (**Al-Eryan *et al)*. 2018**), male annihilation technique (MAT) and bait application technique (BAT) strategies can gradually replace the existing usage of pesticide control methods because they are successful in suppressing *B. zonata*. For example, the National Area-Wide Fruit Flies Extermination Program in Egypt requires the annual application of MAT and BAT procedures to lower the population density of *B. zonata* and other fruit flies.



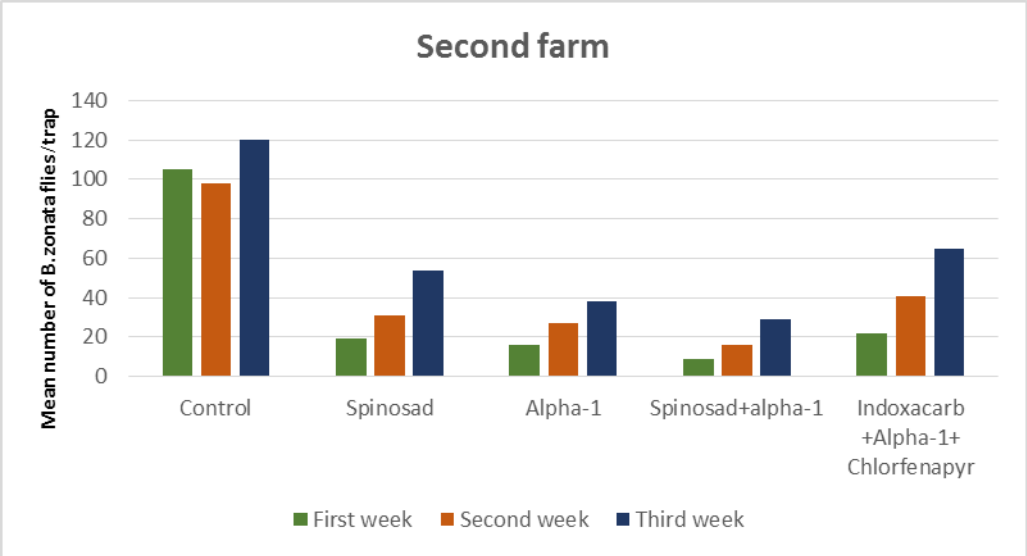


Fig. (3): Numbers of flies/trap of *B. zonata* for three weeks using Jackson sticky traps with methyl eugenol in the two farms at Sharkia Governorate, Egypt.

Conclusively, *Bactrocera zonata* (Saunders), often known as the peach fruit fly (PFF), is a highly destructive insect found worldwide, particularly of fruit. We advise that control operations start in April and continue until the fruits are fully ripe, taking into account the recommended safety periods. *Due to the insect's great ability to develop resistance to insecticides we recommend that, not using insecticides alone more than once and using them in mixtures.*

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دراسات على التقلبات السكانية لذبابة ثمار الخوخ في بساتين المانجو والموالح ومكافحتها حقلياً بمحافظة الشرقية بمصر

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تعتبر ذبابة فاكهة الخوخ من أكثر أنواع الآفات تدميراً في العالم وقد هدفت الدراسة الي إدارة الآفة في الحقل مع توضيح تذبذب ووفرة الذباب على المانجو والحمضيات باستخدام مصائد جاكسون اللاصقة خلال فترة الدراسة لمدة عامين ٢٠٢٢/٢٠٢١ و ٢٠٢٣/٢٠٢٢ وعلاقتها بالعوامل الجوية السائدة.
أظهرت النتائج أن:

١- الزيادة السكانية لذبابة فاكهة الخوخ تبدأ من أبريل فصاعداً وتم تسجيل الحد الأقصى لعدد السكان خلال شهر مايو حتي أكتوبر مع ذروة كبيرة خلال شهر أغسطس.
٢- وصل أعلى معدل نشاط لذبابة الخوخ خلال موسم نمو ٢٠٢٢/٢٠٢١ حيث كان أعلى من موسم نمو ٢٠٢٣/٢٠٢٢ لكل من محصولي الموالح والمانجو.
٣- سُجل أعلى معدل لنشاط الذبابة خلال شهر أغسطس على محصول المانجو (٣٧٦ ± ٩.٤٧حشرة) خلال موسم الأول ٢٠٢٢/٢٠٢١، بينما سُجل أعلى معدل لنشاط الحشرة خلال شهر أغسطس على محصول المانجو (٣٦٠± ٧.٣١حشرة) خلال الموسم الثاني ٢٠٢٣/٢٠٢٢.
٤- سجل أعلى معدل لنشاط الحشرة خلال شهر نوفمبر (٢٤٢ ± ٤.٩٣حشرة) خلال الموسم الأول ٢٠٢٢/٢٠٢١، بينما سجل أعلى معدل لنشاط الحشرة خلال شهر أكتوبر (٢٣٥ ± ٤.٣٥حشرة) خلال الموسم الثاني ٢٠٢٢/ ٢٠٢٣ في بستان الموالح.
٥- أظهرت البيانات أن سبينوساد بالإضافة إلى ألفا سايبرمثرين سجلا انخفاضًا أعلى في متوسط أعداد الذباب المحتجز خلال ثلاثة أسابيع من المكافحة.
٦- سجلت نسبة الإنخفاض في متوسط أعداد الذباب المأسور المعالج بالسبينوساد مع ألفا سايبرمثرين، ألفا سايبرمثرين، إندوكساكارب مع ألفا سايبرمثرين مع كلورفينابير وسبينوساد ٨٢.٤٦، ٧٩.٦٢، ٧٠.١٤، ٦٩.٤٣ على التوالى في المزرعة الأولى (جزيرة السعادة) بينما بلغت نسبة الانخفاض في متوسط أعداد الذباب المأسور ٨٣.٢٨، ٧٤.٩٢، ٦٧.٨٠، ٦٠.٣٧% على التوالي في المزرعة الثانية (القرين).

التوصية:
تعتبر ذبابة فاكهة الخوخ من أكثر أنواع الآفات تدميراً في العالم وخاصة الفاكهة . ننصح بأن تبدأ عمليات المكافحة في شهر إبريل وتستمر حتى تنضج الثمار بشكل كامل مع مراعاة فترات السلامة الموصي بها .نظرًا لقدرة الحشرة الكبيرة على تطوير صفة المقاومة للمبيدات الحشرية، فإننا ننصح بعدم استخدام المبيدات الحشرية بمفردها أكثر من مرة واستخدامها في صورة مخاليط.