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Population Fluctuation of Mediterranean Fruit Fly, *Ceratitis capitata* (Wiedemann) Infesting Three Fruit Varieties in Alexandria Governorate, Egypt

Seham, M. El Mahdy*; Y. E. Afia and Mahenaz, A. A. Gab Alla



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Plant Protection Institute, A.R.C., Dokki, Giza, 12618 Egypt

ABSTRACT

Population fluctuation of Mediterranean-fruit-fly, *Ceratitis capitata* (Wiedemann) on different fruit varieties (three-varieties); mango, pomegranate and navel-orange were studied in seasons 2021/2022 at Borg El-Arab, Alexandria. *C. capitata* has two-peaks on mid-July and beginning of third-week of August for mango. In pomegranate-variety there were two-peaks at third-week of August and second-peak at end-September. Whereas, navel-orange varieties found one-peak at third-week of October recorded of two-tested seasons, respectively. Statistically analysis showed, weather factors and fruits ripping-stage were highly-significant differences (73.4 and 73.9%), (69.6 and 72.2%) and (82.9 and 80.7%) on *C. capitata* population in tested-varieties during two-season compared-with different weather factors. Simple-correlation on second season 2022 between maximum-temperature and CTD on *C. capitata* was highly significant differences in mango tested. Whereas pomegranate-variety, was insignificant between max-temperature and CTD of *C. capitata* during two-seasons, in navel-orange was negative-insignificant during two-seasons. Minimum-temperatures and CTD-number of *C. capitata* were insignificant during two-seasons for mango-variety. In pomegranate were in-significant during two-seasons. While were negative-insignificant for navel-orange. Simple-correlation on two-seasons between relative-humidity for fruit-varieties were highly-significant except mango in first-season was insignificant. Statistical-analysis for three-varieties and different inspections during two-seasons, showed, first-season was highly-significant more-than second-season. Regarding mango-varieties was high more-than pomegranate and navel-orange were mean of mango (5.64) while, no-difference between pomegranate and navel-orange means were (3.45 and 4.04), respectively. Regarding varieties in two-seasons, mango was high more-than navel-orange and pomegranate (132.7 & 93.2) for mango; (101.1 & 68.7) for navel-orange and (78.3 & 53.1) for pomegranate in two-seasons.

Keywords: *Ceratitis capitata*, Mango, pomegranate, navel orange, seasonal abundance.

INTRODUCTION

Mango (*Mangifera indica* L.), Pomegranate (*Punica granatum* L.) and Navel orange as cultivar of the species *Citrus sinensis* are the most fruits were the host preferred for Mediterranean fruit fly, *Ceratitis capitata* (Medfly) (Diptera: Tephritidae). *C. capitata* is a dangerous insect on pomegranate in Turkey Demirel (2020). Fruit flies consider one of the serious groups of insect pests of horticulture fruits which spread all over the world, Drew and Hancock (1994) and Tiring and Satar (2021). More than 1500 fly species which contain 50 species of them are regarded as serious pests and 30 species are low serious. Many species of family Tephritidae have a wide range spreading into Egypt. *C. capitata* consider one of the key pest attacks wide range of fruit trees in Egypt such as peach, guava, mango, apricot, pomegranate, apple and navel orange this is beside different vegetable plants (Joomaye & Price (2000) and White (2000). This dangerous insect attracted the attention and studies of many researchers in Egypt, i.e. Hashem *et al.* (2001), Afia (2007) and Amin (2008).

This study aimed to recorded population fluctuation of *C. capitata* on the three different varieties, mango, pomegranate and navel orange trees using Jackson traps under field conditions in Borg El- Arab, Alexandria Governorate

during both of the two tested seasons of 2021 and 2022. This study was carried out to progress a plan of particular control recommended, population, and infestation level was based on the infestation time of that insect during the season.

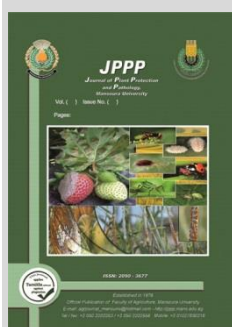
MATERIAL AND METHODS

Seasonal fluctuation of *Ceratitis capitata* (W) and relationship between the population fluctuation of that insect and the weather factors was recorded for both of the two tested seasons 2021, 2022. Population fluctuation was depended on traps method which catches in both of three different fruit varieties; Mango (Awyesy), Pomegranate (Sukari) and citrus (navel orange). These trees were cultivated in the same orchard (20 feddan at Borg El- Arab district, Alexandria Governorate). These trees of different varieties were nearly at the same age between 15-20 years old. Fifteen Jackson traps filled with 4 ml mixture of Trimedlure 90% were distributed randomly in a mango, pomegranate and navel orange orchards. Five traps in three replicates were used for each variety form beginning June to end October for mango, mid-July to end November for pomegranate and beginning August to end December for navel orange (according to fruit stage for every variety). The tested traps were hanged on the shaded side of the planted trees with height about 1.5-2 meters and supplied with the examined mixture every 4 weeks. Tested traps were examined per

* Corresponding author.

E-mail address: Sehamelmahdy67@yahoo.com

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weekly during both of the two tested seasons 2021-2022; then tested traps were caught and transferred to be captured per trap daily in both of the three examined fruit varieties.

Statistically analysis:

Study contained estimating the related between population fluctuation of *C. capitata* and the weather factors during study. Weather factors were recorded; maximum, minimum mean temperatures and mean percentage of relative humidity obtained from Central Laboratory of Agriculture Climate (C.L.A.C.) Giza, Egypt. Mean daily weather factors were recorded and calculated as weekly means presenting. Results obtained both of the total numbers of *C. capitata* and mean population percentages were statistically analysed by using (ANOVA) -analysis of variance- in SAS program (SAS Institute, 1988).

RESULTS AND DISCUSSION

First season 2021:

Data obtained by weekly inspection of *C. capitata* with corresponding means temperature and relative humidity percentage are graphically illustrated in Fig. (1) show that adults of *C. capitata* began to invade mango on mid-June with few numbers of CTD was (0.40) fly, on pomegranate began on end-July with few numbers of CTD was (0.71) flies and in navel orange began on mid- August with few numbers of CTD was (0.31) flies.

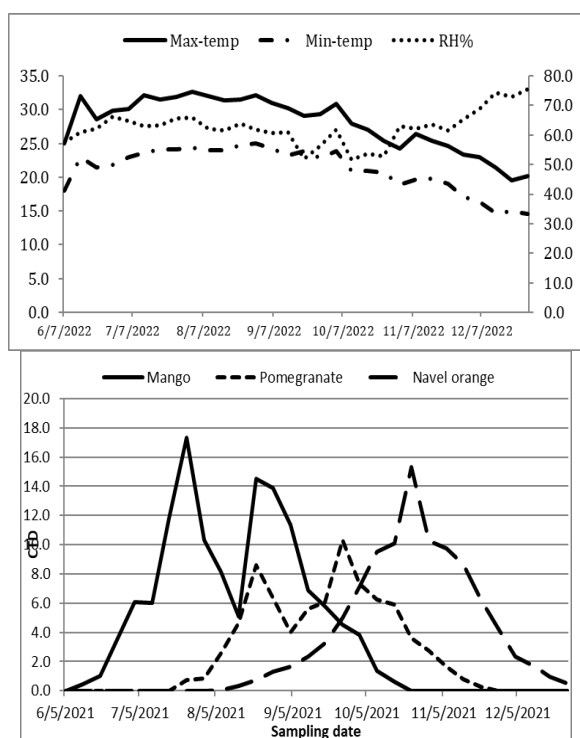


Fig. 1. CTD of attracted males the Mediterranean fruit fly, *C. capitata* on three fruit varieties with weather factors in Borg El- Arab, Alexandria Governorate during 2021 season.

These numbers were noticed with the beginning of the ripping period of fruits and emigration of flies from inter successive varieties host which are cultivated in a wide range, then population were increased gradually to reach to the highest peak on July 24th when mean numbers of CTD was (17.3) flies on mango, (10.3) flies on pomegranate on September 25th and (15.3) flies on navel orange on October 23rd. This increasing due to the suitable weather factors

specially mean of temperature (maximum and minimum) which were (34.3°C and 24.3°C), for mango, (30.4°C and 22.7°C) for pomegranate and (27.2°C and 22.2°C) for navel orange respectively, as well as relative humidity of (65.2%) For mango, (61.9%) for pomegranate and (56.3%) for navel orange, respectively. These periods were at the same period with fruit full ripping stage of mango, pomegranate and navel orange respectively.

Results obtained in Table (1) showed the correlation coefficient between four factors of minimum, maximum temperature, relative humanity, ripping stages of fruit mango, pomegranate, and navel orange on mean number of captured per day (CTD).

1- Effects of three weather factors on the population fluctuation of *C. capitata*, on three different fruit varieties at Borg El-Arab, Alexandria Governorate.

First season 2021:

In mango the correlation coefficient values between maximum, minimum temperatures, relative humidity percentages and CTD number were highly significant effects ($r = 0.677$ and $r = 0.435$) for temperature and no significantly effects ($r = 0.223$) for relative humidity percentage during first seasons, respectively. The partial regression the same factors and CTD number were highly significant effects ($b = 2.357$ and $b = 0.707$) for temperature and no significantly ($b = 0.350$) for relative humidity percentage during first seasons, respectively. The relation between effect of the three weather factors and CTD number were highly significant effects whereas "F value" was (8.27) and the percentage % of the explained variance was (73.4%).

In pomegranate the simple correlation were insignificantly effects ($r = 0.233$ and $r = 0.163$) for temperature and negative highly significantly ($r = -0.682$) for relative humidity percentage during first seasons, respectively. The partial regression were in significantly effects ($b = 0.521$ and $b = 0.715$) for temperature and negative high significantly ($b = -0.462$) for relative humidity percentage during first season, respectively. The relation between effect of the three weather factors and CTD number were significant whereas F value was (5.72) and the percentage % of the explained variance was (69.6%).

In navel orange the simple correlation were negative correlation and in significant ($r = -0.063$ and $r = -0.142$) for temperature and negative high significant correlation ($r = -0.586$) for relative humidity percentage during first seasons, respectively. The partial regression were insignificant ($b = 0.122$ and $b = -0.910$) for temperature and negative significant ($b = -0.625$) for relative humidity percentage during first seasons, respectively. The relation between effect of the three weather factors and CTD number were high significant whereas (F value) was (10.49) and the percentage % of the explained variance was (82.9%).

2- Effect of ripping stage of fruits.

Results obtained during season 2021 show the related between effect of fruit stages of mango, pomegranate and navel orange and number of CTD were highly significant effects whereas the percentage % of the explained variance were (67.3% , 68.3% and 76.9%) for mango, pomegranate and navel orange ripping stage of fruits, respectively. The variance ratio "F values" were highly significant effects (14.41, 12.92 and 17.72) for mango, pomegranate and navel orange, respectively.

Table 1. statistically analysis of the weather factors and the ripping stage of the fruit with (CTD) of *C. capitata* on three fruit varieties at Borg El- Arab, Alexandria Governorate during season 2021.

Varieties	Variables	Simple correlation		Partial regression		"F"	P.	EV%			
		r	P.	B	P.						
Mango	Max. Temp	0.6776	0.0002	2.3570	0.0004	9.05	0.0005	56.4%			
	Min. Temp.	0.43582	0.0002	0.70719	0.0003						
	R.H. %	0.22313	0.2837	0.35014	0.1367						
	Ripping stage	—							14.41	0.0001	67.3%
	Combined effect	—							8.27	0.0002	73.4%
Pomegranate	Max. Temp	0.23313	0.2964	0.52137	0.3614	6.60	0.0034	52.4%			
	Min. Temp.	0.16342	0.4674	0.71518	0.2190						
	R.H. %	-0.68292	0.0005	-0.46211	0.0008						
	Ripping stage	—							12.92	0.0001	68.3%
	Combined effect	—							5.72	0.0029	69.6%
Navel orange	Max. Temp	-0.06379	0.7893	0.12226	0.8305	10.18	0.0005	65.6%			
	Min. Temp.	-0.14264	0.5486	-0.91090	0.1149						
	R.H. %	-0.58622	0.0066	-0.62539	0.0001						
	Ripping stage	—							17.72	0.0001	76.9%
	Combined effect	—							10.49	0.0002	82.9%

Second season, 2022:

Data obtained by weekly inspection of *C. capitata* with corresponding means temperature and relative humidity percentage are graphically illustrated in Fig. (2). show that adults of *C. capitata* began to infested mango on mid-June with few numbers of CTD was (0.5) flies, on pomegranate began on end-July with few numbers of CTD was (0.3) flies and in navel orange began on beginning mid of August with few numbers of CTD was (0.3) flies. These few numbers were at the same times of the beginning of the ripping fruits period and emigration of flies from inter variety hosts which were cultivated in a wide large areas, after that they increased gradually to reach to the highest peak on August 2nd whereas mean number of CTD was (16.2) flies on mango, (9.6) flies on pomegranate on October 4th and (9.2) flies on navel orange on October 18th.

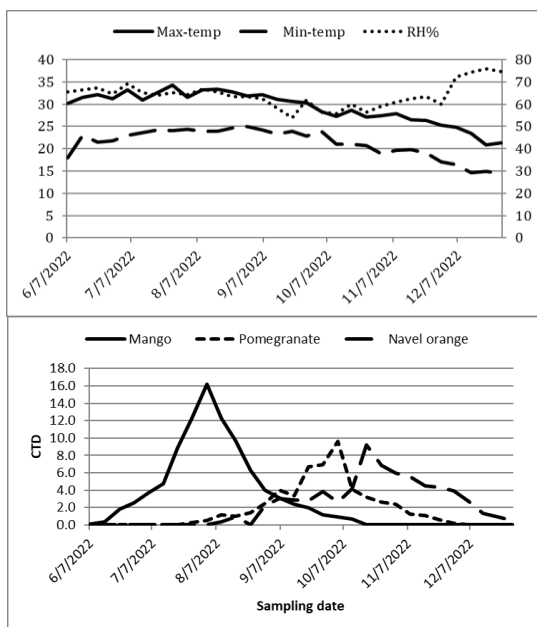


Fig. 2. CTD of attracted males of *C. capitata* on three fruit varieties with corresponding means of the essential weather factors in Alexandria Governorate during season 2022

This increasing due to the suitable weather factors specially mean of maximum temperature, minimum temperature and ripping stage which were (32.7°C and 24.4°C), for mango, (30.9°C and 23.9°C) for pomegranate and (27.0°C) and (21.0°C) for navel orange respectively, whereas

relative humidity of (65.9%) for mango, (61.7%) for pomegranate and (53.7%) for navel orange, respectively. These periods were as the same times with fruits full ripping stage of mango, pomegranate and navel orange, respectively.

Results tabulated in Table (2) showed that the correlation coefficient between four factors of minimum, maximum temperature, relative humidity, ripping stage of fruits mango, pomegranate, and navel orange on CTD number.

1- Effect of three weather factors on the population fluctuation of *C. capitata* on three different fruit varieties at Borg El-Arab, Alexandria Governorate.

Second season, 2022:

In mango the correlation coefficient values between maximum, minimum temperatures, relative humidity percentages and number of CTD were highly significant effects ($r = 0.614$ and $r = 0.511$) for temperature and also, significantly effects ($r = 0.531$) for relative humidity percentage during second season, respectively. The partial regression for the same factors and number of CTD were no significant effects ($b = 1.078$ and $b = 0.087$) for temperature and also, no significant ($b = 0.304$) for relative humidity percentage during second season, respectively. The relation between effect of the three weather factors and number of CTD were highly significant differences whereas "F value" was (5.66) and the percentage % of the explained variance was (73.9%).

In pomegranate the simple correlation were no significantly effects ($r = 0.154$ and $r = 0.281$) for temperature and negative significantly ($r = -0.525$) for relative humidity percentage during second season, respectively. The partial regression were no significantly effects ($b = -0.699$ and $b = -1.174$) for temperature and negative no significant ($b = -0.225$) for relative humidity percentage during the second season, respectively. The relation between effect of the three weather factors and number of CTD were significant whereas (F)value was (5.21) and the percentage % of the explained variance was (72.2%).

In navel orange the simple correlation were negative correlation and not significant ($r = -0.110$ and $r = -0.033$) for temperature and also, negative significant correlation ($r = -0.566$) for relative humidity percentage during second season, respectively. The partial regression were no significant ($b = -0.153$ and $b = -0.298$) for temperature and highly significant ($b = -0.352$) for relative humidity percentage during the second season, respectively. The relation between effect of the three weather factors and number of CTD were highly significant differences whereas "F value" was (9.74) and the percentage % of the explained variance was (80.7%).

2- Effect of ripping stage of fruits.

Results of statistical analysis during season 2022. The combined effects between fruit stages of mango pomegranate and navel orange and number of CTD were highly significant effect while the percentage % of the explained variance were (66.8%, 62.3% and 74.3%) for mango, pomegranate and navel orange ripping stage of fruits, respectively. The variance ratio " F values " were highly significant effects (10.06, 8.26 and 16.76) for mango, pomegranate and navel orange, respectively.

Obtained results were agreement with results obtained by Manrakhan and Price (2000) who indicated to that fruits existence and temperature degree had highly significant effect on the population fluctuation of *C. capitata* insect on mango fruits. Amin (2008) indicated to that certain weather factors were appearance during critical temperature period particularly during winter months in which

population of *C. capitata* reduced to its minimum numbers.

Also Amira et al. (2018) in Egypt indicated to that the highest peak of the population number of *C. capitata* insect was recorded during the period from the 4th week of October month until the 3rd week of November month. Whereas Afia (2007) refereed to that studied weather factors were not the main effectiveness factors for the population fluctuation of *C. capitata* insect infesting many crops. Tiring and Satar (2021) referred to the highest population numbers of the *C. capitata* insect were noticed between the period from June month until July month and the population fluctuation of the *C. capitata* insect was related with the presence of ripe grape fruit period and last adults captured in the first season were counted in February month whereas in the second season were in January month.

Table 2. Simple correlation between the essential weather factors and the ripping stage of the fruit variety in relation with (CTD) of *C. capitata* on three fruit varieties in Borg El- Arab, Alexandria Governorate during 2022 season.

Varieties	Variables	Simple correlation		Partial regression		"F"	P.	EV%
		r	P.	b	P.			
Mango	Max. Temp	0.61465	0.0051	1.07803	0.4666	3.65	0.0371	42.2%
	Min. Temp.	0.51090	0.0254	0.08696	0.9521			
	R.H. %	0.53113	0.0193	0.30427	0.3457			
	Ripping stage					10.06	0.0007	66.8%
	Combined effect					5.66	0.0054	73.9%
Pomegranate	Max. Temp	0.15456	0.5275	-0.69968	0.3966	3.27	0.0508	39.5%
	Min. Temp.	0.28054	0.2447	1.17366	0.2614			
	R.H. %	-0.52501	0.0210	-0.22472	0.1198			
	Ripping stage					8.26	0.0018	62.3%
	Combined effect					5.21	0.0074	72.2%
Navel orange	Max. Temp	-0.11005	0.6349	-0.15386	0.7588	9.40	0.0007	62.4%
	Min. Temp.	-0.03312	0.8867	-0.29884	0.6319			
	R.H. %	-0.56685	0.0074	-0.35287	0.0003			
	Ripping stage					16.76	0.0001	74.3%
	Combined effect					9.74	0.0003	80.7%

Results in Table (3&4) and illustrated in Fig. (3) show that the results obtained of seasonal fluctuation of *C. capitata* insect on three different fruits, mango pomegranate and navel orange by total numbers of males / season captured by Jackson traps baited with ME at Borg El- Arab,

Alexandria Governorate during two successive seasons in fig (3) The mango in two season was the highest than navel orange and pomegranate were (132.7&93.2) for mango; (101.1&68.7) for navel orange and (78.3&53.1) for pomegranate in two seasons, respectively.

Table 3. Seasonal population fluctuation of *C. capitata* insect on three fruit varieties during two successive seasons.

Parameters	Mango			Pomegranate			Navel orange		
	Mean	"F"	P.	Mean	"F"	P.	Mean	"F"	P.
Inspections		4.64	0.0008		5.77	0.0003		6.35	0.0001
Seasons	5.645	4.42	0.0491	3.452	7.33	0.0144	4.042	7.56	0.0123

Table 4. Seasonal fluctuation of *C. capitata* insect on fruit varieties (males/season) captured by Jackson traps at Borg El- Arab zone, Alexandria Governorate during two successive seasons.

Parameters	"F" value	Probability	EV%
Varieties	7.87	0.0007	
Inspections	8.33	0.0001	66.9%
Seasons	12.12	0.0008	

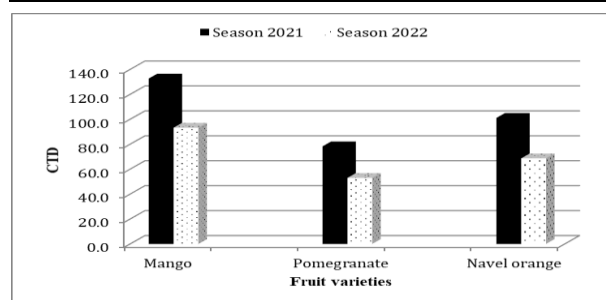


Fig. 3. Total number of male captured in three different fruit varieties during two successive seasons at Borg El- Arab, Alexandria Governorate.

Results of statistical analysis for the three different varieties and different inspections during two successive seasons 2021 and 2022 showed that the first season was highly significant more than second season. Regarding varieties mango was high more than pomegranate and navel orange were mean of mango (5.645) while no different between pomegranate and navel orange means were (3.452 and 4.042). Generally, The "F value" in table (4) were highly significant (7.87) for varieties, (8.33) for inspections and (12.12) for two successive seasons, respectively and the percentages % of explained variance was (66.9%).

Generally, the "F value" in table (4) were highly significant (7.87) for varieties, (8.33) for inspections and (12.12) for two successive seasons, respectively and the percentages % of explained variance was (66.9%).

Results obtained were agreement with those obtained by Grewal and Kapoor (1987), Khan and Khan (1987) in Pakistan and Tiring and Satar (2021) in Turkey indicated to that pest *C. capitata* occurred and increased

from period March month to August month especially the period during the July month until August month. Rana *et al.* (1992) indicated to that the highest activity of *C. capitata* adult males in India was between July month to August month. Ishtiaq *et al.*, (1999) indicated to the population number of *C. capitata* insect for winter variety in September month while negligibly in December month. Also Mohammed (2003) indicated to that *C. capitata* insect adults were active during all over the year except of the cold weather period. Also Khalid and Mishkatullah (2007) in Pakistan indicated to that *C. capitata* pest infested different fruits with low population densities level from November month to February month and then it increased from March month to August month. The population had one peak (highest number) in July month and August month, while low level numbers was recorded during October month depending on the maturity of host fruit and temperature degree. Lastly, Yazid *et al.* (2020) indicated to that captures of that insect occurred continuously from beginning of April month until to late November month with variability between successive years.

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الكثافة العددية لذبابة فاكهة البحر الأبيض المتوسط على ثلاثة أصناف مختلفة من الفاكهة في محافظة الإسكندرية سهام محمد المهدي - يسرى إسماعيل عافية - ماهيناز عبد العزيز أحمد جاب الله

معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقي - الجيزة - ١٢٦١٨ مصر

المخلص

تم دراسة التوزيع الموسمي لذبابة فاكهة البحر الأبيض المتوسط على ثلاثة أصناف من ثمار الفاكهة مانجو (عويس)، رمان (سكرى) و موالج (برتقال بسره) وذلك لمدة عامين متتاليين 2022/2021 في منطقة برج العرب - الإسكندرية. خلال موسمي الدراسة تم رصد قمتين نشاط لذبابة فاكهة البحر الأبيض المتوسط في نهاية يوليو و أغسطس بالنسبة للمانجو، وقمتين نشاط في آخر أغسطس وسبتمبر بالنسبة للرمان خلال الموسمين على التوالي، وعلى العكس تم رصد قمة نشاط واحدة في آخر أكتوبر على البرتقال أبو سره خلال الموسمين. وكان تعداد الذباب في السنة الأولى أعلى من السنة الثانية وفي محصول المانجو اعلى من البرتقال ابوسره والرمان في الموسمين. وكان هناك تأثيرات عالية المعنوية بين تعداد الذباب وفترة نضج الثمار والعوامل الجوية الثلاثة بين الأصناف حيث سجلت نسب التباين (% 73.9 & % 73.4) في المانجو، (% 72.2 & % 69.6) في الرمان، (% 82.9) (% 80.7 & في البرتقال أبو سره للسنتين على التوالي. وكان الارتباط البسيط خلال العام الثاني بين تعداد الذباب ودرجات الحرارة العظمي عالي معنويا في المانجو، وغير معنوي في الرمان، وسالب غير معنوي في البرتقال أبو سره، كما كان هناك ارتباط معنوي بين تعداد الذباب ودرجات الحرارة الصغرى خلال السنتين في المانجو، وغير معنوي في الرمان، وسالب غير معنوي في البرتقال أبو سره، اما الرطوبة النسبية سجلت ارتباط معنوي وعالي المعنويه للأصناف الثلاثة خلال السنتين ماعدا السنة الأولى في المانجو. وللمقارنة بين الأصناف سجلت المانجو أعلى معنوية (٥,٦٥٤) من الرمان (٣,٤٥٢) والبرتقال أبوسره (٤,٠٤٢)، خلال موسمين الدراسة على التوالي.