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Effect of Biotic and Abiotic Factors on the Pear Psylla, *Cacopsylla bidens* (Šulc) Abundance of Pear Trees in Ismailia Governorate.

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ABSTRACT

The experimental fruit orchards located at Tenth of Ramadan Association of agricultural lands in Ismailia Governorate. This study was carried out to evaluate the effect of a biotic factor as age plant and abiotic factor maximum, minimum temperature and relative humidity from first march 2013 to end of November 2014. Correlation, regression analysis and multi regression between abiotic factors and population density of pear psylla was in liner degree but with age plant was polynomial degree. In addition, the combined effect of biotic factor (plant age) on the changes of *Cacopsylla bidens* eggs, nymphs and adult population represented by (88.87 , 87.45 and 85.02%) respectively, in 2013. While in the second year 2014 the value of E.V% was (82.44, 88.72 and 85.21%) for eggs, nymphs and adult, respectively. This revealed that the effect of plant age was a more effective factor on *C. bidens* abundance than weather factors. In this study one predator *Orius albidipennis* (Reut.) was recorded few numbers in spring and autumn season this predator fed on the egg stage of pear psylla.

Keywords: pear psylla *Cacopsylla bidens*, Seasonal activity, weather factors, plant age.

INTRODUCTION

The pear psylla *Cacopsylla bidens* (Šulc, 1907) (Hemiptera: Psylloidea: Psyllidae) is a very small sap-feeding insect and is considered as a serious insect pest of pear trees *Pyrus communis* L., *P. pyraster* and *P. syriaca* in Central Asia (Burckhardt, 1994). This species is the common pear psylla in Israel, and was also reported in Lebanon, Moldova, Romania, France, and Italy, but are not considered a pest in Western Europe Zeidan-Geze and Burckhardt (1998).

Damage to pear trees is twofold: first, the nymphs excrete large quantities of honeydew, an excellent medium for the growth of a black sooty mold. The presence of this mold on fruit renders it unsaleable. Second, heavy infestations can cause trees to wilt and lose their leaves as the psyllids ingest large amounts of sap and inject their toxic saliva into the plant tissues and vessels. However, the pear psylla C. *bidens* is not known as a vector of the phytoplasma responsible for the pear decline disease. Pear decline is one of the most dangerous diseases of pear trees, transmitted by *C. pyricola* and *C. pyri* in Europe (Mohamed *et al*. 2013).

The psyllids are monophagous phloem feeding insects Gullan and Martin (2003) & Civolani *et al*. (2011). Seven species of pear-feeding psyllids are present in North America, Europe, and other temperate and subtropical regions, of which most notably *Cacopsylla pyricola* Forster, *C. pyri* and *C. bidens* are pests of commercial pears Burckhardt and Hodkinson (1986). High-density populations of these insects can cause premature leaf and fruit drop, diminish plant growth, and reduce fruit size. In addition, their honeydew promotes sooty mould on leaves and russetting on fruits Pfeiffer and Burts (1983). Pear psylla are also considered vectors of pear pathogens such as the bacterium *Erwinia amylovora* Burrill, which causes fire blight, Emmett and Baker (1971) & Hildebrand *et al*. (2000) and *Candidatus Phytoplasma pyri*, causing pear decline disease Carraro *et al*. (1998). *C. pyricola* is the vector in northern America Burts *et al*. (1989) and *C. pyri* in Europe Berrada *et al*. (1995).

Horton *et al*. (1992) reported that, after the diapause period has ended and temperatures begin to warm (usually in February in California), the female psylla return to pear trees and lays their eggs on the emerging pear leaf buds. These eggs then develop into the summer form psylla.

The aim of this work to study the effect of a biotic factor as plant age and abiotic factor maximum, minimum temperature and relative humidity on the population density of pear psylla *C. bidens*.

MATERIALS AND METHODS

The experimental fruit orchards located at Tenth of Ramadan Association of agricultural lands in Ismailia Governorate.

Evaluation the infestation score of *C. bidens* on pear trees.

To determine the infestation level by *C. bidens*, on pear trees, *Pyrus communis* L.), five trees were sampled starting from March 2013. Five twigs (20 cm long) were collected from the different cardinal directions (north, south, east and west) and center of each tree. The collected twigs were cut, kept inside poly ethylene bags and transferred to the laboratory for investigation. Sampling continued till November when trees lost almost all their leaves in autumn.

The number of *C. bidens* on the collected twigs was counted and the infestation was determined.

Estimation of *C. bidens* population and its associated predators on pear trees:

The present experiments were conducted on pear trees located at the previously mentioned fruit orchard.

To determine the seasonal abundance of the pear psylla *C. bidens* and its predators, samples were collected weekly from pear trees during the period from March to November 2013 -2014.

The collected predators were counted and recorded. The pear psylla *C. bidens* instars were examined by the aid of a stereo microscope of 40 – 100 times magnification force.

Effect of biotic and abiotic factors on the abundance of *C. bidens*.

Weather factors as maximum, minimum temperature and relative humidity were considered from the http//:www: Weather underground.eg. The weekly maximum and minimum temperatures as well as relative humidity were calculated.

Plant phenology emulating plant nutritional value dynamics aver the griming season was considered as plant age (X). This relation was presented by polymanial equation of third degree ($Y= a + b_1 x + b_2 x^2 + b_3 x^3$).

Multiple regressions were conducted for weather factors combined as well as plant age as described. The obtained determination factor (R^2) of E.V. % was used to explain the effect of testing factors. Process Correlation and Regression were used in SAS to analysis the obtained date (SAS Instue.1998).

RESULTS

Seasonal activity of *C. bidens*.

The obtained results showed that, the seasonal activity of *C. bidens* on pear trees in the first and second year was illustrated in (Fig.1). *C. bidens* recorded first appearance in both years in the second week of March.

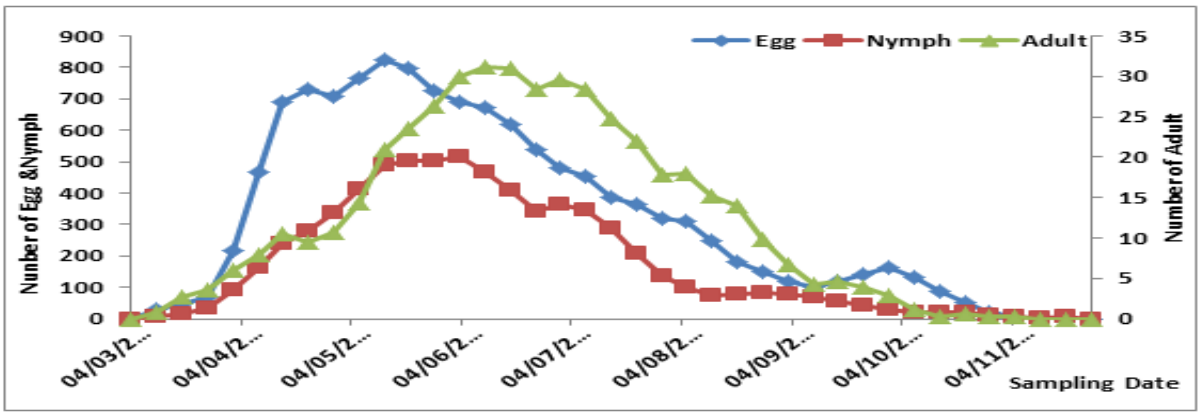
Mean number of *C. bidens* was (319,176 and 12) for egg, nymph and adult respectively in 2013.

In the first year of study the number of eggs of the pear psylla count was highest (826 eggs / sample) on May 13th , while the nymph was (514 nymphs / sample) on Jun 3rd. Adult reached the highest peak (31 adults / sample) on Jun 17th (Fig.1A).

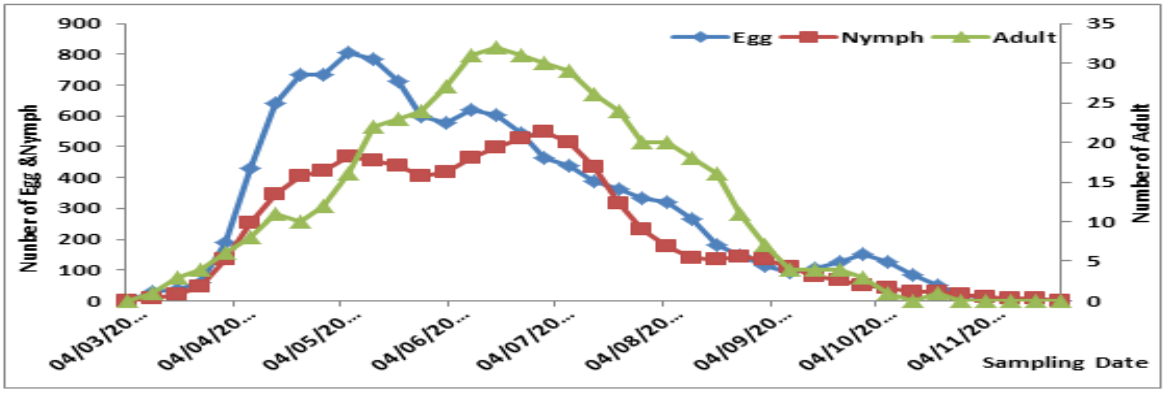
In the second year of the study pear psylla showed that relatively same number was recorded (305,219 and 12) for egg, nymph and adult respectively.

Egg recorded first peek at 8th of April (782 eggs / sample). While the highest peak was found in the first week of May (916 eggs / sample) and the lowest peak was recoded (170 eggs / sample) in the middle of September in autumn season in the second year.

Nymph stage showd that three beaks clearly in the 6th of May, 1st of July and last week of August, respectively. The highest beak was recorded in summer (590 nymphs /sample).



(A)

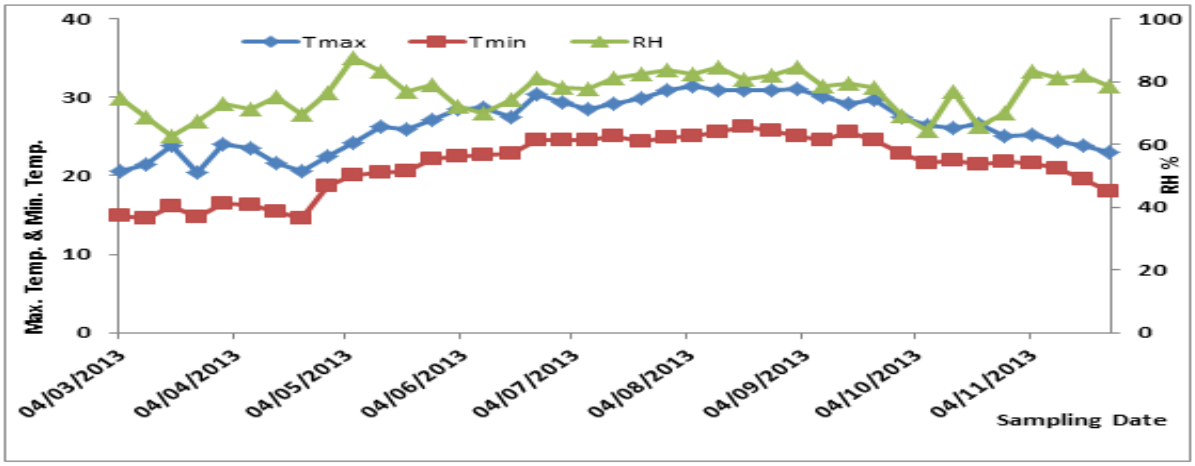


(B)

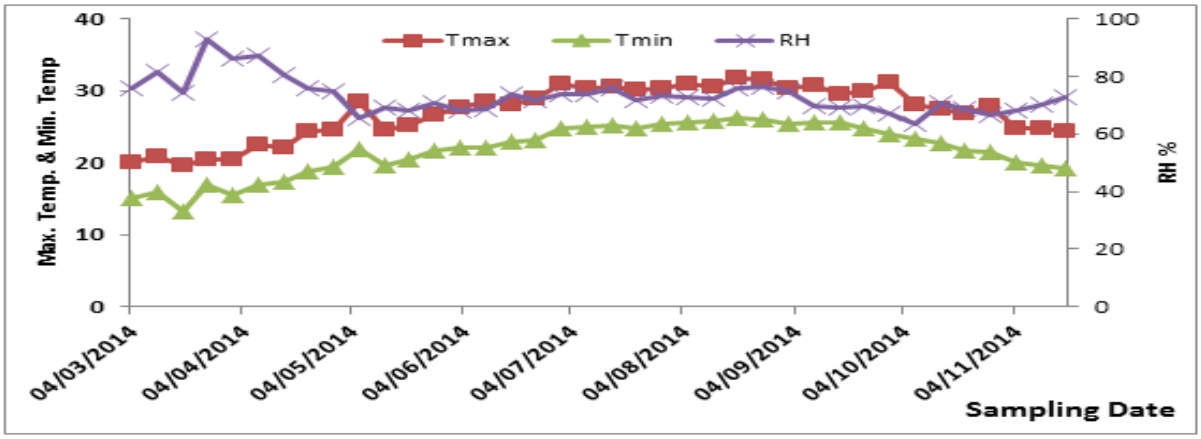
Figure 1. Seasonal activity of *C. bidens* on pear trees in 2013 (A) and 2014 (B).

Adult stage recorded four beaks, the highest one in the first week of Jun and lowest one in middle of September.

The pear pasylla *C. bidens* show no synchronization with the maximum, minimum temperature centegrate and relative humidity (Fig.2).



(A)



(B)

Figure 2. Maximum, minimum temperature centegrate and relative humidity 2013 (A) and 2014 (B).

Predator associated with the pear psylla

The obtained results revealed that, one predator was recorded, *Orius albidipennis* (Reut.) with fewer numbers in spring and autumn season this predator fed on the egg stage of pear psylla. Correlation analysis between *O. albidipennis* and *C. bidens* were significant (r = 0.538 and r = 0.744) in both years of study as seen in (Fig. 3).

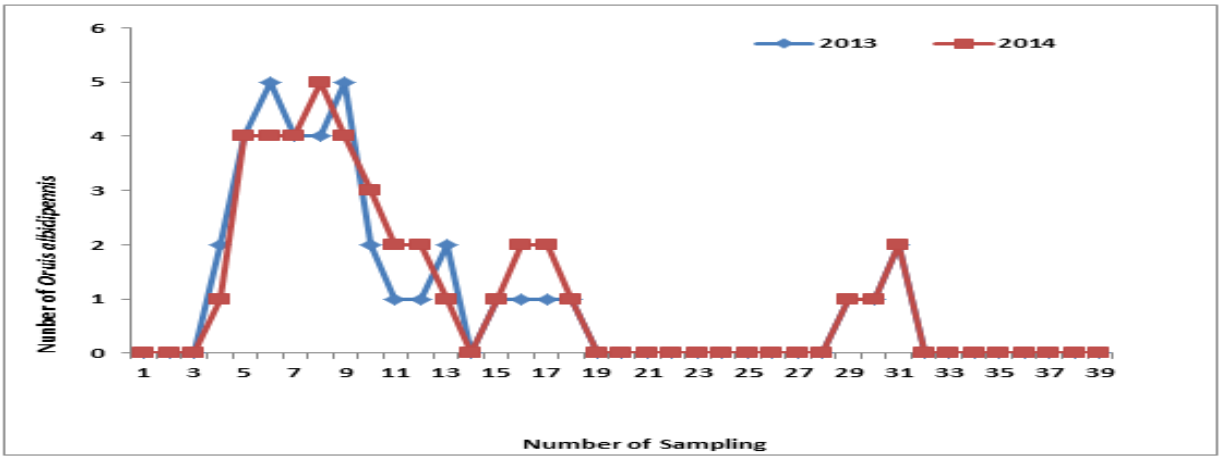


Figure 3. Seasonal activity of the predator, *O. albidipennis* on pear trees during 2013 and 2014.

Effect of biotic and abiotic factors on the abundance of *C. bidens* .

The effect of a biotic factor as age plant and abiotic factors maximum, minimum temperature and relative humidity were studied. Correlation, regression analysis and multi regression between abiotic factors and population of pear psylla was in liner degree, but with age plant was polyminal degree in two years of study 2013and 2014.

Statistically, the results represented in Tables (1 and 2) showed the effect of the weather factors

(maximum, minimum temperature and relative humidity) on population density of *C. bidens*.

With the respect to abiotic factors had no significant effect on the population density of the egg and nymph stage *C. bidens* in two years of study, while adult had significant effect on the population with maximum temperature in two years of study, and the correlation coefficient values were nearly close (0.465 and 0.104) during 2013 and 2014 (Tables, 1 and 2).

The combined effect of temperature and relative humidity was responsible for 5.16 % and 7.66 % of the egg stage, nymph was (3.96 % & 12 %) and adult was (24.04 % & 13.95%) during the first and second seasons, respectively (Tables, 1and 2).

In addition, the combined effect of biotic factor (trees age) on the changes of *C. bidens* egg, nymph and adult population represented by 88.87% , 87.45% and 85.02% respectively in 2013(Table,1). While in the second year 2014 the value of E.V% was (82.44, 88.72 and 85.21%) for egg, nymph and adult, respectively (Table, 2).

To evaluate the common effect of biotic and abiotic factors was (92,27 and 83.99%) for egg, while for nymph was (90.66% and 90.60%) and adult was (91.53% and 86.65%) in 2013and 2014 (Table,1 and 2). This revealed that the effect of trees age was a more effective factor on *C. bidens* abundance than weather factors.

Table 1. The simple correlation and regression coefficients and multiple regressions between the different stages of *C. bidens* and biotic and abiotic factors of 2013 year.

Factor		Simple correlation and regression			Multiple regression		
		r	b	P	F	P	E.V.%
Egg	T max.	o.o2733	3.3081	0.8688			
	T min.	-0.01131	-1.4867	0.9455	0.64	0.5975	5.16
	R.H.%	0.13908	0.0031	0.3984			
	Plant Age1-Age3				93.15	0,0001	88.87
	All above				63.65	0,0001	92,27
Nymph	T max.	0.13745	0.0026	0.4041			
	T min.	0.11392	0.0023	04899	0.48		3,96
	R.H.%	0.16075	0.0057	0.3283			
	Age1-Age3				81.28	0,0001	87.45
	All above				51.79	0,0001	90.66
Adult	T max.	0.46474	0.1449	0.0029			
	T min.	0.40401	0.1368	0.0107	3.69	0.0207	24.04
	R.H.%	0.25337	0.1477	0.1196			
	Age1-Age3				66.24	0,0001	85.02
	All above				57.63	0,0001	91.53

Table 2. The simple correlation and regression coefficients and multiple regressions between the different stages of *C. bidens* and biotic and abiotic factors of 2014 year.

Factor		Simple correlation and regression			Multiple regression		
		r	b	p	F	P	E.V.%
Egg	T max.	-0.01879	-2.5277	0.9096			
	T min.	-0.06380	-8.1478	0.6996	0.97	.4191 ns	7.66
	R.H.%	0.07938	0.0017	0.6310			
	Age1-Age3				54.78	.0000 ***	82.44
	All above				27.98	.0000 ***	83.99
Nymph	T max.	0.05340	0.0016	.7468			
	T min.	0.07037	0.0013	0.6703	1.60	.2090 ns	12.00
	R.H.%	0.12182	0.0023	0.4601			
	Age1-Age3				91.78	.0000 ***	88.72
	All above				51.43	.0000 ***	90.60
Adult	T max.	0.10399	0.3170	.0492			
	T min.	0.08747	0.2809	.0832	1.90	.1491 ns	13.95
	R.H.%	-0.04705	-0.0909	.5820			
	Age1-Age3				67.23	.0000 ***	85.21
	All above				34.63	.0000 ***	86.65

DISCUSSION

The pear psylla in this study recorded in the second week of March in 2013-2014 this agree with After the diapause period has ended and temperatures begin to warm (usually in February in California), the female psylla return to pear trees and lay their eggs on the emerging pear leaf buds (Horton *et al*. 1992). These eggs, then develop into the summerform psylla.

High population of *C. bidens* recorded in spring and summer season in both year 2013 & 2014. Similar finding was recorded by Shelton and Trumble (1991) common pistachio psyllid, *Agonoscena pistaciae* infestation is very high during certain periods of the year (e.g. late spring-early summer) and it is important to keep the number of samples to a minimum. Therefore, the pattern of sampling (random or stratified) is critical to minimize variance.

The present study indicated that age of trees had highly effect population density of pear psylla *C. biends*. Also Tezerji *et al*. (2015) studied the distribution of population of immature stages of the common pistachio psyllid, *Agonoscena pistaciae* within the tree and development of sampling strategy and found that probably mature leaves are essential for CPP to enter into the reproductive phase and complete its life cycle. Probably, the low density of immature stages of old leaves compared with mature leaves exhibit these leaves are unsuitable to complete life cycle of this pest and cause greater mortality and generally is a failure. The observed high number of eggs and nymphs on mature leaves than young leaves may be attributed to leaf color because; young leaves are light green and female psyllid reluctant to lay egg on light green leaves.

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تأثير العوامل الحيوية والغير حيوية على كثافة تعداد سيلد الكمثرى(Šulc) *Cacopsylla bidens* على أشجار الكمثرى بمحافظة الإسماعيلية

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معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى – جيزة – مصر

وإجريت هذه الدراسة فى إحدى مزارع الكمثرى بجمعية العاشر من رمضان بمحافظة الإسماعيلية خلال الفترة من بداية مارس الى نهاية نوفمبر خلال عامى ٢٠١٣و ٢٠١٤ . وفى هذه الدراسة تم تقييم تأثير بعض العوامل الغير حيوية (درجة الحرارة العظمى و الصغرى و الرطوبة النسبية) بإجراء الارتباط و الانحدار البسيط والمتعدد من الدرجه الاولى اما عن تأثير العوامل الحيوية (دورة النموالسنوية للنبات) بإجراء الارتباط و الانحدار البسيط والمتعدد فكانت من الدرجة الثالثة. و تبين ان دورة النمو للنبات كانت ذات تأثير فعال على تعداد بسيلد الكمثرى حيث سجل نسبة (٨٨,٨٧، ٨٧,٤٥ و ٨٥,٠٢ %) على طور البيضة و الحوريات و الحشرات الكاملة خلال العام الاول ٢٠١٣ بينما كانت فى العام الثانى ٢٠١٤ (٨٢,٤٤، ٨٨,٧٢ و ٨٥,٢١ %) على التوالى. وفي هذه الدراسة لم يتم تسجيل سوى مفترس واحد هو بقة الاوريس على طور البيضة بأعداد ضئيلة خلال فترة الربيع و الخريف.