

IMPACT OF SOME ABIOTIC FACTORS ON POPULATION FLUCTUATION OF WHITEFLY, *BEMISIA TABACI* (GENN.) AND POD BORER, *HELICOVERPA ARMIGERA* (HÜBNER) INFESTING TWO TOMATO VARIETIES

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Received: May 31, 2017

Accepted: Jul. 5, 2017

ABSTRACT: Weather factors plays a critical role in the population fluctuation of certain insects infesting tomato in field. Whitefly, *Bemisia tabaci* (Genn.) (Homoptera : Alyrodidae) , pod borer, *Helicoverpa armigera* (Lepidoptera: Noctuidae) infesting tomato foliage and fruits and considered the most serious pests infesting tomato plantation all over the world. This research was conducted to study the effect of air temperatures , relative humidity and dew point on population fluctuation of *Bemisia tabaci* and *Helicoverpa armigera*, eggs and larvae at different examination dates. The field experiment were carried out in a private farm of Elghaba village , Abukabier district , Sharkia governorate, along two successive summer plantations 2014 and 2015. Experimental area was planted with tomato , *Lycopersicon esculentum* (Mill.) Super Strain B (SSB) and Castle rock (CR) varieties. The obtained results show that there were significant differences and positive correlation between air temperature , relative humidity & dew point and eggs and larvae number of *Bemisia tabaci* and *Helicoverpa armigera* along the two successive seasons (2014 and 2015). Air temperature , relative humidity and dew point affect egg and larvae numbers of both studied insects by 16.7 to 82.6 % and 1.2 to 69.8% during 2014 and 2015, respectively. *Bemisia tabaci* recorded three peaks on castle rock (CR) and super strain B (SSB) recorded (30,300 and 140 eggs/ ten leaves) and (40, 32 and 20 eggs/ ten leaves) at 13th May , 10th and 30th June , while *H. armigera* recorded one peak on both varieties during 10th June 2014 recorded 107 and 32 eggs/ ten leaves , respectively on CR and SSB. Also, the results indicated that *B. tabaci* and *H. armigera* larvae population during 2014 summer season recorded three peaks on CR and SSB , during 20th May, 10th June and 6th July 2014 . At 2015 summer season the results revealed that population fluctuation of *B. tabaci* and *H. armigera* eggs recorded one peak on both varieties , except *B. tabaci* egg on CR which recorded two peaks (15, 3 egg / 10 leaves) at 13th May and 3rd June. Regarding to larvae population of *B. tabaci* on SSB , there were three peaks , but larvae population of *B. tabaci* on CR , *H. armigera* on SSB and CR recorded two peaks.

Key words : Tomato, *Lycopersicon esculentum* , *Bemisia tabaci* , *Helicoverpa armigera* , population fluctuation , climatic change .

INTRODUCTION

In recent years , disappearance of cotton seedling from year to year cause migration a lot of insect pests to vegetable plants from its tomato is considered one of most valuable vegetables crops, whereby tomato fruits contain moderate percentages of proteins , mineral salts , vitamins (A,B and C) and neutralization materials for gut acidity (Abdel – Fattah *et al* ., 1989) , but

unfortunately , tomato infested with many pests , among of the most serious pest, whitefly, *Bemisia tabaci* (Genn.) (Homoptera : Alyrodidae) , *Helicoverpa armigera* and *Tuta absoluta* is a serious pests on tomato foliage and fruits Soliman and Ismail 2008, Shedeed *et.al.* 2013, Soliman *et. Al.* 2014, Soliman 2015 and El-Aassar *et. al.* 2015. The most predominant damaging with *B. tabaci* biotypes are B and Q, and both are

vectors of *tomato yellow leaf curl virus* (TYLCV). Previous research has shown that Q outperforms B in many respects but comparative research is lacking on the ability of B and Q to transmit viruses, whitefly cause direct and indirect damage to tomato plants and 21 plant hosts others Rafiqi *et. al.* , 2008 , pod borer, *Helicoverpa armigera* (Hubn.) (Lepidoptera : Noctuidae) plays a detrimental role in the destruction of tomato which infested tomato in all stages (Rheenen and Van Rheenen, 1991) ,The countries affected by the devastating attack of *H. armigera* include India, Pakistan, Turkey, Mexico, Iran, Australia and Ethiopia (FAO, 1994). *H. armigera* often causes substantial damage to the crop at the pod formation stage (Lal *et. al.*, 1985; Naresh & Malik, 1986; Deka *et. al.*, 1987), also , these pests cause large loss of plants and produced fruits Dussourd and Denno, 1994 and Namesny (1996). Given to climatic changes in late years. The paper aimed to study population fluctuation of *Bemisia tabaci* and *Helicoverpa armigera*, eggs and larvae in different examination dates and effect of Temperature, Relative humidity and Dew point on population fluctuation.

MATERIALS AND METHODS

The field experiment were carried out in a private farm of Elghaba village , Abukabier district , at Sharkia governorate, during two successive summer plantations 2014 and 2015. Experimental area was planted with tomato, *Lycopersicon esculentum* (Mill.) Super Strain B and Castle rock varieties after seeded in green house and then transferred to the field at 1st Marsh and 25th February , 2014 and 2015, respectively . The experimental area was six kirate, from it 3 kirate planted with Supper strain B and 3 kirate with Castle rock , each area was divided into three replicates / variety, was in distribution of complete randomized block design, ten plants were randomized selected in each replicate using cross diagonals sampling techniques, select ten leaves from ten plants put in paper bag thenceforth

transmitted to laboratory, the eggs and larvae were counted using binocular in laboratory according to Soliman and Ismail 2008 in case of whitefly, *Bemisia tabaci* and pod borer, *Helicoverpa armigera* (Lepidoptera: Noctuidae) . The effect of mean temperatures , relative humidity and dew point (Table 1) were also related with the population fluctuations at different development. Analysis were conducted using the statistical package JMP 7.0.1 (SAS Institute , 2007).

RESULTS

1-Population fluctuation of *Bemisia tabaci* and *Helicoverpa armigera* eggs on tomato (Super Strain B and Castle rock variety) during 2014 summer plantation:

The data presented in Tab. 2 and Fig .1 showed that there are correlation between temperature , relative humidity and dew point with eggs and larvae number of *Bemisia tabaci* and *Helicoverpa armigera* during two successive seasons (2014 and 2015), without number egg of *B. tabaci* on SSB and CR 2014 season, temperature , relative humidity and dew point affect on egg and larvae number 16.7 to 82.6 % and 1.2 to 69.8% (%E) during 2014 and 2015, respectively.

The activity of *Bemisia tabaci* and *Helicoverpa armigera* on laying (eggs) on tomato castle rock and super strain B variety was commenced from first week from May to final the first week from July 2014 , tomato CR was attractive to *B. tabaci* and *H. armigera* where the data recorded high population during 2014 summer season .

Egg number of *B. tabaci* recorded three peaks on castle rock (CR) and super strain B (SSB) recorded (30,300 and 140 eggs/ ten leaves) and (40, 32 and 20 eggs/ ten leaves) at 13th May , 10th and 30th Jun. while *H. armigera* recorded one peak on two varieties during 10th Jun. 2014 recorded 107 and 32 eggs/ ten leaves , respectively on tomato CR and SSB.

Impact of some abiotic factors on population fluctuation of whitefly,

Table 1. Weekly mean of temperature , relative humidity and dew point during two successive seasons 2014 and 2015

Date of inspection	Mean of temp., relative humidity and Dew point 2014		
	Temperature (°C)	Relative humidity (RH)	Dew point (DP)
13/05/2014	22	50	11
20/05/2014	27	26	6
26/05/2014	26	39	11
03/06/2014	29	27	7
10/06/2014	27	50	15
17/06/2014	29	42	15
24/06/2014	27	45	14
30/06/2014	28	58	18
06/07/2014	28	57	18
Date of inspection	Mean of temp., relative humidity and Dew point 2015		
	Temperature (°C)	Relative humidity (RH)	Dew point (DP)
29/04/2015	28	34	9
06/05/2015	22	52	11
13/05/2015	23	46	9
20/05/2015	28	35	10
27/05/2015	36	14	4
03/06/2015	26	48	13
10/06/2015	26	54	15
17/06/2015	29	49	16

Table 2. Correlation (r) and polynomial of *Helicoverpa armigera* and *Bemisia tabaci* infesting tomato varieties . Super strain B (SSB) and Castle rock (CR)

Stage	Var.	Summer 2014					
		r	SE	P	r ²	% E	P
Egg <i>H.a</i>	SSB	1	-	***	0.455	45.5	***
Egg <i>H.a</i>	CR	1	-	***	0.301	30.1	***
Larva <i>H.a</i>	SSB	1	-	***	0.826	82.6	***
Larva <i>H.a</i>	CR	1	-	***	0.413	41.3	***
Egg <i>B.t</i>	SSB	- 0.496	0.354	Ns	0.423	42.3	**
Egg <i>B.t</i>	CR	0.365	0.268	Ns	0.285	28.5	***
Larva <i>B.t</i>	SSB	0.893	0.483	**	0.182	18.2	***
Larva <i>B.t</i>	CR	1.0	-	***	0.167	16.7	***
		Summer 2015					
		r	SE	P	r ²	% E	P
Egg <i>H.a</i>	SSB	0.911	0.167	**	0.302	30.2	***
Egg <i>H.a</i>	CR	0.980	0.080	**	0.698	69.8	***
Larva <i>H.a</i>	SSB	0.786	0.252	*	0.388	38.8	***
Larva <i>H.a</i>	CR	0.893	0.183	**	0.345	34.5	**
Egg <i>B.t</i>	SSB	1.0	-	***	0.586	58.6	**
Egg <i>B.t</i>	CR	1.0	-	***	0.209	20.9	*
Larva <i>B.t</i>	SSB	1.0	-	***	0.401	40.1	*
Larva <i>B.t</i>	CR	1.0	-	***	0.012	1.2	*

H.a = *Helicoverpa armigera* , *B.t* = *Bemisia tabaci*

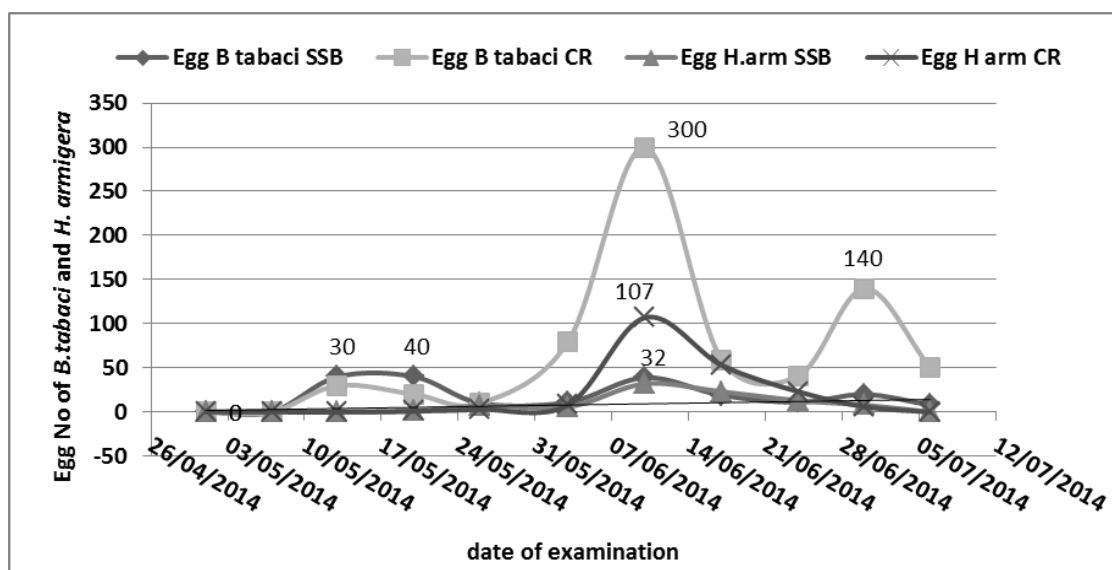


Figure 1. Mean numbers of *Bemisia tabaci* and *Helicoverpa armigera* (eggs) during summer season 2014 on tomato super strain B and Castle Rock.

2- Population fluctuation of *Bemisia tabaci* and *Helicoverpa armigera* larvae on tomato (Super Strain B and Castle Rock variety) during 2014 summer plantation:

Data illustrated in Fig. 2. showed mean numbers of *Bemisia tabaci* and *Helicoverpa armigera* (Larvae) during summer season 2014 on two tomato varieties.

Data in Fig. 2 showed that larval population during 2014 summer season . *B. tabaci* larvae recorded three peaks on two varieties (CR and SSB) , Castle rock was more infestation compared with SSB, the first peak in case of *Bemisia tabaci* recorded 179 and 32 at 20th May. and 30th Jun., the second peak during 10th and 24th Jun , the third peak noticed at 24th Jun. and 6th July recorded (40 and 129 larvae / ten leaves) and (69 and 120 larvae / 10 leaves) . *Helicoverpa armigera* on two varieties recorded three peaks during 20th May, 10th June and 6th July.

The correlation study indicated significant between larval population of *H. armigera* , *B.tabaci* on tomato two varieties and

temperature , relative humidity and dew point (r= 1.0,1.0, 0.893 and 1).

3-Population fluctuation of *Bemisia tabaci* and *Helicoverpa armigera* eggs on tomato (Super Strain B and Castle Rock variety) during 2015 summer plantation:

Data in Table 2. and Fig .3. illustrated that there are significant between temperature , relative humidity and dew point with egg of *B. tabaci* and *H. armigera* on two varieties during 2015 summer season. Also , statistical analysis showed positive correlation (1.0) in case *B. tabaci* eggs on CR and SSB but less (0.980 and 0.911) with *H. armigera* eggs on CR and SSB. Especially, population fluctuation of egg of *B. tabaci* and *H. armigera* recorded one peak on two varieties without *B. tabaci* egg on CR recorded two peaks (15, 3) at 13th May and 3rd Jun.

4- Population fluctuation of *Bemisia tabaci* and *Helicoverpa armigera* larvae on tomato (Super Strain B

Impact of some abiotic factors on population fluctuation of whitefly,

(SSB) and Castle Rock variety (CR) during 2015 summer plantation:

Data illustrated in (Table 2 and Fig. 4) show that larvae population of *B. tabaci* on SSB recorded three peaks at (13/5 , 27/5

and 10/6/ 2015) but larvae population *B. tabaci* on CR , *H. armigera* on SSB and CR recorded two peaks at (27/5, 10/6) , (6/5, 27/5) and (13/5 and 27/5) , respectively.

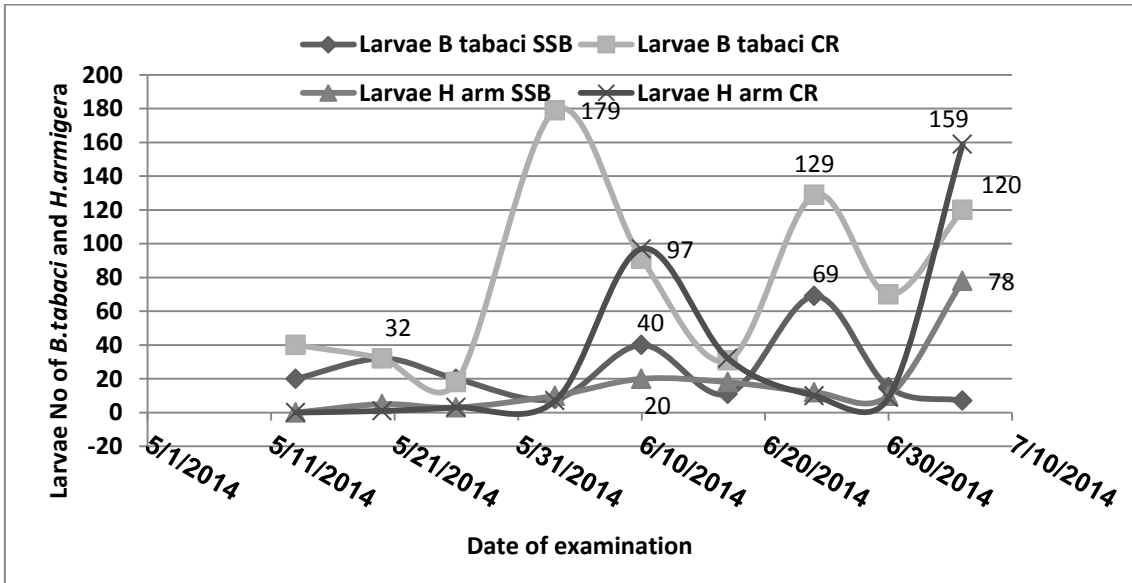


Fig. 2. Mean numbers of *Bemisia tabaci* and *Helicoverpa armigera* (Larvae) during summer season 2014 on tomato super strain B and Castle Rock.

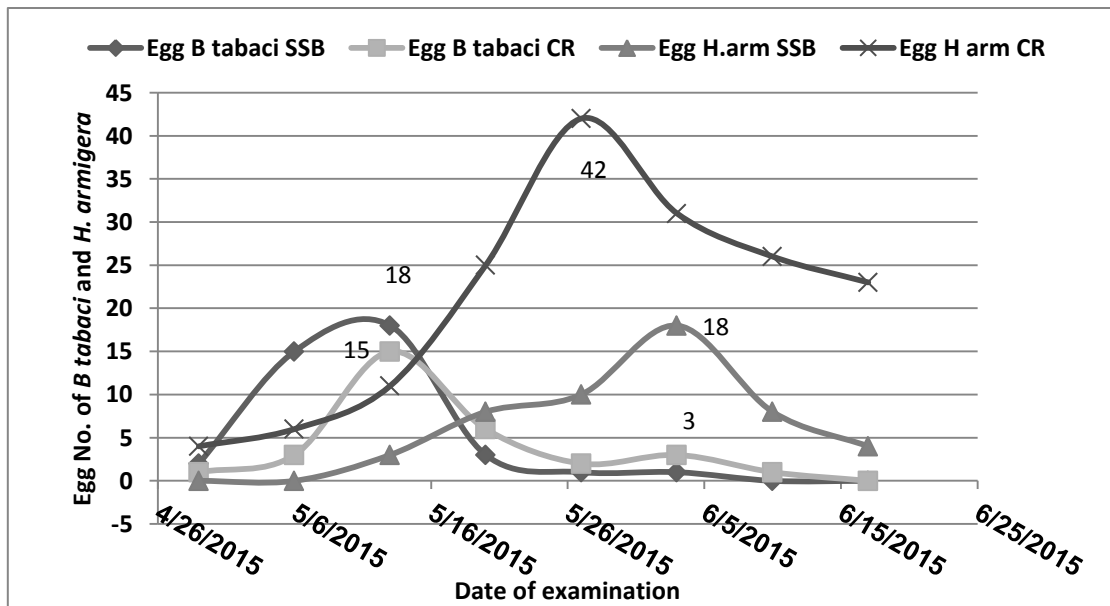


Fig.3. Mean number of *Bemisia tabaci* and *Helicoverpa armigera* (eggs) during summer season 2015 on tomato super strain B and castle rock.

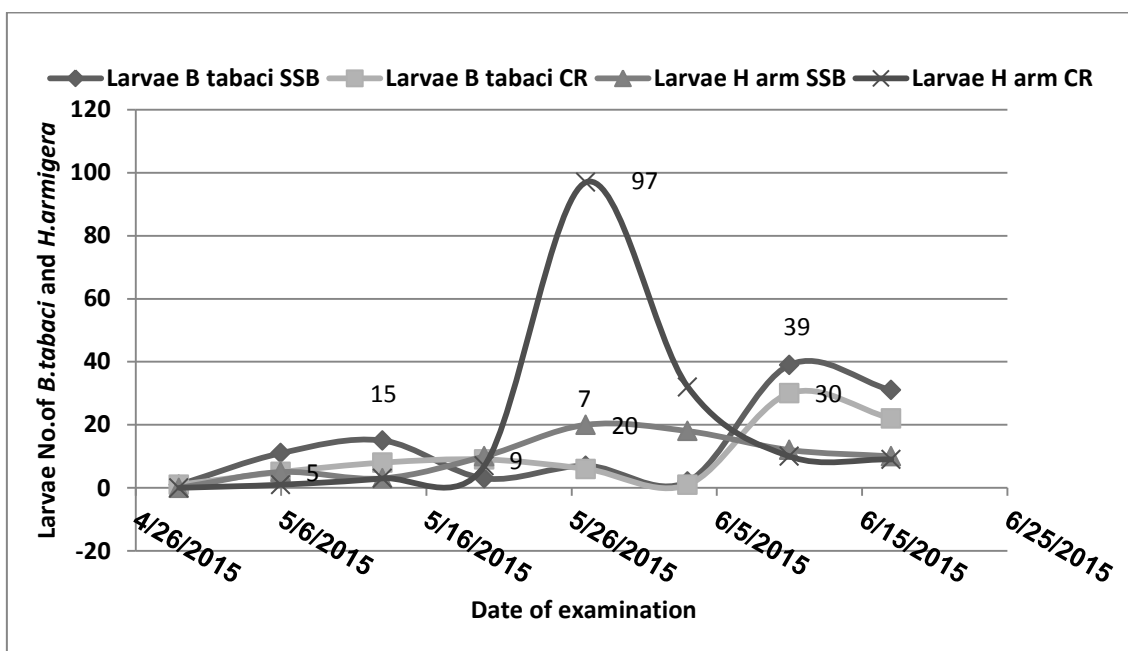


Fig. 4. Mean number of *Bemisia tabaci* and *Helicoverpa armigera* (larvae) during summer season 2015 on tomato super strain B and castle rock.

The obtained results are in agreement with Horowitz *et. al.* (1984), found that population fluctuation of *Bemisia tabaci* (Genn.) and *Helicoverpa armigera* egg and larvae affected with many factors of climate such (temperature, relative humidity and dew point), natural enemies, surrounding area, and host plants. Shah and Shahzad 2005 found that the densities of eggs and different larval instars of *H. armigera* were significantly positively correlated with temperature, and significantly negatively correlated with the average morning relative humidity (RH;%) but not with the average evening RH (%).

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Impact of some abiotic factors on population fluctuation of whitefly,

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تأثير بعض العوامل الغير حية على تذبذب أعداد الذبابة البيضاء ودودة ثمار الطماطم التي تصيب صنفان من الطماطم

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الملخص العربي

تلعب عوامل الطقس دور هاماً في تذبذب أعداد مجتمعات بعض الحشرات التي تصيب الطماطم في الحقل ، سواء الاجزاء الخضرية والثمارية للطماطم . يهدف البحث الى دراسة تذبذب أعداد الذبابة البيضاء ، دودة ثمار الطماطم خاصة في طور البيض واليرقات في مواعيد الفحص المختلفة ، وايضا دراسة تأثير متوسط درجات الحرارة والرطوبة النسبية ونقطة الندى على تذبذب التعداد.

أجريت التجربة في مزرعة خاصة في قرية الغابة مركز ابوكبير محافظة الشرقية خلال الموسمين الصيفيين لعام 2014 ، 2015 . تم زراعة ارض التجربة بصنفى الطماطم سوبر ستارين بى ، كاسل روك .

أظهرت نتائج التحليل وجود معنوية وعلاقة ارتباط بين درجة الحرارة ، الرطوبة النسبية ونقطة الندى مع عدد البيض واليرقات للذبابة البيضاء ودودة ثمار الطماطم خلال موسمى 2014 ، 2015 فيما عدا عدد البيض للذبابة البيضاء على صنفى الطماطم خلال موسم 2014 . درجة الحرارة والرطوبة النسبية ونقطة الندى تؤثر على عدد البيض واليرقات بنسبة تتراوح بين 16.7 الى 82.6 % ، 1.2 الى 69.8 % خلال موسمى 2014 و 2015، على التوالي . سجلت الذبابة البيضاء 3 زروات على صنف الطماطم كاسل روك والسوبر ستارين بى (30 ، 300 ، 140 بيضة / 10 ورقات) ، (40 ، 32 ، 20 بيضة / 10 ورقات) خلال ايام 13 مايو ، 10 ، 30 يونيو / 2014 بينما دودة ثمار الطماطم سجلت زروة واحدة فقط على صنفى الطماطم فى 10 يونيو 2014 ، حيث سجلت 107 ، 32 بيضة / 10 ورقات على التوالي على كاسل روك والسوبر ستارين بى . كما اوضحت النتائج ايضا أن عدد يرقات الذبابة البيضاء ، يرقات دودة ثمار الطماطم فى الموسم الصيفى 2014 سجلوا ثلاثة فورانات على صنفى الطماطم المختبرين خلال ايام 20 مايو ، 10 يونيو ، 6 يوليو / 2014 . وبخصوص الموسم الصيفى 2015 أوضحت النتائج أن عدد بيض الذبابة البيضاء ودودة ثمار الطماطم سجلوا زروة واحدة على صنفى الطماطم ماعدا بيض الذبابة البيضاء على الصنف كاسل روك حيث سجل زروتين (15 ، 3 بيضة / 10 ورقات) ولك فى 13 مايو ، 3 يونيو . كما سجل عدد يرقات الذبابة البيضاء 3 زروات بينما عدد يرقات دودة ثمار الطماطم سجل زروتين فى العروة الصيفى لعام 2015 على صنفى الطماطم .

يوصى البحث بضرورة زراعة نباتات الطماطم فى الميعاد المناسب وخاصة صنف الطماطم سوبر ستارين بى وذلك لقله إصابته بكل من الذبابة البيضاء ، دودة ثمار الطماطم .

الكلمات المفتاحية : الطماطم ، الذبابة البيضاء ، دودة ثمار الطماطم ، تذبذب الاعداد ، التغير المناخى