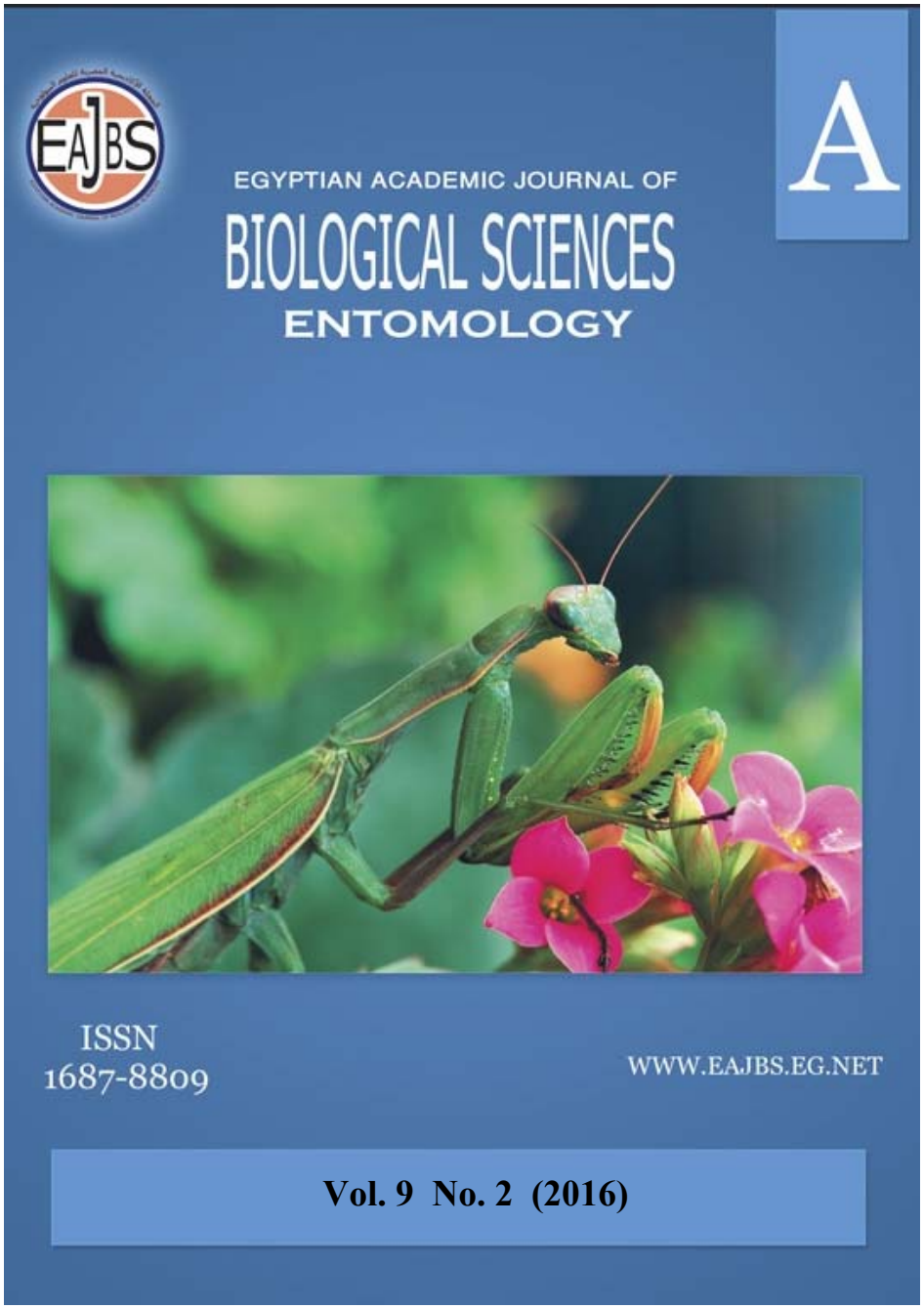

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Influence Of Plant Phenology (As Plant Age) And Some Weather Factors On *Aphis gossypii* Glover Population On Four Solanaceae Crops

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ABSTRACT

Experimental trials were conducted on four different vegetable Solanaceae crops; namely tomato, white eggplant, spicy pepper and potato throughout 2013 early summer growing season at the Agricultural Research Center Experimental Station (Qaha), Qalyoubia Governorate, Egypt.

Results revealed that the combined effect of the three weather factors (*i.e.* maximum and minimum temperatures and relative humidity) did not fully explained the variance in the population density over time. Explained variance (EV) was 19.98, 62.23, 60.62 and 59.7 % for tomato, eggplant, pepper and potato plants, respectively.

Considering plant phenology as plant age (X) (presented by three degree polynomial equation, $Y= a + b_1X+ b_2X^2+ b_3X^3$) revealed the most relation to the variance in population. EV was 49.67, 90.58, 76 and 84.22% for tested plants, respectively.

The added effect of weather factors to the plant age revealed EV as 74.32, 92.24, 83.45 and 94.02% for tomato, eggplant, pepper and potato plants, respectively. These added values did not seem to be significant.

These results do not eliminate the effect of weather factors on the population dynamics. Under laboratory conditions; these factors may reveal a great deal of effect. Under field conditions these factors firstly affect the plant growth which makes the plant more palatable for infestation. So plant phenology as plant age took over the effect of weather factors mathematically.

INTRODUCTION

Vegetables are subjected to be attacked by many piercing sucking insect pests such as aphids, whiteflies and jassides (El-Khawas, 2005).

The solanaceous plants, potato and tomato are considered the two principal vegetable crops in Egypt. They are infested with considerable numbers of economic important insect pests particularly those which are ideal vectors for viruses causing plant diseases (Kassem, 1990)

The cotton aphid, *Aphis gossypii* Glover (Homoptera: Aphididae), is a highly

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polyphagous species (Agarwalaand and Choudhury, 2013). It is one of the most widespread species of aphids infesting numerous crops (Margaritopoulos *et al.,* 2006). In temperate zones *A. gossypii* mainly attacks vegetables in fields and greenhouses (Baniameri and Nasrollahi 2003 and Isikber, 2005). The damage includes a reduction in yield and fruit quality through direct feeding and honeydew production as well as damage incurred from the transmission of more than 50 plant viruses (Roistacher *et al*., 1984 and Blackman and Eastop, 2000).

Plant phenology can have significant impact on the pest status of aphid species infestation. For example, phenology determines at which growth stage the crop is likely to be invaded by aphids and which crops are likely to be most severely affected (Williams and Dixon, 2007).

The stem extension growth stage of barley harboured the highest population of *Rhopalosiphum maidis* Fitch in comparison with the tillering or heading stage (El-Fatih, 2006). The abundance of *Sitobion avenae* Fab. varied also on wheat plants with the growth stage of the plant, the season and probably other factors related to the plant physiology (Dedryver, 1978).

The present study focused on the effect of some weather and plant phenology factors on the population dynamics of *A. gossypii* on four solanaceae plants over the growing season.

MATERIAL AND METHODS

Field studies were conducted during 2013 early summer growing season at the Agricultural Research Center Experimental Station (Qaha) of the Plant Protection Research Institute, Qalyoubia Governorate, Egypt.

Monitor included four different Solanaceae vegetable crops. They were tomato (E603 F1 hybrid, lojain); white eggplant (*Solanum melongera*, local variety); spicy pepper (*Capsicum annuum* Murad F1 hybrid) and potato (*Solanum tuberosum* cv. Hermes). Planting date was in early February and seedlings were transplanted in the end of February, 2013. Each host plant was replicated three times in a complete randomized blocks design. The cultivated area of each plot size was about 42 m^2.All agricultural practices were applied except for pest control. Sampling started on March, 5^{th} and continued until June, 4^{th}. Random samples of ten leaves per plot were picked up weekly. Direct count of aphid samples was conducted. Meteorological data of maximum and minimum temperatures and relative humidity were obtained and used in data analysis. Considering plant phenology as plant age (X) was presented by three degree polynomial equation ($Y= a+ b_1X+ b_2X^2+ b_3X^3$).

RESULT AND DISCUSSION

Aphid population on the four studied solanaceae crops:

Tomato (E603 F1 hybrid, lojain):

Results indicated that *A. gossypii* appeared on tomato plants on March, 5^{th} (13 individuals/sample) then increased gradually until reaching its maximum (963.33 individuals/sample) on April, 23^{rd}. These numbers decreased to be 131.33 and 14. 67 individuals/sample on April. 29^{th} and May, 7^{th}, respectively. After that date it disappeared (Fig. 1). Homopterous sap sucking species were the most dominant insect pests infesting potato where they formed 86.4 - 94.2% of insects occurred on tomato plants in the field (Kassem, 1990).

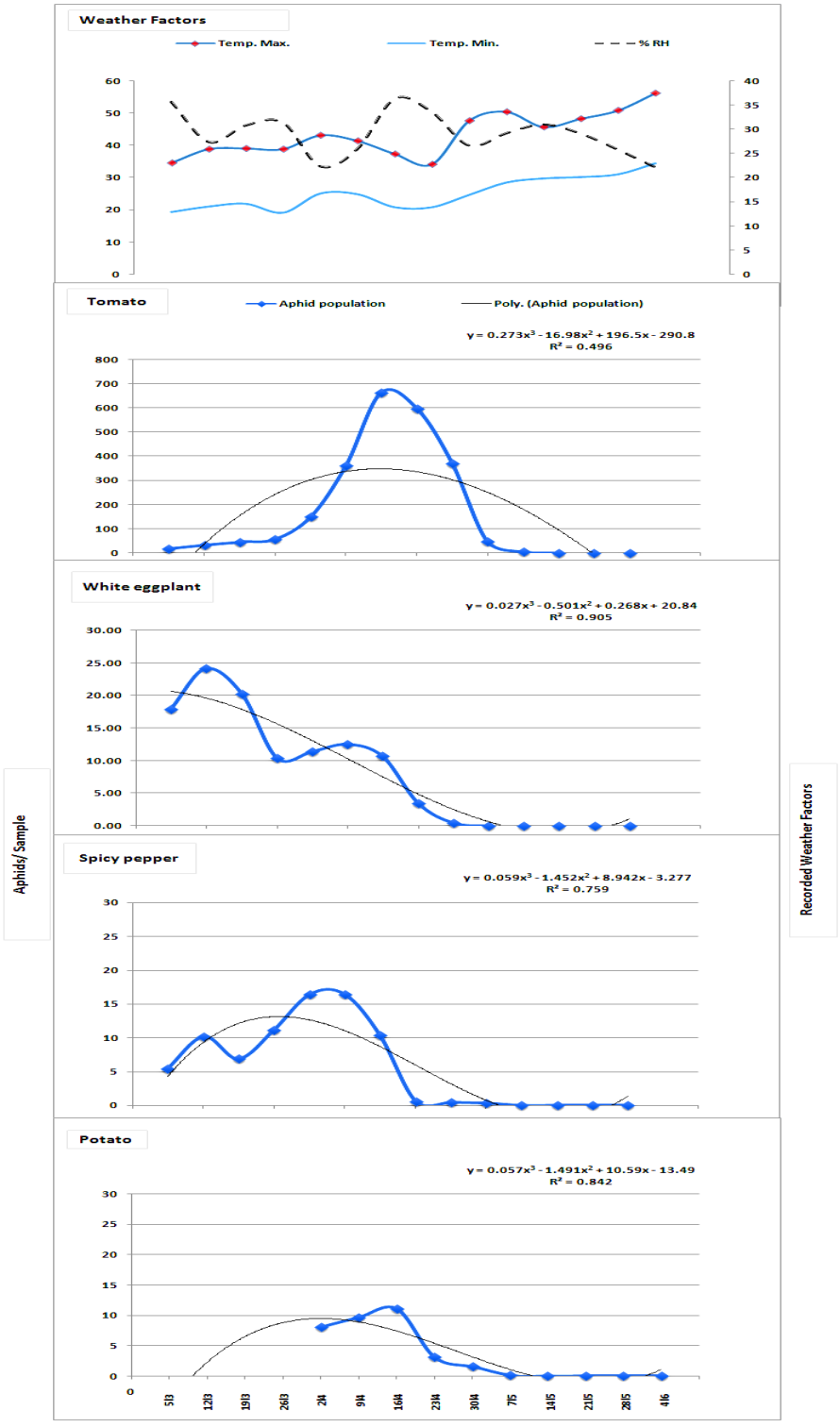

Fig. 1: Population dynamic of *A. gossypii* on four Solanaceae crops in relation to three weather factors at Qaha Station during early summer cultivated season (2013).

White eggplant (*Solanum melongera*, local variety):

Results revealed that *A. gossypii* appeared in few numbers on eggplant plants on March, 5th (17 individuals/sample) then increased gradually until reaching its maximum (21.67 individuals/sample) on April, 9th. After that it decreased gradually until disappeared on April 29th, 2013 (Fig. 1). This species was recorded as a pest of

eggplant (Mousa, 2003). *A. gossypii* was the only recorded species attacking eggplant during the summer plantations of the two seasons, 2006 and 2007 (El-Khawas and El-Khawas, 2008). They added, that aphid populations were increased gradually until reaching their maximum total numbers during the last week of April of the two seasons 2006 and 2007, respectively; where being 631 & 483 individuals/200 leaflets. It was obvious that population was decreased until disappeared at the last week of September of the two seasons, 2006 and 2007.

One peak was noticed for *A. gossypii* on eggplants plants during the fourth week of August with a total number of 426 insects/sample during the season of 2010, while in season of 2011; the peak was occurred at the second week of August with a total number of 487 insects/sample on eggplant plants (Hegab *et al.,* 2014).

Spicy pepper (*Capsicum annuum* Murad F1 hybrid):

Results graphically illustrated in Fig. (1) indicated that *A. gossypii* appeared on spicy pepper plants on March, 5th which being 10.33 individuals/ sample then it fluctuated in few numbers until reaching its maximum (30.33individuals/sample) on April, 9th. These numbers decreased until the disappeared on May, 7th.

Pepper is a very important vegetable worldwide, providing spice and color to foods, while providing essential vitamins (Green and Kim, 1991).

During season of 2010, one peak was noticed for *A. gossypii* population on pepper plants at the fourth week of August with a total number of 214 insects/sample, while in season 2011; the peak was occurred at the second week of August with a total number of 214 insects/sample on pepper plants (Hegab *et al.,* 2014).

Potato (*Solanum tuberosum* cv. Hermes):

Results shown in Fig. (1) indicated that *A. gossypii* appeared on potato plants on April, 9th (24.33 individuals/sample). These numbers decreased until disappear on May, 7th.

The highest grand average number of aphid at all over the season was recorded on tomato (167.60) followed by white eggplant (8.33) then spicy pepper (5.83) and potato (3.06) during 2013 early summer season (Fig. 1).

Homopterous sap sucking species were the most dominant insect pests on potato where they formed 98-99% of insects occurred on potato plants in the field (Kassem, 1990). *A. gossypii* was recorded on potato (cv. Nicola) plants at El-Badrshein region, Giza Governorate (Abd El-Fattah *et al.* 2000). They added that infestation of potato plants by aphid species was much higher in the summer than nili [autumn] during the studied period between 1995-1996. During summer, infestation increased and fluctuated from the beginning of the season until the end of March, then decreased rapidly until crop harvesting during May. In nili plantation, aphid infestation was much lower at the time of plant sprouting, then it decreased with the growing season from late October to the end of harvesting time.

Statistical analysis

Statistical analysis of the obtained data using multiple or partial regression for factors affecting population dynamics of aphids considered three weather factors (maximum & minimum temperatures and relative humidity) and plant phenology (as plant age (X)) are presented in Table (1).

Obtained results revealed that the effect of different weather factors, within considered ones indicated negative effect in most cases with non significant effect (Table 1).

Results revealed that the combined effect of the three weather factors did not fully explain the variance in the population density over time. Explained variance was

19.98, 62.23, 60.62 and 59.7% for tomato, eggplant, pepper and potato plants, respectively.

Table 1: Result of applying partial regression to factors affecting aphid population on four Solanaceae vegetable crops during 2013 growing season.

Host Plant	Variable	b	P	F	P	EV %
Tomato	T Max	-17.41	0.7032	0.83	0.506	19.98
	T Min	-3.34	0.9528			
	RH%	3.24	0.8202			
	Plant (Age1-Age3)	-	-	3.29	0.0665	49.67
	Combined effect	-	-	3.38	0.0682	74.32
Eggplant	T Max	-1.08	0.3575	4.94	0.0269	62.23
	T Min	-1.17	0.4174			
	RH%	-0.68	0.089			
	Plant (Age1-Age3)	-	-	32.03	0.0001	90.58
	Combined effect	-	-	13.87	0.0014	92.24
Spicy pepper	T Max	-1.0076	0.2609	5.13	0.021	60.62
	T Min	-0.68	0.5299			
	RH%	-0.76283	0.0161			
	Plant (Age1-Age3)	-	-	10.56	0.0019	76
	Combined effect	-	-	5.88	0.0174	83.45
Potato	T Max	-0.48	0.5222	2.96	0.1194	59.7
	T Min	-0.74	0.4758			
	RH%	-0.26	0.2797			
	Plant (Age1-Age3)	-	-	10.67	0.0081	84.22
	Combined effect	-	-	7.86	0.0595	94.02

Considering plant phenology as plant age (X) (presented by three degree polynomial equation $Y= a+ b_1X+ b_2X^2+ b_3X^3$) revealed that the most relation to the variance in population. EV was 49.67, 90.58, 76 and 84.22% for tomato, eggplant, pepper and potato plants, respectively.

The added effect of weather factors to the plant age revealed EV as 74.32, 92.24, 83.45 and 94.02% for tomato, eggplant, pepper and potato plants, respectively. These added values did not seem to be significant.

These results do not eliminate the effect of weather factors on the population dynamics. Under lab conditions these factors may reveal a great deal of effect. Under field conditions these factors first affect the plant growth which makes the plant more palatable for infestation. So plant phenology as plant age took over the effect of weather factors mathematically.

Climatic factors exert a great influence on the growth, development, distribution, and population dynamics of insect pest (Chang, *et al.* 2008). Both the physical and biological factors are much vital causing the variations in the densities of aphid population (Naeem, 1996).

Aphid population density was partially and negatively related with temperature, wind velocity, photoperiod and rainfall in summer and nili plantation of 1995 and 1996. In addition, plant age was positively related with population density in nili one (Abd El-Fattah *et al.* 2000).

Effect of maximum and minimum temperatures and relative humidity on population density of the dominant leafhoppers, aphids and white fly infesting certain vegetable plants (tomato, potato, cabbage, cauliflower, squash and cucumber) were studied under Dakahlia Governorate (Elgindy, 1997). Statistical analysis indicated

that the effect of maximum and minimum temperatures affected the population of insects more than relative humidity.

Aphid population showed significant negative correlation with minimum and maximum temperatures (Shakeel *et al*., 2015). They added, significant positive correlation with relative humidity and non-significant negative correlation with rainfall were recorded. The determination of effects of different weather factors on population of aphids in tomato was essential for effective pest management.

Aphid population varied due to temperature Aheer *et al*. (2008). They incidicated that aphid population showed significantly negative correlation with maximum and minimum temperatures and precipitation, whereas relative humidity was positively correlated. Significant negative correlation of the aphid population with maximum temperature was reported by Chandrakumar *et al.* (2008).

The highest aphid population occurred during March (Aheer *et al*. 2007; Wains *et al*. 2010 and Iqbal *et al*. 2008).

Population of aphid increased with decrease in temperature, lowest population was found on tomato at temperature of 32.5°C and the highest population was recorded at temperature of 27.5°C (Shakeel *et al*., 2015).

Plant phenology can have significant impact on the pest status of aphid species infestation. For example, phenology determines at which growth stage the crop is likely to be invaded by aphids and which crops are likely to be affected most severely (Williams and Dixon, 2007).

The stem extension growth stage of barley harboured the highest population of *R. maidis* in comparison with the tillering or heading stage (El-Fatih, 2006). The abundance of *Sitobion avenae* Fab. varied also on wheat plants with the growth stage of the plant. The season and probably other factors related to the plant physiology (Dedryver, 1978). The same findings were noticed by Vidya (1982) who reported that the aphid population started to decline when ear head emergence started.

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ARABIC SUMMERY

تأثير ظواهر نمو النبات مقدرة كعمر وبعض العوامل المناخية على تعداد من القطن *Aphis gossypii* على أربعة محاصيل من العائلة الباذنجانية

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3- المعمل المركزي للمناخ- مركز البحوث الزراعية- مصر

تم من خلال هذه الدراسة محاولة تفسير تأثير كل من ظواهر نمو النبات مقدرة بعمر النبات وبعض العوامل الجوية شملت درجات الحرارة القصوى والصغرى والرطوبة النسبية على تعداد حشرات من القطن على بعض نباتات العائلة الباذنجانية وهي الطماطم، الباذنجان، الفلفل الحار والبطاطس المنزرعة بمحطة بحوث قها التابعة لمعهد بحوث وقاية النباتات بمركز البحوث الزراعية خلال موسم الزراعة في آخر شهر فبراير 2013.

وقد أوضحت قيم التحليل الإحصائي للبيانات المتحصل عليها ان معظم النتائج تدل على ان العوامل الجوية تحت الدراسة لم يكن لها تأثيرا معنويا واضحا على تعداد الآفة حيث كانت قيم معامل التحديد المتحصل عليها 19.98، 62.23 ، 60.62 و 59.7% على كل من محصول الطماطم ، الباذنجان، الفلفل الحار والبطاطس على الترتيب.

في حين كانت العلاقة أكثر وضوحا ومعنوية في حالة تأثير مرحلة نمو النبات مقدرة كعمر النبات وممثلا بعلاقة غير خطية من الدرجة الثالثة على شدة الإصابة بالآفة حيث كانت قيم معامل التحديد المتحصل عليها 74.32، 92.24، 83.45 و 94.02 % على كل من محصول الطماطم ، الباذنجان ، الفلفل الحار والبطاطس على الترتيب مقارنة بالقيم المتحصل عليها عند الاعتماد على العوامل الجوية تحت الدراسة بمفردها.