# EFFECT OF SOME WEATHER FACTORS ON COTTON APHID, *APHIS GOSSYPII* GLOVER (HEMIPTERA: APHIDIDAE) AND ITS PREDATOR *COCCINELLA UNDECIMPUNCTATA* L. (COLEOPTERA: COCCINELLIDAE)

**Fatina Baiomy and H. S. Shaalan**
Plant Protection Research Institute Dokki – Giza, Egypt

**ABSTRACT:**

In field experiment at Giza Governorate, Egypt during 2012 and 2013 seasons, aphids; *Aphis gossypii* Glover and its predator; *Coccinella undecimpunctata* L. on cucumber plantations were affected by temperature and relative humidity. The temperature had a significant positive correlation with population densities of aphids and the predator (r = 0.78, 0.79, 0.66 and 0.73) in both sucssive seasons; respactively, meanwhile rlative humidity correlated significantely negative with the population dinisty of Aphids, (r = -0.75 and -0.71). *Coccinella undecimpunctata* however was non-significant correlated with relative humidy , (r = -0.59 and -0.51) respectively. Statistical analysis also showed a strong positive significant correlation between aphids and the predator (r= 0.90 and 0.91). Therefore the studied abiotic factors affect independently the activities of both the pest and predator. *A. gossipii* was affected positively by temperature and negatively by relative humidity while, *C. undecimpunctata was* affected positively by temperature and aphid population. Relative humidity had no significant effect on the predator.

**Keywords:** *Aphis gossypii* Glover, *Coccinella undecimpunctata* L., Relative humidity, Temperature

## INTRODUCTION

Cucumber, *Cucumis sativus* L. is considered one of the most important cucurbitaceous vegetable crops in Egypt, cultivated in wide areas of old land or newly reclaimed land, as well as in greenhouses.

Cotton aphid, *Aphis gossypii* Glover is a diverse species widely distributed in tropical, subtropical and in warm regions (Isikber, 2005). It is known as one of the most destructive pests in pepper, cucumber, and eggplant crops (Kim *et al.* 2013). *Coccinella undecimpunctata* L. is a significant biological control agent that predates on aphids and other soft bodied arthropods and is the most beneficial against cotton pests; immature and mature stages as voracious feeder of all the species of aphids (Karpacheva, 1991). Coccinellids, comprise one of the most active groups of predatory species that feed on different sucking pests including aphids on different crop plants (Bahy El-Din, 2006).

All living organisms are influenced environmental factors which have direct impact on the biology. Therefore, temperature and relative humidity were evaluated for their effect on population of aphids and its predator *C. undecimpunctata.*

## MATERIALS AND METHODS

To study the effect of some weather factors (temperature and relative humidity) on population of aphid (*A. gissypii*) and its predator (*C. undecimpunctata*) in cucumber plantation in open field. Experiment was carried out at Giza Governorate during two successive seasons (2012 and 2013). The experimental area was four kirats (700 $m^2$) divided to four replicate plots and cultivated with cucumber plants (Madina variety) in March1$^{st}$. All plots received the normally recommended agricultural practices of land preparation, thinning, irrigation, and mechanical weed control and kept free from any insecticidal application.

### Sampling procedure

Samples of 20 leaves/ plot were randomly picked weekly and transferred in paper bags to the laboratory for pest and predator counting starting one month of planting and continuing for eight weeks.

The meteorological data provided by the central laboratory for agricultural climate (CLAC), Giza, Egypt was employed to test the effect of temperature and relative humidity on population densities.

**Statistical Analysis:** The mean and simple correlation explained the possible relationship of aphid and predator populations with those abiotic factors. The SAS system by users Guid SAS (1988) was used for this analysis.

### Results and Dissections

### The effect of temperature and relative humidity on Aphid population

Figure (1) shows the effect of temperature on mean of Aphid population fluctuation in the summer plantation during two successive seasons (2012 and 2013). Aphid mean population showed the same trend during two last mentioned seasons. Aphid population started low with (1 and 3 individual /leaf) then increased to reach first peak in 15 and 18 of April during summer 2012 and summer 2013, respectively.

The highest mean of aphid population (38 and 38.5 individual / leaf) were recorded in April of seasons (2012 and 2013), when the mean of temperature was 28$^0$C and 26$^0$C. On the other hand, the lowest aphid mean population was recorded when the temperature was 17$^0$C in the March 18$^{th}$ (summer 2012). The present findings are comparable with several research workers (Yamamura and Kiritani, 1998 and Makled 2012) found that the activity and population of sucking pests such as aphids increases with increase in temperature. Moreover, (Soni et al 2013) found the temperature range from 20.2 to 28.8°C was most favorable for buildup of aphid colonies in the field.

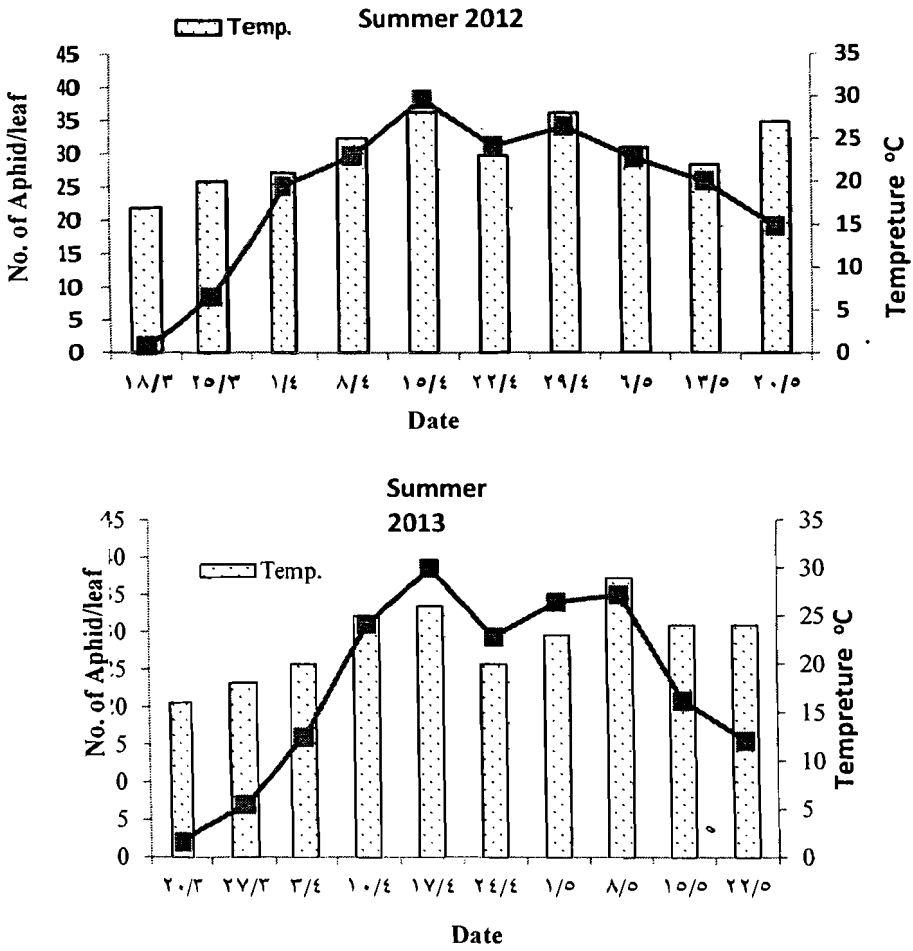


**Figure (1): The effect of temperature on aphid population fluctuation.**

Figure (2) shows the simple correlation coefficients between mean of temperature and the population dnsity of A. gossypii during succissive seasons (2012&2013). Generally, increased temperature increases the population denisty of A. gossypii. Temperature has a high significant positive correlation coefficents, r = 0.78** and 0.79** with the population dinisties. ( Makled 2012 and Sharma et al. 2013) found that aphid population was positively correlated temperature.

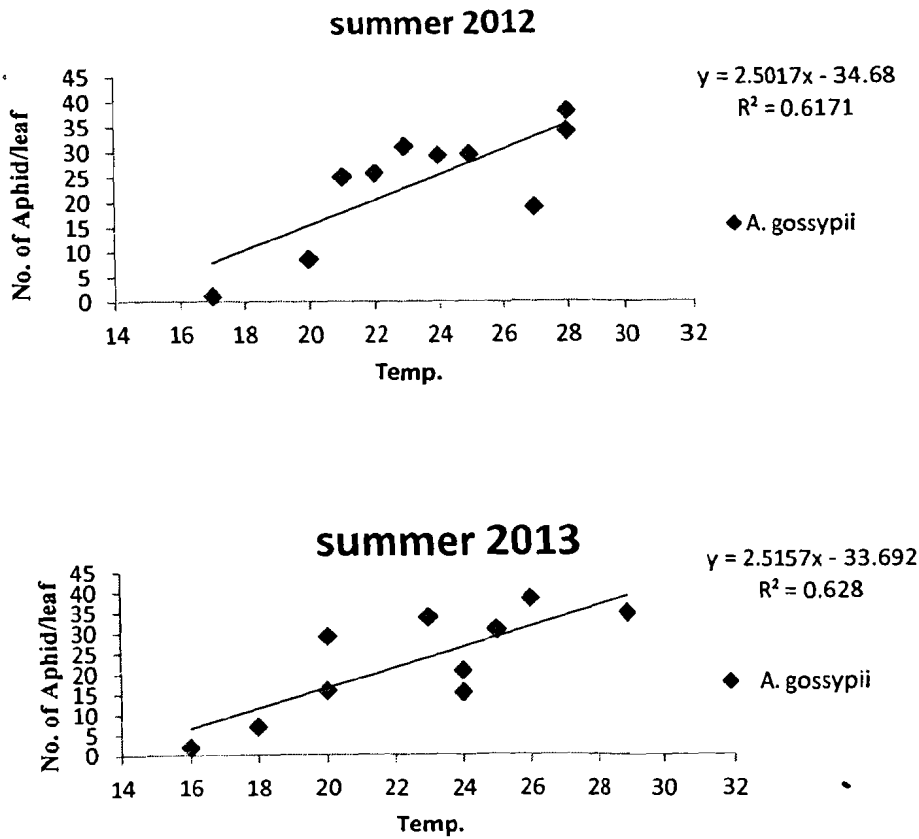


**Figure (2): The correlation between aphid and temperature during the summer period of two successive seasons (2012 & 2013).**

Figure (3) shows the effect of relative humidity on mean of aphid population fluctuation in the summer plantation during two successive seasons (2012 and 2013). The general trend is the decrease of relative humidity causing increases in aphid population. The lowest mean of aphid population was recorded in March in both seasons where the relative humidity was 61% and 60% in the first and second season, respectively. On the other hand, the high means of aphid population (38 and 38.5 individual / leaf) were recorded at mid-April where the relative humidity was 31% & 40%, respectively. In this respect (Makled et. al. 2012) reported that the decreasing of relative humidity lead to decrease of aphid population

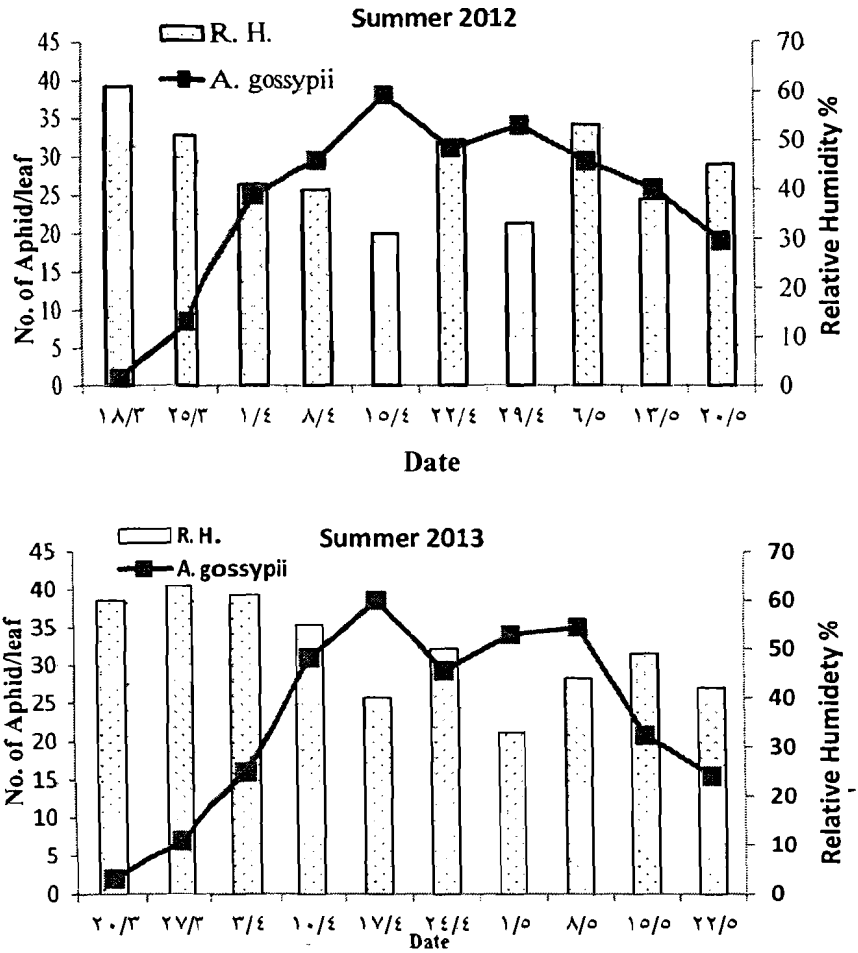


**Figure (3): The effect of relative humidity on aphid population fluctuation.**

Figure (4) shows the simple correlation coefficients between releative humidity avarege and the population density of *A. gossypii* during two succissive seasons (2012 and 2013). Inverse relationship was found between the relative humedity and *A.gossypii* population denisty. Moreover, relative humidity had a negative significant correlation coefficents, r = -0.75* & -0.71 respectively, with the population denisties.

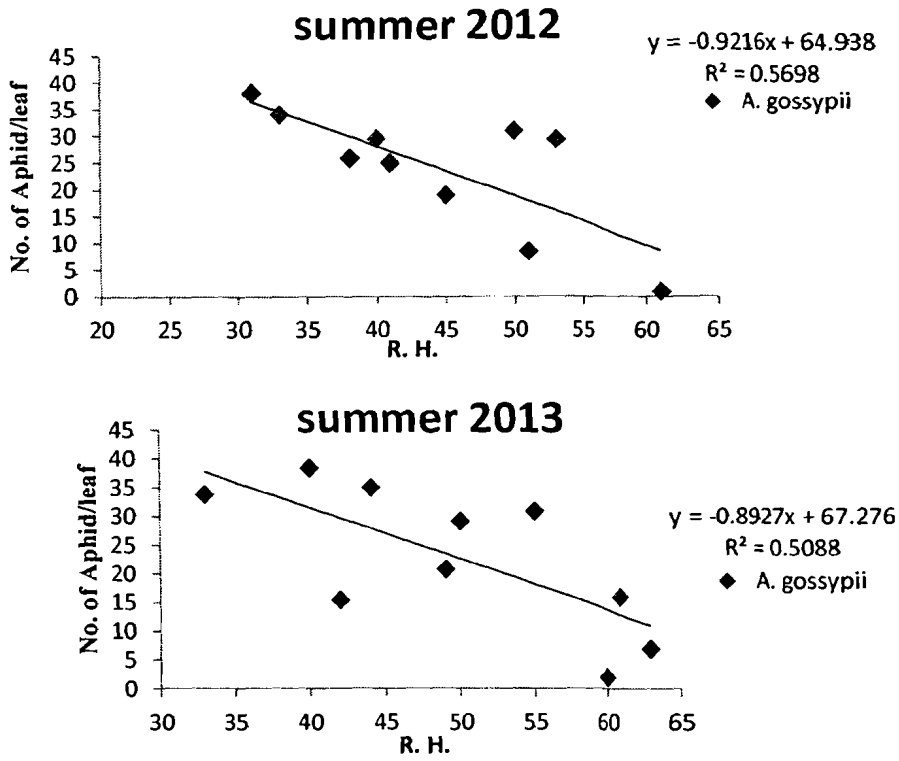


**Figure (4): The correlation between aphid and relative humidity during the summer period of two successive seasons (2012 & 2013).**

**The effect of temperature and relative humidity on predator population**

Figure (5) shows that the population of *C. undecimpunctata* was affected temperature in both two seasons (2012 and 2013). In the first season (summer 2012) the population gradually increased according to increase in temperature till reached first peak (9.2 individual at 28°C.), in mid-April. The population decreased to 6.5 individual in April 22nd then, the mean population of *C. undecimpunctata* got second peak at the end of April (10.3 adult at 28°C.). In the second season (summer 2013) mean population of *C. undecimpunctata* fluctuated and reached peak in May 8th (9.5 individual at 29°C.). These results have harmony with Srivastava (2003) that the increase in temperature increased the rate of development of *C. undecimpunctata*. Abdel-Rahman (2005) mentioned that the temperature affects growth and reproduction of *C. undecimpunctata*, suggesting that the optimum temperature for this carnivorous insect and its development ranges between 25 to 30°C. El-Dessouki et al, (2014) reported that the population of *C. undecimpunctata* started to increase in March and April and reached their higher peaks in April and May.

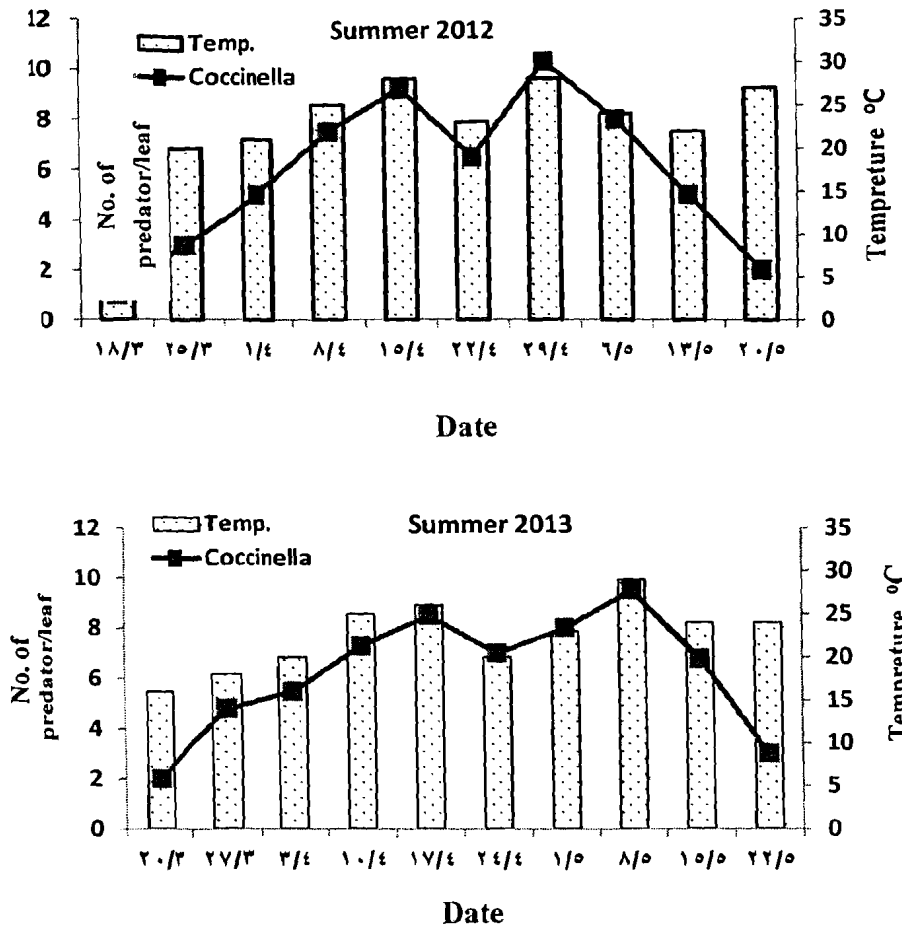


**Figure (5): The effect of temperature on predator population fluctuation.**

Figure (6) shows the simple correlation and regration between tempreature and the population dnesity of *C. undecimpunctata* during successive seasons (2012 and 2013). Incidence of the predator showed significant positive correlation with tempreature during the two study seasons, r = 0.66* and 0.73* respectively. Srivastava (2003) and Soni et al. (2013) mentioned that there is a linear relationship with a significant positive correlation between temperature and the population of ladybeetle.

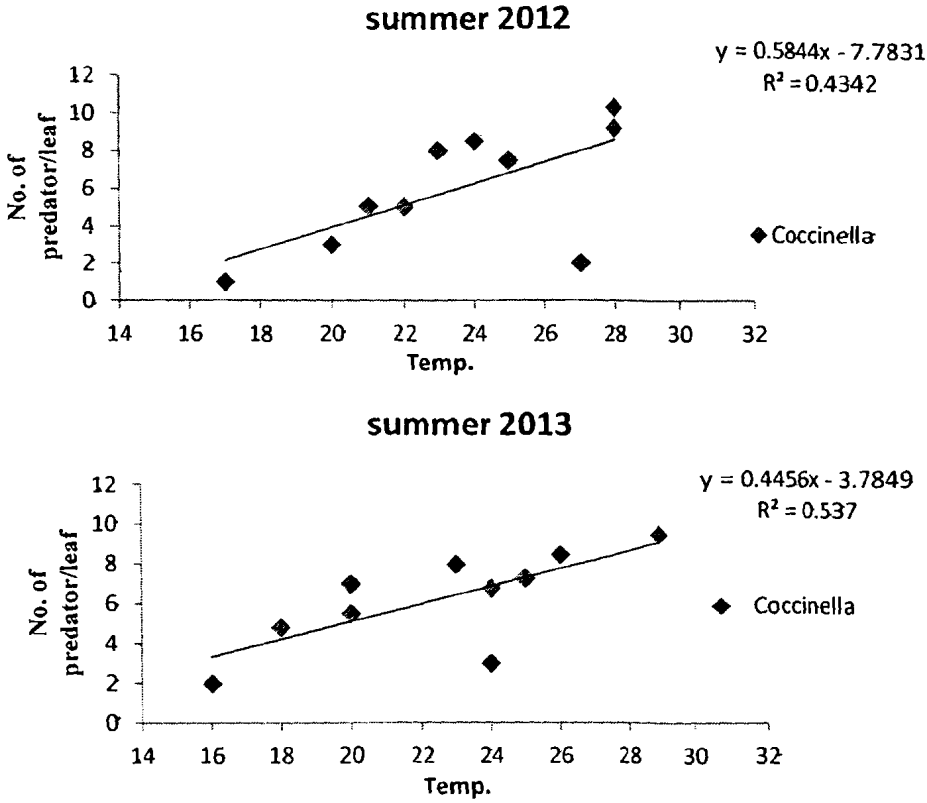


**Figure (6): The correlation between predator and temperature during the summer period of two successive seasons (2012&2013).**

figure (7) shows that the highest population of *C. undecimpunctata* occurred under the lowest relative humidity condition. In first season (summer 2012) the *C. undecimpunctata* recorded two peaks, 9.2 and 10.3 individual where the R.H. was 31% and 33 % respectively. While in the second season (summer 2013) the height mean of population 9.5 observed at 44% R.H. These results are in agreement with some authors findings (Abdel-Rahman 2005 and Al-Digail et al 2012).

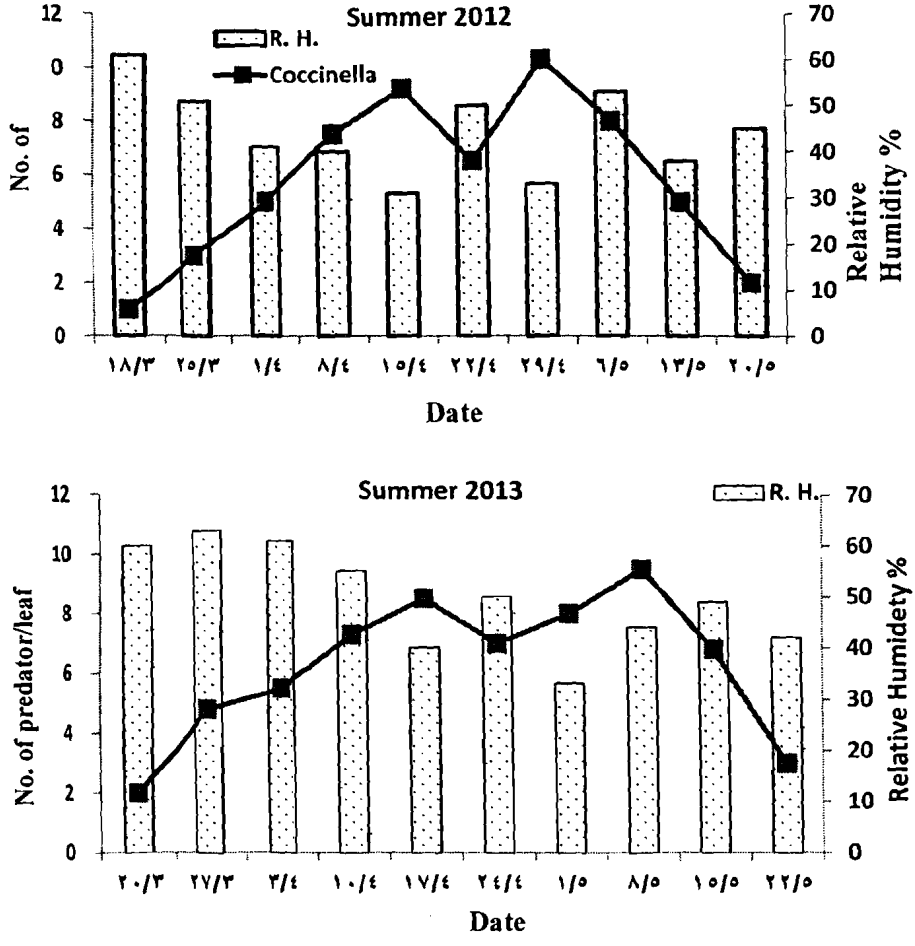


**Figure (7): Effect of relative humidity on predator population fluctuation.**

Figure (8) shows the simple correlation coefficients between relative Humidity and the mean population dnsity of *C. undecimpunctata* during two succissive seasons (2012&2013). Incidence of the predator showed inverse non-significant negative correlation relative humidy either in the first season or in the second season, r= -0.59 and -0.51 respectively.

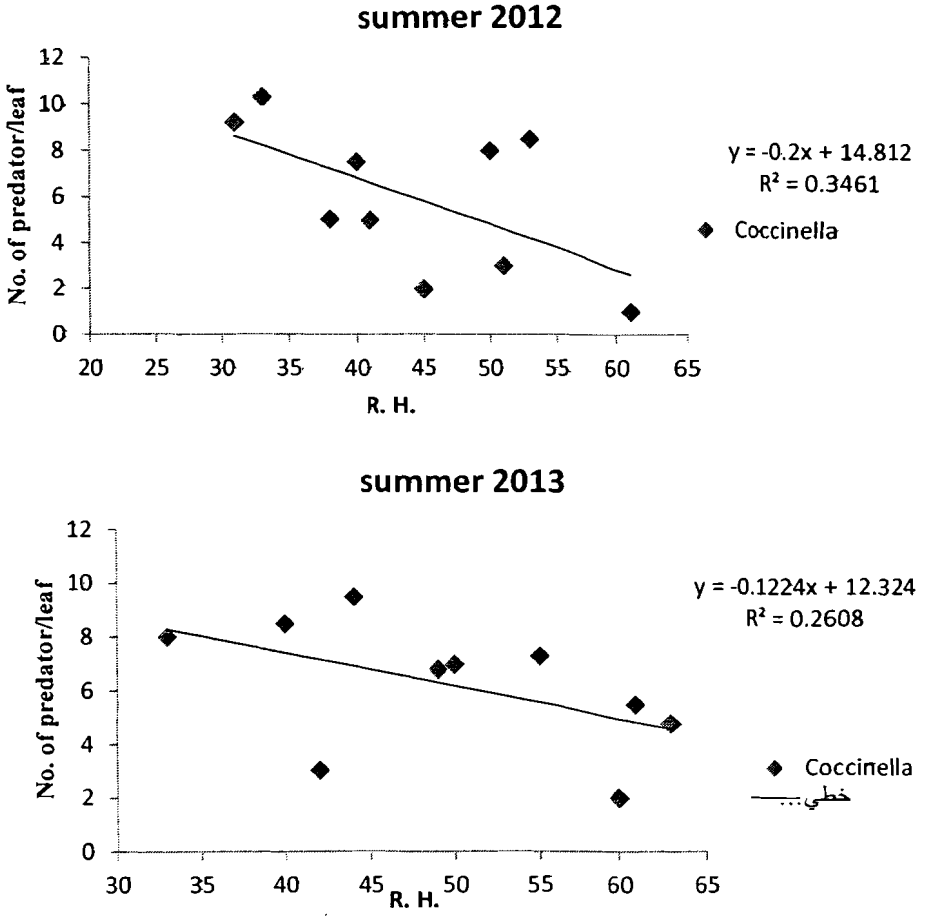


**Figure (8): the correlation between relative humidity and predator population during the summer period of two successive seasons (2012&2013).**

Statistical analysis showed that, there was strong positive significant correlation between *A. gossypii* population and the population of the coccinellid beetles *C. undecimpunctata* (r = 0.90*** and 0.91***, Figure 9). This result is agreement with Khan et al. (2011) who reported that *C. undecimpunctata* populations had a strong positive and significant correlation with the aphid numbers in the field.

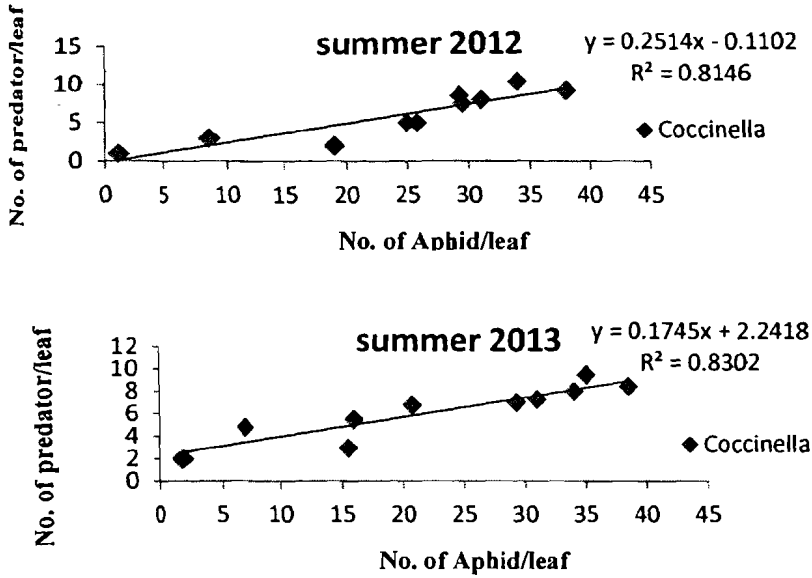


**Figure (9): Correlation between *Aphis gossypii* and its predator *Coccinella undecimpunctata***

## REFERENCES

**bdel-Rahman, M. (2005):** Influence of constant temperature on the development, and reproductive potential of the ladybird beetle, (*Coccinella undecimpunctata* L. Coleoptera: Coccinellidae). 3rd International Conf. on IPM role in Integrated Crop Management and Impacts on Envi. and Agr. Products, 26-29 (2005), Geiza ,Egypt.

**Al-Digail, S. A., Ahma, I., and Mahyoub, J. A. (2012).** Effect of temperature and humidity on the population abundance of spotted oriental cucumber beetle epilachna chrysomelina (F.)(Coccinellidae: Coleoptera) In Al–Qunfudah Western Saudi Arabia. *Curr World Environ*, 7(1), 07-12.

**Bahy El-Din, I. A. E. (2006):** Studies on the biology and feeding capacity of some coccinellid species. Unpublished M.Sc. Thesis, Fac. of Agric., Moshtohor Benha Univ., Egypt.

**El-Dessouki, S. A., EI-Awady, S. M., El-Khawass, K. A. M. H., Mesbah, A. H., and El-Dessouki, W. A. A. (2014):** Population fluctuation of some insect pests infesting sugar beet and the associated predatory insects at Kafr El-Sheikh Governorate. *Annals of Agricultural Sciences*, *59*(1), 119-123.

**Isikber, A. A. (2005):** Functional Response of Two Coccinellid Predators, Scymnus levaillanti and Cycloneda sanguinea, to the Cotton Aphid, Aphis gossypii. Turk. J. Agric., 29: 347-355.

**Karpacheva, N.S.,(1991):** Ladybird beetle. Zaschchita Rastenii. Journal of.Economic Entomology 10, 34-35

**Khan, A.A., A.M. Khan, H.M. Tahir, M. Afzal, A. Khaliq, S.Y. Khan and I. Raza (2011):** Effect of wheat cultivars on aphids and their predator populations. African J. Biotch., 10, 18399- 18402

**Kim J. J., Gayoung Jeong, Ji Hee Han and Sangyeob Lee (2013):** Biological Control of Aphid Using Fungal Culture and Culture Filtrates of Beauveria bassiana. Mycobiology, 41(4): 221-224

**Makled, A. M. H., Abolmaaty, S. M., Hassanein, M. K., and Abd El-Ghafar, N. Y. (2012).** Impact of Type of Greenhouse Cover Sheets on Certain Major Cucumber Pests under Protected Cultivation. *New York Science Journal*, *5*, 19-24.

**SAS institute (1988):** SAS / Stat user's guide, 6.03 ed. SAS institute, Cary, NC.

**Sharma, D., Maqbool, A., Ahmad, H., Srivastava, K., Kumar, M., and V. V. S. Jamwal, (2014).** Effect of meteorological factors on the population dynamics of insect pests of tomato. *Vegetable Science*, *40*(1), 90-92.

**Soni, R., G.S. Deol and S., Satnam (2013):** Seasonal dynamics of wheat aphid complex and predator *Coccinella septempunctata* in relation to abiotic and biotic factors. J. Environ. Biol., 34, 689-694.

**Srivastava, S. (2003):** Influence of temperature on certain biological attributes of a ladybeetle *coccinella septempunctata* linnaeus. Insect Science, 10: (3) 185-193

**Yamamura, K., and K. Kiritani. (1998):** A simple method to estimate the potential increase in the number of generations under global warming in temperate zones. Applied Entomology and Zoology, 33:289- 298.

## تأثير بعض العوامل المناخية علي من القطن (*Aphis gossypii* Glover) ومفترس أبو العيد ذو الأحدي عشرة نقطة (*Coccinella undecimpunctata* L.)

فتينه بيومي و هشام صالح شعلان

معهد بحوث وقاية النباتات – مركز البحوث الزراعية– دقي –جيزة

أجريت التجربة في محافظة الجيزة خلال موسمي ٢٠١٢ و ٢٠١٣ لدراسة تأثير بعض العوامل الجوية متمثلة في درجات الحرارة والرطوبة النسبية على آفة من القطن *Aphis gossypii* ومفترس أبو العيد ذو الأحدي عشرة نقطة *coccinella undecimpunctata* على نباتات الخيار. وقد أظهرت النتائج أن درجة الحرارة ترتبط ايجابيا مع تعداد المن والمفترس حيث أن قيمة معامل الأرتباط كانت ٠.٧٨، ٠.٧٩ ، ٠,٦٦ و ٠,٧٣ في كلا الموسمين على التوالي. كما اشارت النتائج الى وجود علاقة عكسية بين الرطوبة النسبية وتعداد المن ذات ارتباط معنوي خلال موسمي الدراسة حيث وجد ان قيم معامل الأرتباط -٠,٧١ و -٠,٧٥ على التوالي. علاوة على ذلك، أظهرت النتائج وجود ارتباط عكسي غير معنوي بين تعداد المفترس والرطوبة النسبية سواء في الموسم الأول أو الثاني، قيمة معامل الأرتباط -٠,٧١ و -٠,٥٩ على التوالي. أوضحت نتائج التحليل الإحصائي وجود ارتباط موجب قوي بين تعداد المن *A. gossypii* وتعداد المفترس *C. undecimpunctata* قيمة معامل الأرتباط ٠,٩٠ و٠,٩١ في موسمي 2012 و 2013على التوالي. واخيرا، فإن العوامل المناخية تؤثر بشكل مستقل على نشاط كل من حشرة المن و المفترس، حيث كان تأثير درجة الحرارة إيجابياعلى تعداد المن في حين كان تأثير الرطوبة النسبية سلبيا. علاوة على ذلك فقد كان تأثير درجة الحرارة ايجابي على تعداد المفترس بينما لم يكن هناك تأثير معنوي للرطوبة النسبية على تعداد المفترس.