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EFFECT OF CERTAIN WEATHER FACTORS AND SOME NATURAL ENEMIES ON THE POPULATION DENSITY OF THE BOLLWORMS AND COTTON LEAFWORM AT KAFR EL-SHEIKH GOVERNORATE, EGYPT

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ABSTRACT

Experiments were carried out at the Farm of Sakha Agricultural Research Station Kafr El-Sheikh Governorate, during two successive seasons, 2014 and 2015 to evaluate the effect of certain weather factors (temperature, relative humidity and wind speed), and some natural enemies (six insect predators were recorded, *Coccinella undecimpunctata* L., *Scymnus interruptus* Goez., *Paederus alfierii* Koch, *Syrphus spp.*, *Orius* spp. and *Chrysoperlla carnea* (Steph.)) on the population density of the bollworms larvae (pink bollworm, *Pectinophora gossypiella* (Saund.) and spiny bollworm, *Earias insulana* (Boisd.) and the egg-masses of the cotton leafworm, *Spodoptera littoralis* (Boisd.). The initial occurrence of the pink bollworm larvae on cotton bolls was recorded in the last week of July (26th) during the first season and week early (18th of July) during the second season and exhibited four peaks of population density in every season. Numbers of larvae were highly significant and negative correlated with changes of the temperature (-0.752** and -0.798**) of both seasons, respectively. While, the correlation between numbers of larvae and changes of the relative humidity was insignificantly and negatively (-0.103 and -0.140) in both seasons, respectively. But, the wind speed influenced on the larval occurrence were significant and negative (-0.472*) during the first season, and insignificant and positive (0.020) during the second season. So, the correlation were positive and significant (0.495* and 0.480*) between the density of larvae of pink bollworm and the insect predators during the two seasons, respectively. While, the initial occurrence of the spiny bollworm larvae on cotton bolls was recorded in the 9th and 15th of August during the two successive seasons, respectively, and exhibited three peaks of population density in every season, number of larvae of this insect was highly significant and negative correlated (-0.631** and -0.690**) with changes of the temperature during both seasons, respectively. While, the relationship between the relative humidity and number of the spiny bollworm larvae was negative and insignificant (-0.177) during the first season, but, it was positive and insignificant (0.083) during the second season, while, the wind speed influenced was significant and negative (-0.408*) during the first season, and it was insignificant and negative (-0.173) during the second season, on the larval occurrence of this insect. So, the correlation were positive and significant (0.542* and 0.585*) between density of the spiny bollworm and the insect predators during the two seasons, respectively. The cotton leaf worm egg-masses exhibited three peaks of population density in every season, the effect of temperature on the population density of the cotton leaf worm egg-masses was significant and positive (0.459*) during the first season, and insignificant and positive (0.212) during the second season, while, the effect of the relative humidity on egg-masses of this insect was insignificant and positive (0.347) during the first season, and negative (-0.134) during the second season. So, the effect of wind speed on egg-masses was insignificant and negative (-0.162) during the first season, and positive (0.263) during the second season. While, the correlation were highly significant and positive (0.631** and 0.620**) between the population density of cotton leaf worm egg-masses and the insect predators during the two successive seasons.

INTRODUCTION

Cotton is the most important economic crop in Egypt, and is one of the major sources of foreign currency to the Egyptian national income. Cotton plants are subjected to attack by a wide range of insect pests throughout growing stages until near maturity. Among the main insect pests are the pink bollworm, *Pectinophora gossypiella* (Saund.) and the spiny bollworm, *Earias insulana* (Boisd.), so the cotton leaf worm, *Spodoptera littoralis* (Boisd). are serious pests of cotton in Egypt. Due to the great damaging potential of these pests, great attention has been paid to reduce crop losses as for as possible. The relationship between the infestation by (bollworms and cotton leafworm) and certain weather factors and natural enemies was studied by Hassanein *et al*. (1995), El-Zanan *et al*. (1998), Parajulee *et al*. (2006); Mesbah *et al*. (2008) and Gosalwad *et al*. (2009). More information about the behavior and abundance of the cotton pests as affected by changes in the environmental weather factors and some natural enemies are required to facilitate the prediction of their population density which may help to reduce the amount of the used insecticides for their control.

The present study was designed to add to the knowledge on the relative abundance of the above pests and to clarify the effect of temperature, relative humidity, wind speed and some natural enemies as well as their simultaneous effect on the occurrence of those pests during the two successive cotton growing seasons, 2014 and 2015.

MATERIALS AND METHODS

Experiments were carried out at the Farm of Sakha Agric. Res. Station, Kafr El-Sheikh Governorate, during two successive seasons, 2014 and 2015, in order to study the population density of the three insect pests attacking cotton plants (cotton bollworms, *Pectinophora gossypiella* (Saund.) and *Earias insulana* (Boisd.) as well as the cotton leafworm, *Spodoptera littoralis* (Boisd.), and six insect predators were recorded, *Coccinella undecimpunctata* L. (adults and larvae), *Scymnus interruptus* Goez (adults and larvae), *Paederus alfierii* Koch. (adults and larvae), *Syrphus* spp. (larvae), *Orius* spp. (adults and nymphs), and *Chrysoperla carnea* (Steph.) (larvae). An area of about ¼ feddan was cultivated with Giza 88 cotton variety on 30th and 25th of March in both seasons.

All agricultural practices were followed in due time and no pesticidal treatments were applied. To determine the larval population density of pink and

spiny bollworms, samples of 25 green bolls/replicate (four replicates) were picked weekly immediately after bolls formation and continued till harvest. These bolls were taken at random from different levels of plant height (one boll per plant) and transferred to the laboratory. The bolls were dissected in the laboratory on the same day to determine the larval population density of both bollworms at the respective dates.

In case of the cotton leafworm, counting of egg-masses was done every three days for all plants of the cultivated area during the period from the first week of June to the end of the last week of October in both seasons. The total number of egg-masses found on all plants of the cultivated area was taken as an indication for the insect population density. The numbers of above insect predators were estimated by counting, the total numbers of this predators on both surfaces of 25 leaves (one leaf per plant) on the plant/replicate (four replicates) at early morning, three weeks after sowing and continued at weekly intervals till harvest, these leaves were random from different levels of plant height.

For studying the effect of certain ecological weather factors such as temperature, atmospheric relative humidity and wind speed on the population density of the three insect pests. The daily means of the three factors were provided by the Ministry of Agric., Agric. Res. Center, Rice Res. Training Center, during the whole period of the two tested seasons of 2014 and 2015. The statistical analysis was conducted using the software programme MSTATC. To show the effect of each factor as well as the interactions on the population density of the studied pests.

RESULTS AND DISCUSSION

The pink bollworm, *Pectinophora gossypiella* (Saund.):

As clearly shown in Figs. (1 and 2), the initial infestation of cotton bolls with the insect larvae occurred in low numbers of 0.04 larvae/boll on the 26th of July 2014 in the first season and a week early (18th of July) 2015 in the second season. The corresponding means of temperature, relative humidity and wind speed were (29.57, 29.39^{o}C; 70.00, 68.14%; 100.00, 86.00 km/24 hr) for the first and second seasons, respectively. During 2014 season, after the first appearance, the number of larvae increased gradually to reached the first peak (0.08 larva/boll) in 9th of August (at 30.45^{o}C; 67.58% R.H. and 93.57 km/24 hr). After this low peak, the samples of cotton bolls taken on 16th of august were free from insect larvae. In the following week (on 23rd of August), the insect larvae reappeared with a mean number of 0.04 larva/boll. Thereafter, the population density of larvae was noticed showing three other peaks, the second and the third peaks were attained on the 6th and 27th of September with means of 0.20 and 0.56 larva/boll, at (28.59, 26.62^{o}C; 69.29, 64.79 R.H.% and 90.86, 79.29 km/24 hr), respectively. The fourth one was the highest peak (0.96 larva/boll), occurring on the 18th of October at (26.05^{o}C; 69.95% R.H. and 67.00 km/24 hr). Through the period of population activity of the pink bollworm on cotton plants in 2015 season, which extended from the 18th of July to late of October, the insect fluctuated in number to show four peaks of activity. The first peak was the lowest in number (0.08 larva/boll) and was recorded in the first of August at (29.00^{o}C; 68.50% R.H. and 85.00 km/24 hr).

The second peak was highly with a mean numbers of 0.16 larva/boll on 29th of August at (28.95^{o}C; 71.0% R.H. and 81.43 km/24 hr), while the third and the fourth peaks were attained on the 26th of September and 17th of October with means of numbers of 0.52 and 0.60 larva/boll, at (27.19, 24.45^{o}C; 68.43%, 69.57% R.H. and 78.57, 84.57 km/24 hr), respectively.

The occurrence and rate of infestation of cotton bolls with pink bollworm in the first season were higher than in the second season. The mean numbers of larvae/boll were 0.56 and 0.36 in 2014 and 2105 seasons, respectively.

The data presented in Table (1) reveal that temperature negatively and significantly affect the insect pink bollworm larvae population in both seasons 2014 and 2015 (-0.752** and -0.798**), respectively. Liu *et al*. (1986) found that mortality was highest in the egg stage and in newly hatched larvae of pink bollworm, in additions to death by natural causes, mortality was attributed to precipitation wind and low temperature. Also, Khurana and Verma (1990) in China found that the highest infestation by pink bollworm in mean maximum and minimum temperatures of (34.3 and 20.5^{o}C), respectively, a mean R.H. of 73% than mean maximum and minimum temperatures of (36.3 and 23.2^{o}C), respectively, and a mean R.H. of 64.8%.

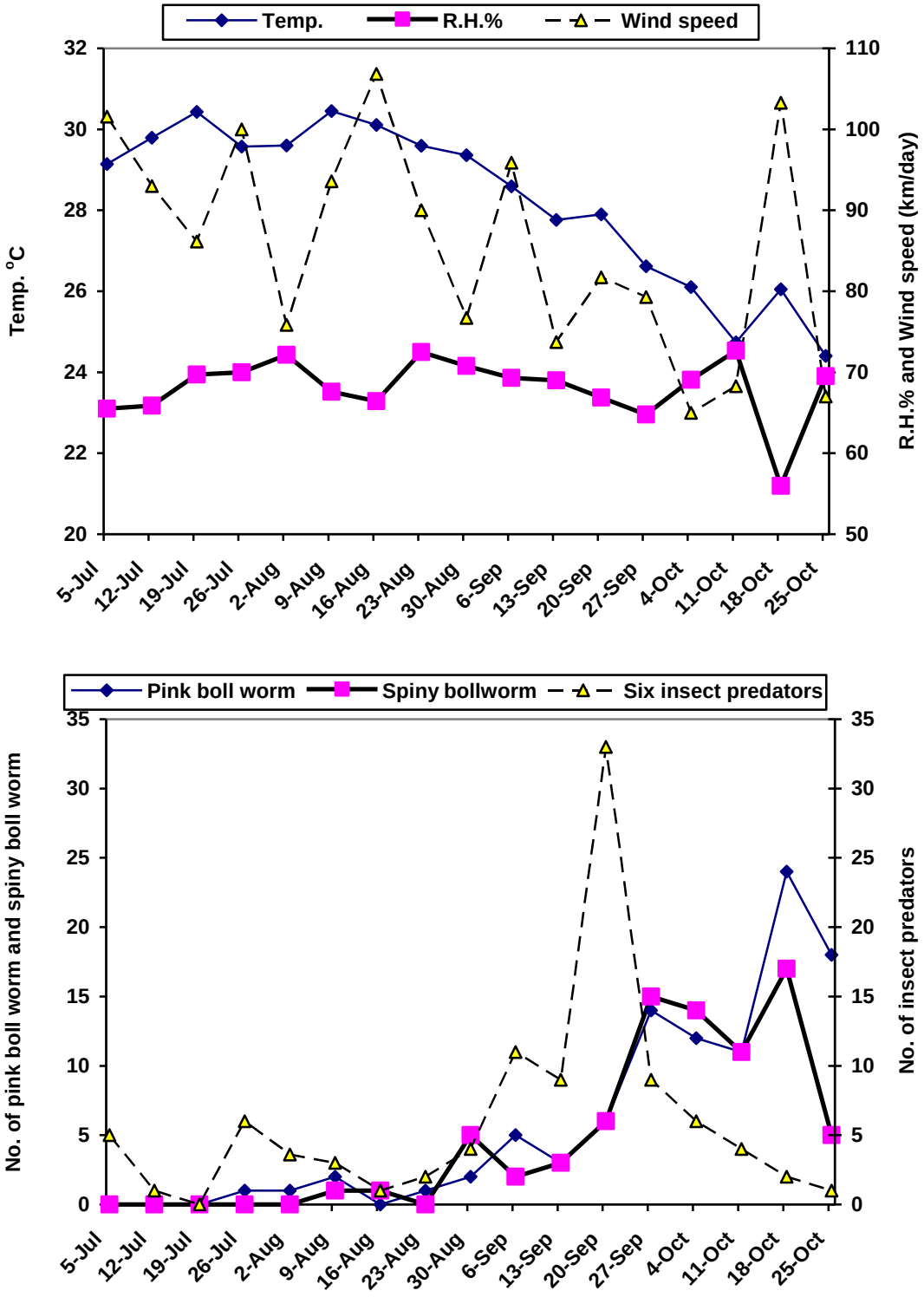

Fig. (1): The population density of the bollworms, certain weather factors and insect predators during 2014 season

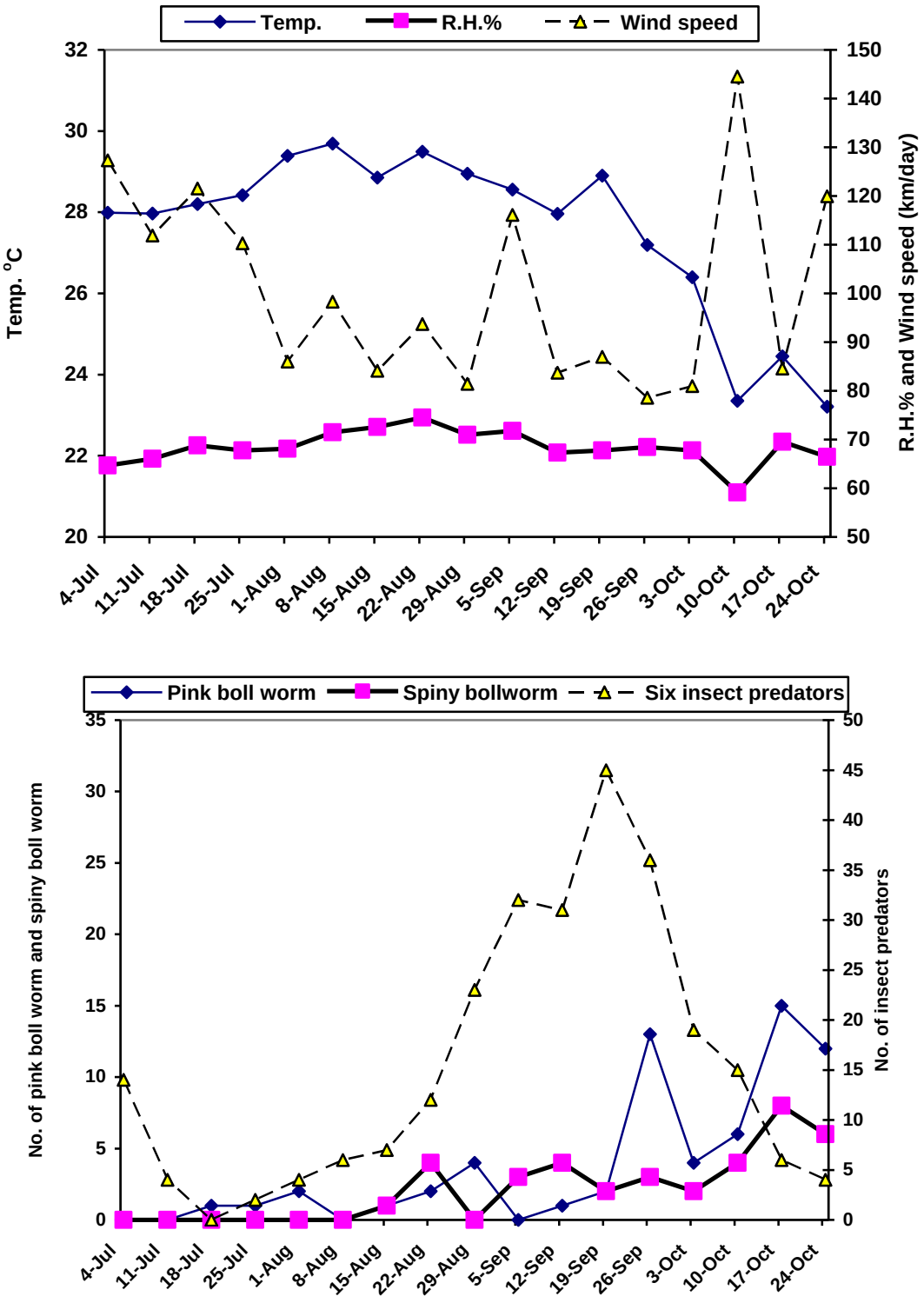

Fig. (2):The population density of the bollworms, certain weather factors and insect predators during 2015 season

Table(1):Sample correlation coefficient (R) between pink bollworm, spiny bollworm and cotton leaf worm and temperature, relative humidity, wind speed and insect predators for seasons 2014 and 2015

Correlation coefficient (R)	Pink bollworm	Spiny bollworm	Cotton leaf worm
		2014 season	
Temperature	-0.752**	-0.631**	0.459*
Relative humidity	-0.103	-0.177	0.347
Wind speed	-0.472*	-0.408*	-0.162
Insect predators	0.495*	0.542*	0.631**
		2015 season	
Temperature	-0.798**	-0.690**	0.212
Relative humidity	-0.140	0.083	-0.134
Wind speed	0.020	-0.173	0.263
Insect predators	0.480*	0.585*	0.620**

***, ** significant at 0.05 and 0.01 level of probability, respectively.**

These results are in agreement with those of Dhaka and Pareek (2008) and Dubey (2010). The effect of temperature was negative and significant, while, El-Zanan *et al*. (1998) and Nadaf and Goud, 2007), they found that the effect of temperature was positively and insignificant or significant.

In Table (1) the effect of relative humidity was negative and insignificant in both seasons (2014 and 2015) were (-0.103 and -0.140), respectively, these results agreed with Hassanein *et al*. (1995), Nassef *et al.* (1996) and El-Zanan and Watson (1998). But, some authors found different results, the effect of relative humidity. on the insect population larvae of pink bollworm was negative and significant by Nadaf and Goud (2007), Dhaka and Pareek (2008) and Dubey (2010).

On the other hand, the correlation between wind speed and population larvae of pink bollworm was negative and significant of first season (-0.472*), while it was positive and insignificant (0.020) in the second season. These results agreed with Nassef *et al*. (1996), El-Zanan and Watson (1998) and Dubey (2010).

The data presented in Table (1) reveal that the insect predators. These predators were affected on the population density of pink bollworm larvae were positive and significant correlations recorded in both seasons (2014 and 2015) were (0.495* and 0.480*), respectively. These results agreed with Mesbah *et al*. (2008), were recorded also, the effect of same predators on pink bollworm larvae was highly positive significant. Henneberry and Clayton (1982). They found predation of pink bollworm eggs artificially placed in cotton terminals in the field ranged from 95 percent in July to 35 percent in September. Parajulee *et al*. (2006), they evaluated many predators in laboratory, and they found all predators consumed the highest number of bollworm eggs (80% of eggs/24 hr) at 35 degree C and the lowest number (8% of eggs/24 hr) at 15 degrees C.

2.The spinybollworm, *Earias insulana* Boisd.:

The results in Figs. (1 and 2) clearly show that green cotton bolls were initially infested with spiny bollworm, *E. insulana* larvae on the 9th and 15th of August in 2014 and 2015 seasons, respectively, and the mean number was of 0.04 larva/boll in both seasons. The insect population larvae of spiny bollworm fluctuated during long period of (9th of August to 25th of October) and (15th of August to 24th of October), of both tested seasons (2014 and 2015), respectively. The sample of 23rd and 29th of August were free from larvae of this pest in both seasons. In season 2014, the insect population larvae show three peaks, the first peak in 30th of August with a mean numbers of (0.20 larva/boll) at (29.36^{o}C; 70.79% R.H. and 76.71 km/24 hr). The second peak in 27th of September with a mean numbers of (0.60 larva/boll) at (26.62^{o}C; 64.79% R.H. and 79.29 km/24 hr). The third peak was the highest with a mean numbers of (0.68 larva/boll) at the end of the season (18th of October) at (26.05^{o}C; 55.95% R.H. and 103.29 km/24 hr).

In the second season (2015), also, the insect population larvae show three peaks. The first peak in 22nd of August with a mean numbers of (0.16 larvae/boll) at (29.49^{o}C; 74.50% R.H. and 93.7 km/24 hr). The second peak in 12th of September, also, with a mean numbers of (0.16 larva/boll) at (27.19^{o}C; 68.43% R.H. and 78.57 km/24 hr). So, the third peak was the highest with a mean numbers of (0.32 larva/boll) at the end of this season (17th of October) at (24.45^{o}C; 69.57% R.H. and 84.57 km/24 hr). The occurrence and rate of infestation of cotton bolls with *E. insulana* in the first season were higher than in the second season. The mean numbers of larvae/boll were 0.18 and 0.12 in 2014 and 2015 seasons, respectively.

The data presented in Table (1) show that the effect of temperatures was recorded significant negative correlation on the insect spiny bollworm population in both seasons 2014 and 2015 (-0.631** and -0.690**), respectively. These results agreed with El-Zanan *et al*. (1998), Dhaka and Pareek (2008) and Dubey (2010).

Khurana and Verma (1990), in China found that the higher infestation by spiny bollworm in mean maximum and minimum temperatures of 34.3 and 20.5^{o}C, respectively, a mean R.H. of 73% than mean maximum and minimum temperatures of 36.3 and 23.2^{o}C, respectively and a mean R.H. of 64.8%.

But, Bhatti *et al*. (2007), in Pakistan, found maximum infestation on green bolls was 25.77 percent at 26.54 degree C, relative humidity 62.51 percent.

Also, in Table (1), the effect of relative humidity was negative and insignificant (-0.177) in the first season (2014), while, in the second season (2015) was positive and insignificant (0.083) on the population of spiny bollworm larvae. These results agreed with Hamid *et al*. (1994) and Hassanein *et al*. (1995), while, Dhaka

and Pareek (2008) and Dubey (2010) found that the effect of relative humidity was negative and significant on population larvae of this pest.

On the other hand, the effect of wind speed on population larvae of spiny bollworm was negative and significant in the first season (2014) (-0.408*), while in the second season (2015) was negatively and insignificant (-0.173). These results agreed with Hamid *et al*. (1994) and Dubey (2010).

The data presented in Table (1) reveal that the effect of the insect predators on the population density of spiny bollworm larvae were (0.542* and 0.585*) in both seasons (2014 and 2015), respectively. Mesbah *et al*. (2008) found that highly significant correlation between the same predators and spiny bollworm larvae. So, Gosalwad *et al*. (2009), they mentioned that correlation positive between incidence of spotted bollworm and population density of (ladybird beetle, *Coccinella* spp. and green lacewing, *Chrysopa* spp.

3. The Egyptian cotton leafworm, *Spodoptera littoralis* (Boisd.):

The data illustrated in Figs. (3 and 4) indicate that the population density of this noctuid show three peaks of number of egg-masses laid during every season. In 2014 season, the first peak was recorded in 13th of June (120 egg-masses/feddan) at (27.25^{o}C; 61.67% R.H. and 108.67 km/hr). The second peak was recorded in 2nd of July (200 egg-masses/feddan) at 29.63^{o}C; 68.17% R.H. and 103.67 km/24 hr. While, the third peak was the highest peak was recorded in 2nd of August (280 egg-masses/feddan) at (29.83 ^{o}C; 70.67% /R.H. and 104.33 km/24 hr), but in the 2015 season, the first peak was recorded in 13th of June (180 egg-masses/feddan) at 27.60^{o}C; 62.67% R.H. and 108.00 km/24 hr). While, the second peak was the highest peak (460 egg-masses/feddan) which was recorded in 14th of July at (28.53^{o}C; 68% R.H. and 143.33 km/24 hr), the third peak was recorded in 14th of August (380 egg-masses/feddan at (29.07+^{o}C; 73.17% R.H. and 88.00 km/24 hr). After the last peak, the number of egg-masses declined to vanish completely at the end of September.

The occurrence and number of egg-masses laid on cotton leaves by cotton leaf worm during both seasons, the second season was higher than the first season, the mean number of egg-masses/inspection were (86.29 and 173.02) in 2014 and 2015 seasons, respectively. These results agreed with El-Zanan and El-Hawary (1995), Hassanein *et al*. (1995) and El-Zanan *et al*. (1998). With respect to the effect of the tested weather factors on the cotton leafworm population density (egg-masses), the data given in Table (1), indicate that among the three factors (temperature, relative humidity and wind speed), the effect of temperature was positive and significant (0.459*) in the first season (2014), while it was positive and insignificant (0.212) in the second season (2015). These results agreed with El-Zanan and El-Hawary (1995), Hassanein *et al*. (1995) and El-Zanan *et al*. (1998). They found positive and insignificant correlation between egg-masses count and temperature. The data presented in Table (1) reveal that the effect of relative humidity was positive and insignificant (0.347) in the first season, while it was negative and insignificant (-0.134) in the second season. The relationship between wind speed and cotton leaf worm population density (egg-masses) was negative and insignificant (-0.162) in the first season, but in the second season, was positive and insignificant (0.263).

Many authors found different results, the correlation between relative humidity and egg-masses of cotton leaf worm was positive and insignificant (1994, 1996 and 1997 seasons), on the other hand, the relationship was positive and significant (1995 season) by El-Zanan *et al*. (1998), Hassanein *et al*. (1995) who stated that there were negative highly significant correlation between egg-masses count and relative humidity during 1992 season and negative and insignificant in 1993 season.

Data presented in Table (1) reveal that the effect of the insect predators on the population density of cotton leaf worm egg-masses were positively highly significant (0.531** and 0.620**) in both seasons 2014 and 2015, respectively. Mesbah *et al*. (2008), they found that highly significant in correlation between the same predators and the leaf-worm egg-masses in 2005 season and only positive in 2006 season.

Study the effect of abiotic and naturally occurring biotic factors on seasonal population fluctuations of insect pests, this factors to played a main factors in the evolution and distribution of this insect pests.

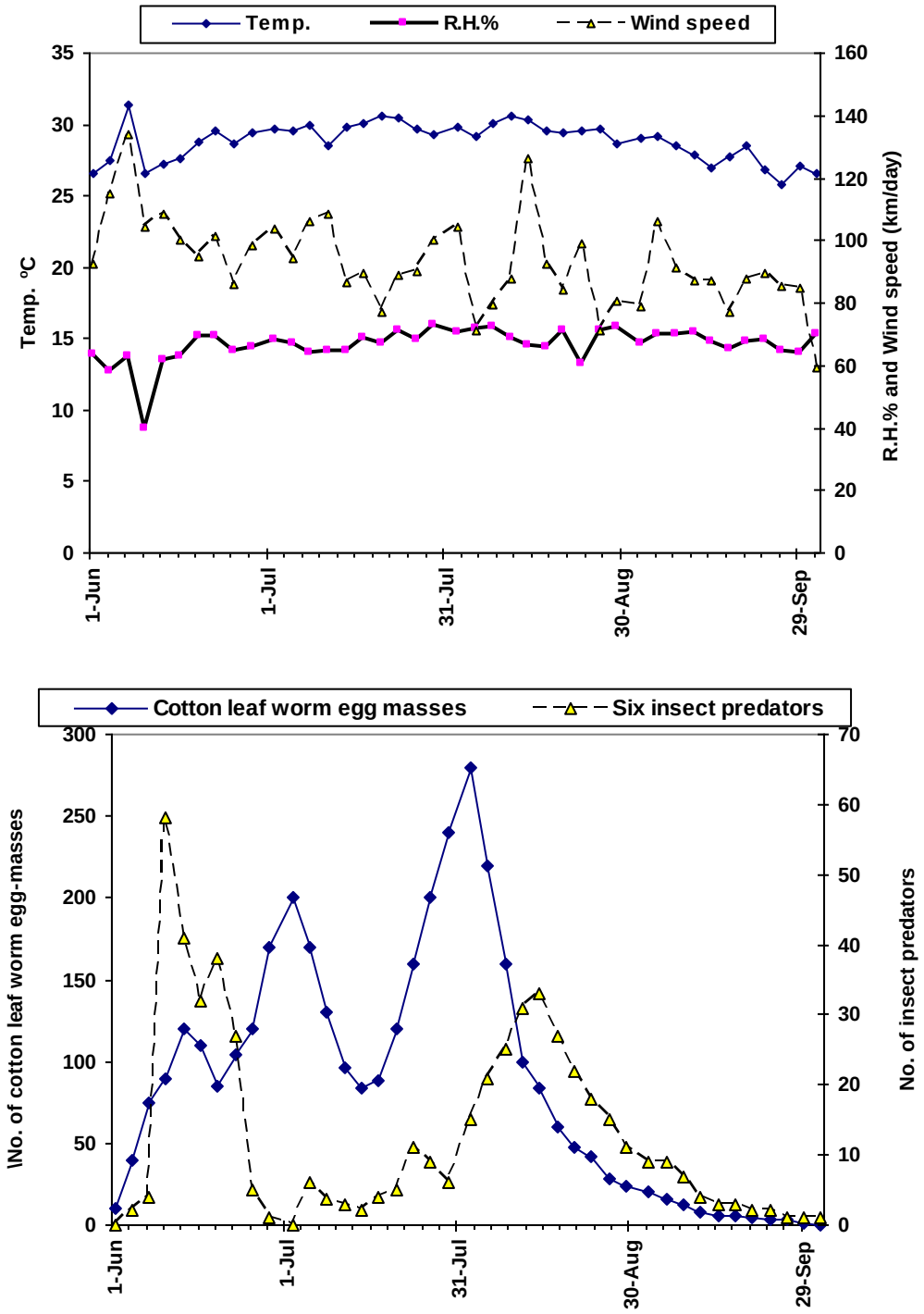

Fig. (3):The population density of the cotton leaf worm egg-masses, certain weather factors and insect predators during 2014 season

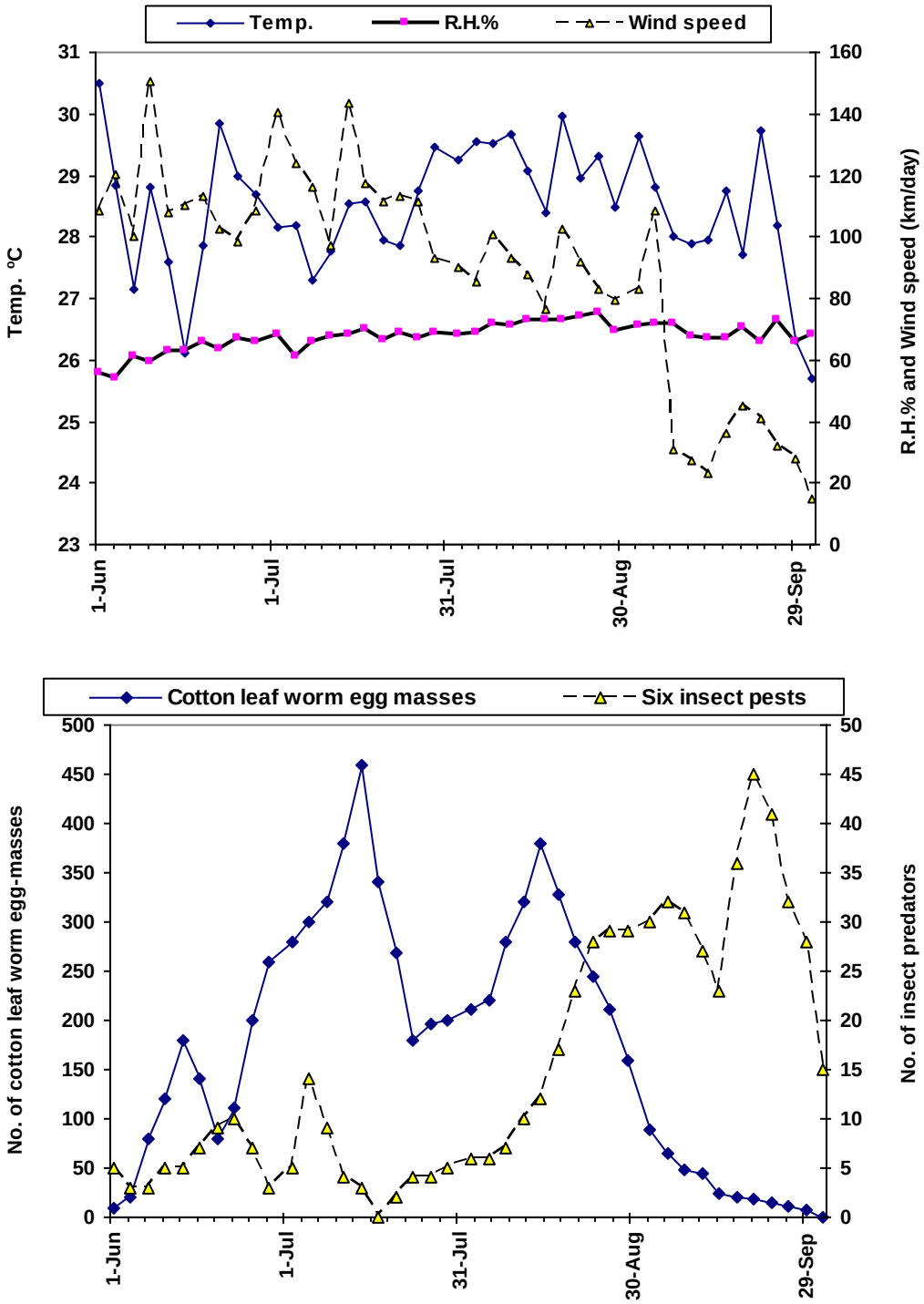

Fig. (4):The population density of the cotton leaf worm egg-masses, certain weather factors and insect predators during 2015 season

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تـأثر بعض العوامـل الجويـة وبعض الأعداء الحيويـة علـى الكثافـة العدديـة لديـدان اللـوز ودودة ورق القطـن فـى محافظة كفرالشيخ بمصر

حسن محمد حسن صومع

معهد بحوث وقاية النباتات ـ مركز البحوث الزراعية ـ الجيزة ـ مصر

تمت هذه الدراسة فى مزرعة محطة البحوث الزراعية بسخا ـ محافظة كفرالشيخ خلال موسمى ٢٠١٤م ، ٢٠١٥م لتقييم تـأثير بعض العوامل الجوية (درجة الحرارة ونسبة الرطوبة وسرعة الرياح) وبعض الأعداء الحيوية (ستة مفترسات حشرية وهى أبو العيد ١١ نقطة وحشرة الإسكمنس والحشرة الرواغة وذبابة السرفس وبقة الأوريس وأسد المن) على الكثافة العددية ليرقات دودتى اللوز القرنفلية والشوكية ولطع بيض دودة ورق القطن.

سجل التواجد الأولى ليرقات دودة اللوز القرنفلية فى لوز القطن فى الأسبوع الأخير من يوليو (٧/٢٦) فى الموسم الأول وقبل ذلك بأسبوع (٧/١٨) فى الموسم الثانى وأظهرت هذه الحشرة أربع ذروات للتعداد فى كلا الموسمين ، وكان تـأثر أعداد يرقات دودة اللوز القرنفلية بـالتغيرات فى درجات الحرارة سالبا وعالى المعنوية فى كلا الموسمين ، بينما كان هذا التـأثير لتغير فى نسبة الرطوبة النسبية كان سالبا وغير معنوى فى كلا الموسمين. لكن سرعة الرياح كانت تأثيرها سالبا ومعنوى وموجب وغير معنوى على الكثافة العددية لليرقات فى كلا الموسمين ، بالترتيب ، كذلك كانت العلاقة موجبة ومعنوية بين الكثافة العددية لليرقات لدودة اللوز القرنفلية والمفترسات الحشرية.

بدأت يرقات دودة اللوز الشوكية فى إصابة لوز القطن فى ٩ ، ١٥ أغسطس فى كلا الموسمين بالترتيب ، وأظهرت ثلاث ذروات من التعداد فى كلا الموسمين ، وكان تأثر أعداد يرقات هذه الحشرة سالبا وعالى المعنوية للتغيرات فى درجات الحرارة فى كلا الموسمين ، بينما العلاقة بين الرطوبة النسبية وأعداد يرقات دودة اللوز الشوكية كانت سالبة وغير معنوية فى الموسم الأول ، ولكنها كانت موجبة وغير معنوية فى الموسم الثانى ، بينما كان تأثير سرعة الرياح سالبة ومعنوية فى الموسم الأول وسالبة وغير معنوية فى الموسم الثانى على الكثافة العددية ليرقات دودة اللوز الشوكية ، كذلك كانت العلاقة موجبة ومعنوية بين الكثافة العددية ليرقات دودة اللوز الشوكية والمفترسات الحشرية.

لطع بيض دودة ورق القطن أظهرت ثلاث ذروات للتعداد لهذه الحشرة فى كلا الموسمين ، وكان تـأثير التغيرات فى درجات الحرارة على الكثافة العددية للطع بيض دودة ورق القطن معنوى وموجب فى الموسم الأول ، وموجب وغير معنوى فى الموسم الثانى ، بينما كان تـأثير التغير فى الرطوبة النسبية على الكثافة العددية للطع بيض هذه الحشرة موجبا وغير معنوى فى الموسم الأول وسالبا وغير معنوى فى الموسم الثانى ، كذلك تـأثير التغير فى سرعة الرياح على أعداد لطع البيض كان سالبا وغير معنوى فى الموسم الأول ، وموجبا وغير معنوى فى الموسم الثانى ، بينما كان العلاقة عالية المعنوية وموجبة بين الكثافة العددية للطع بيض دودة ورق القطن والمفترسات الحشرية فى كلا الموسمين.