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Seasonal Abundance of Piercing Sucking Insect Pests Associated with Cotton Plant and their Relation to Natural Enemies

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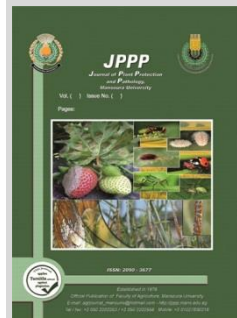


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ABSTRACT

The cotton aphid, *Aphis gossypii* (Glover.) had four peaks during the first season and three peaks during the second season, the cotton thrips, *Thrips tabaci* Lindeman had two peaks during both seasons, the sweet potato white fly, *Bemisia tabaci* (Genn.) had two peaks during the first season and four peaks in the second season and *Empoasca* spp. exhibited three peaks during the first season and two peaks in the second season. Also, the lady bird beetle, *Coccinella undecimpunctata* L. had seven peaks during both seasons. Whereas the green lacewing, *Chrysoperla carnea* (Steph.) had seven peaks during 2018 season and eight peaks during 2019 season. The parasitoid, *A. colemani* had three peaks during 2018 season and five peaks during 2019 season on the cotton aphid. There was a correlation between insect pests and the natural enemies, insignificant positive correlation was observed between *C. undecimpunctata* and both of *A. gossypii* and *T. tabaci* in both seasons. However, *C. undecimpunctata* has highly significant positive correlation with *B. tabaci* in the first season only, but it has a significant positive correlation with *Empoasca* spp. in the first season only. *C. carnea*, has a highly positive significant correlation with the aphid and the whitefly numbers in the season 2018, whereas during the second season 2019 the correlation was highly positive significant with the whitefly and the green leafhoppers only. The correlation between the parasitoids *A. colemani* and the aphid was highly significant during both seasons.

Keywords: Cotton, Aphid, Thrips, Whitfly, predators, parasitoid, fluctuation, correlation.



INTRODUCTION

Cotton, *Gossypium barbadense* L. is one of the most important crops in Egypt and all over the world where it is employed in several industrial productions, i.e. textile, ginning, food, oil, furniture, soap and many other industries, as well as a source of foreign coin when it exported (Al-Shannaf and Hegab, 2010).

In tropical and sub-tropical countries a cultivated area of cotton is about 2.4% of the aridable land. Twenty million farmers are those which totally dependent on cotton production (Taqi *et al.*, 2019)

In almost all cotton producing countries, insect pests and crop diseases consider the major factors affecting cotton production, (Masood *et al.*, 2011). Cotton plants are attacked by insect pests starting from germination of seedlings till harvest, causing several damages to the vegetation, flowers, fibers, and seeds, (Afazal *et al.*, 2003). Among all the pests, sucking pests are many and they cause a huge loss by affecting the vegetative growth of the plants, by directly retarding the production of bolls to a large extent (Sahu and Samal, 2020).

In balance ecosystems, insect pests are kept under economic threshold by their natural enemies (predators and parasitoids), (Nirmala *et al.*, 1996). During the last few years, populations of certain sap sucking insect species which were known as unimportant organisms, started to increase reaching pest status on cotton plants. This might be due to the heavy use of pesticides applications which destroyed a large number of natural enemies, causing upset

of the natural balance and the previously known as secondary pests became a major pest (Fayad *et al.*, 1990). Therefore, the aim of this work found out the changes that occurred in the numbers of these pests and their natural enemies, and the extent to which these pests are related to the presence of their natural enemies.

MATERIALS AND METHODS

The present study was carried out at the cotton fields in El-Maragha district, Sohag Governorate, during the two successive growing seasons of 2018 and 2019. An area of about 1\4 feddan was assigned for the current study. By the beginning of April in the two seasons, the recommended cotton variety Giza 95 was sown for the experimentation. Experimental plots received regular cultural practices as recommended, except the use of pesticides.

1- The seasonal abundance of piercing sucking insect pests infesting cotton :-

From April, 17th to October, 16th during 2018 and 2019 seasons respectively, weekly samples, each of 10 leaves were examined in the field to record the numbers of *A. gossypii*, *B. tabaci* (adult) and *T. tabaci*. The immature stages of *B. tabaci* were examined in the laboratory using the Stereomicroscope.

2-The seasonal abundance of certain insect predators associated with cotton pests:

During 2018 and 2019 seasons, weekly samples of cotton plants were taken randomly beginning from April, 17th to October, 16th respectively . Each sample consisted of

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10 cotton plants. The plants were gently confined into converting plastic bags that contained the plants down to the soil surface. Then, the plants were cut and transferred to the laboratory. In the laboratory, a piece of cotton saturated with chloroform was put inside the bag to anesthetize the harbored predators. Then, the catch was dropped on a white paper sheet (1×1 m.) to sort and count the insect predators i.e. *Coccinella undecimpunctata*, *Chrysoperla carnea*.

3-The associated parasitoids with the cotton aphid, *A. gossypii* on cotton plants:

The cotton aphid, *A. gossypii* was reared in 28 × 19 × 11cm. ventilated clear plastic boxes with 100 aphid per box. Fresh leaves of cotton were provided for feeding until all parasitoids emerged. A percentage of parasitism was calculated according to the following formula:

$$X* = P / P+U * 100$$

X* : Parasitism percentage .

P: Parasitized aphid number

U: un parasitized

4-The relationships between the piercing sucking insect pests infesting cotton plants and its associated natural enemies:-

The relation between the population of certain piercing sucking insect pests and the associated predators and parasitoids, through the two growing seasons, was carried out using simple correlation according to Fisher, (1950).

RESULTS AND DISCUSSION

1- The seasonal abundance of piercing sucking insect pests infesting cotton plants:-

1-The cotton aphid, *Aphis gossypii* (Glover):

Data illustrated in Fig. (1) show the seasonal abundance of *A. gossypii* during the two successive cotton growing seasons, 2018 and 2019. In the first season, the aphids were detected during the fourth week of April and then its number began to increase gradually to reach the first peak (135.7 aphids / 10 leaves) on May 22nd . The second peak (35.3 aphids / 10 leaves) was obtained on June 19th, the third peak (220.3 aphids / 10 leaves) on August 7th, while, the fourth peak was the highest one (340.3 aphids / 10 leaves) on September 11th. Also, in 2019 season three peaks of aphid were recorded, 154.0, 377.7, and 368.7 aphids / 10 leaves on May 15th, August 28th and September 11th, respectively.

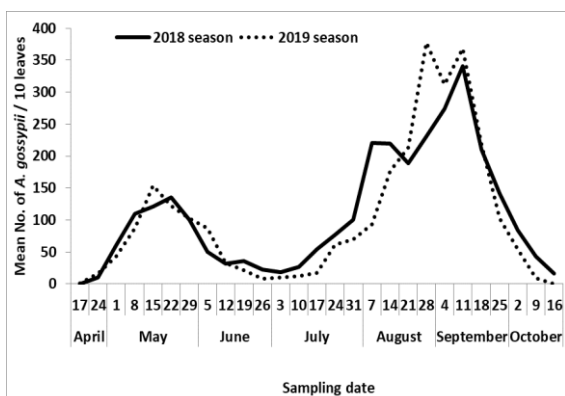


Fig. 1. The seasonal abundance of *A. gossypii* during the two cotton growing seasons, 2018 and 2019 at Sohag Governorate.

The current results are in accordance with those of Abou-Elhagag (1998) who found that *A. gossypii* population was low during the early cotton season, and then

the aphid disappeared from the fields for about three weeks and Mazed (2014) who found that *A. gossypii* population exhibited two periods of activity, the 1st period was short and extended from 6th of April to 15th of May, whereas the second one was somewhat longer and lasted from the last week of July to the end of cotton growing season (October). Whereas Bashir *et al.* (2020) found that in Pakistan the incidence of aphids was nil in cotton during the season.

2- The cotton thrips, *Thrips tabaci* (Lindeman):

Fig. (2) illustrated that the population fluctuation of *T. tabaci* throughout the 2018 season ranging between 5.3 and 163.7 individuals / 10 cotton leaves. In addition the highest peak of the insect (163.7 individuals /10 leaves) was recorded in May 29th. The second peak of the thrips was obtained on June 26th with density of 142.7 individuals /10 leaves. The same trend was observed in 2019 season with two peaks, 168.0 and 156.3 individuals /10 leaves on May 29th and June 19th, respectively.

The current results agree partially with the findings of Abo-Shola (2001) and Mazed (2014) who mentioned that *T. tabaci* peaked twice on cotton plants during May and June and El-Ghobary, (2011) found that seasonal abundance of thrips was high during May, moderate during June and July, but rare in August and September. The thrips exhibited three peaks in each of 2005 and 2007 seasons. The peaks of 2005 season occurred on May 30th, July 4th and September 8th, while those of 2007 season occurred on June 6th, June 27th and September 8th. Two peaks were recorded in the 2006 season on May 30th and July 4th. Bashir *et al.* (2020) in Pakistan who found that in Pakistan the incidence of thrips was observed from 10 days after sowing (DAS). The peak incidence of thrips was observed after (64 days) with a population of 8.26 thrips / trifoliate leaf / plant.

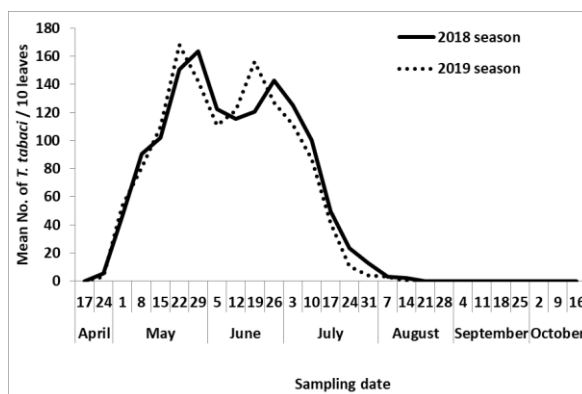


Fig. 2. The seasonal abundance of *T. tabaci* during the two cotton growing seasons, 2018 and 2019 at Sohag Governorate.

3-The sweet potato white fly, *Bemisia tabaci* (Genn.):

Fig. (3) illustrated that during 2018 cotton season, a small peak of 10.7 individuals/10 leaves was recorded on May 22nd. The insect abundance increased progressively during July and reached a second peak of 80.7 individuals/10 leaves on August 14th. The insect abundance took a similar trend in the 2019 cotton season with five peaks of 9.7, 22.0, 76.0 and 70.7 individuals/10 leaves on May 8th, July 10th, August 7th and August 21st, respectively.

El-Dewy (2006) obtained results similar to those reported in the current study, at Kafr El-Sheikh, and recorded two *B. tabaci* peaks on cotton plants in late August

and late September. Thereafter, a sharp decline was recorded towards the end of cotton season. El-Ghobary (2011) at Kafr El-Sheikh, found that *B. tabaci* had two peaks of abundance in 2005 season, June 20th and August 23rd, also it had two peaks in 2006 season, June 25th and August 28th. However, it had one peak in 2007 season in August 16th. Mazeed (2014) recorded *B. tabaci* in a low numbers during April, May and June and in a high numbers during July and August. Bashir *et al.* (2020). in Pakistan found that the incidence of whiteflies was observed 15 days after sowing and peak incidences of whitefly population was observed during the 5th standard week (64 DAS) with a population of 1.4 nymphs/trifoliate leaf/plant.

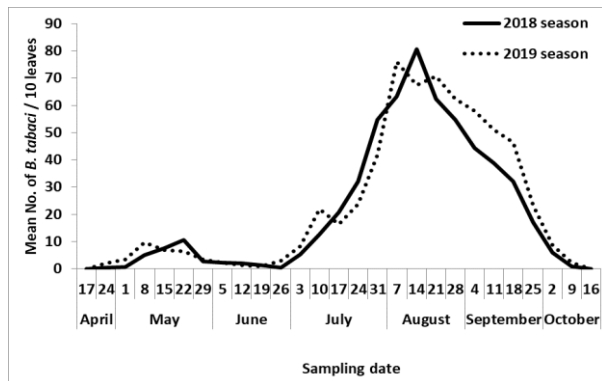


Fig. 3. The seasonal abundance of *B. tabaci* during the two cotton growing seasons, 2018 and 2019 at Sohag Governorate.

4 -The green leafhoppers, *Empoasca* spp.:

During 2018 season *Empoasca* spp. exhibited three peaks and two peaks in 2019 season (Fig. 4). The peaks of *Empoasca* spp. during 2018 were detected on May 29th, August 21st and September 25th with values of 25.0, 46.3 and 32.7 nymphs and adults per 10 leaves, respectively. As for 2019 season, the peaks were recorded in June 5th and August 14th with population densities of 33.0 and 52.7 nymphs and adults, respectively.

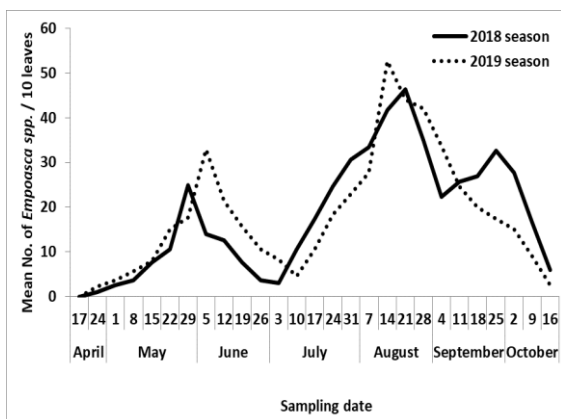


Fig. 4. The seasonal abundance of *Empoasca* spp. during the two cotton growing seasons, 2018 and 2019 at Sohag Governorate.

These results are partially in agreement with those of El-Ghobary (2011) reported that *Empoasca* spp. had multiple peaks throughout the experimental period. Three peaks were detected in 2005 season, four peaks in 2006 season and four peaks in 2007. Mazeed (2014) found that

Empoasca spp. had three peaks in 2010 season, and four peaks in 2011 season.

2- The seasonal abundance of the insect predators associated with cotton pests:

1- The lady bird beetle, *Coccinella undecimpunctata* (Linnaeus):

The lady bird beetle, had seven peaks during 2018 season, in May 8th, 29th, June 19th, July 3rd, 24th, August 14th and September 11th with 3.7, 6.7, 8.0, 7.7, 8.7 and 6.7 individuals/ 10 cotton plants respectively. The peaks of 2019 season were detected on May 8th, June 12th, 26th, July 10th, August 7th, 28th and September 11th with 2.7, 5.7, 8.0, 10.7, 5.7, 6.7 and 4.3 individuals/ 10 cotton plants, respectively.

These results are in agreement with Abou-Elhagag (1998), at Assuit who found that the predators; *C. undecimpunctata*, was starting to appear in cotton fields in April reaching their peak during June and July and then decreased gradually by migrating to other host plants (maize and sorghum) surrounding cotton fields. Samhan (2003) stated that the highest seasonal abundance of *C. undecimpunctata* was recorded in cotton in Egypt in May-October 2000. Mazeed (2014) found that *C. undecimpunctata* was presented throughout the season on cotton plants.

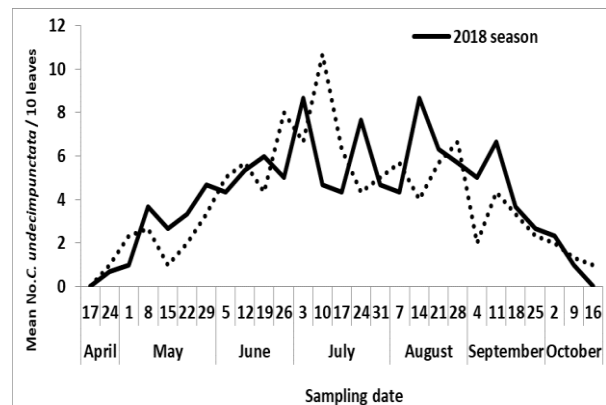


Fig. 4. The seasonal abundance of *C. undecimpunctata* during the two cotton growing seasons, 2018 and 2019 at Sohag Governorate.

2. The green lacewing, *Chrysoperla carnea* (Steph.):

Over the two cotton seasons, *C. carnea* eggs, larvae and adults were recorded (Fig. 5) the peaks were obtained in the 2018 season on May 15th, June 5th, 26th, July 10, August, 14th, September 11th and September 25th with 2.3, 5.7, 4.3, 4.3, 9.0, 5.3 and 4.0 individuals/ 10 cotton plants, respectively. The peaks were found during 2019 in May 8th, 29th, June 26th, July 10th, 24th, August 14th, 28th and September 11th with 2.0, 3.7, 5.0, 5.0, 5.0, 9.0, 5.3 and 5.0 individuals/ 10 cotton plants, respectively.

These results partially agree with Khattab (2003) who found that the high numbers of *C. carnea* were observed on mid-May and late July. El-Ghobary (2011) found that *C. carnea* had three peaks during 2005 season; June 6th, July 25th and September 1st, two peaks during 2006 season on June 13th and July 18th. However, five peaks were recorded in 2007; on May 17th, May 30th, June 13th, July 25th and August 9th. Mazeed (2014) found that *C. carnea* appeared on cotton fields during May and increased gradually till the end of the season.

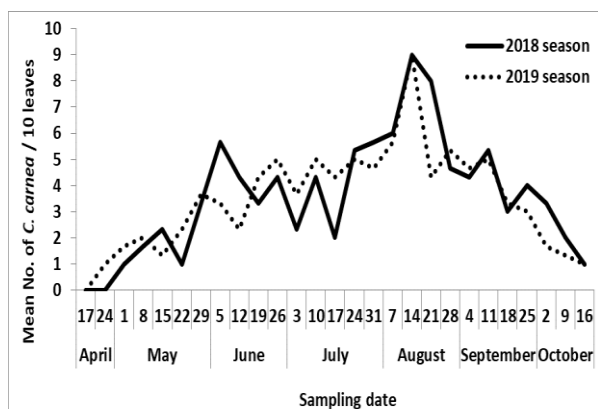


Fig. 5. The seasonal abundance of *C. carnea* during the two cotton growing seasons, 2018 and 2019 at Sohag Governorate.

3-The associated parasitoid with the cotton aphid, *A. gossypii* on cotton plants:

Results showed that, in the first season 2018, the parasitoid, *A. colemani* was considered as an active parasitoid on the cotton aphid, *A. gossypii* from the 24th of April till the 9th of October and it had three peaks during that season in, May 22nd, August 21st, and September 4th with 18.3, 20.7 and 14.3 parasitoids / 100 aphids. Whereas in the second season 2019, it had five peaks in May 15th, June 5th, July 3th, August 7th and August 28th, with 17.3, 9.0, 1.7, 15.7 and 18.3 parasitoids / 100 aphids, (Fig. 6).

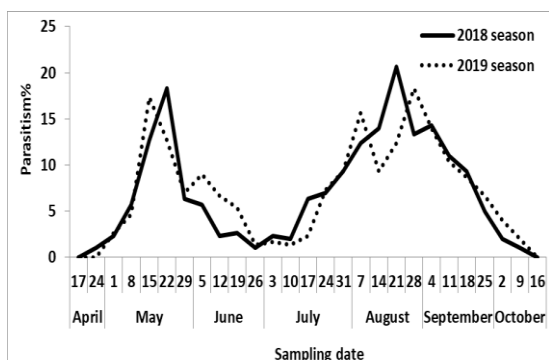


Fig. 6. The seasonal abundance of *A. colemani* on cotton aphid during the two cotton growing seasons, 2018 and 2019 at Sohag Governorate.

The present results are generally in agreement with Bolckmans and Tetteroo, (2002), Van Lenteren, (2003) and Yano (2006) who were described *A. colemani* Viereck as the main parasitoid of cotton aphid. Mazeed (2014) found that The parasitoid, *A. colemani* had three peaks during 2010 season in May 4th, July 20th and August 17th and had five peaks during 2011 season in, April 27th, May 11th, July 27th, August 10th and August 24th.

4-The relationships between the piercing sucking insect pests infesting cotton plants and associated natural enemies:-

Data in Table (1) present the simple correlation between the insect pests infesting cotton plants and its associated insect natural enemies in 2018 and 2019 seasons.

Insignificant positive correlation was observed between *C. undecimpunctata* and both of *A. gossypii* and *T. tabaci* in both seasons. However, *C. undecimpunctata* has highly significant positive correlation with *B. tabaci* in the first season only but it has a significant positive correlation with *Empoasca* spp. in the first season only. The correlation values between the coccinellid predator with *A. gossypii*, *T. tabaci*, *B. tabaci* and *Empoasca* spp. were 0.3491, 0.2116, 0.5116 and, 0.4394 respectively, during the first season, and 0.0038, 0.2516, 0.2535 and 0.2609 respectively, during the second season.

Concerning, *C. carnea*, the correlation coefficients (r) with the aphid, the whitefly and The green leafhoppers numbers was highly positive significant in the season 2018, whereas during the second season 2019 the correlation was highly positive significant with whitefly and The green leafhoppers only. The correlation values between the chrysoperlid predator with *A. gossypii*, *T. tabaci*, *B. tabaci* and *Empoasca* spp. were 0.5328, -0.1997, 0.7809 and, 0.7888 respectively, during the first season, and 0.3994, 0.0954, 0.6681 and 0.7224 respectively, during the second season.

The correlation between the parasitoids *A. colemani* and the aphid was highly significant during all seasons with r values 0.7820 and 0.7678 during 2018 and 2019 seasons respectively.

In accordance with these results, Abo-Shola (2001) indicated that *C. carnea*, *C. undecimpunctata*, *P. alferii*, *Orius* spp. and *Scymnus* spp. were correlated with aphid, jassids, whitefly and bollworms.

Table 1. The simple correlation between natural enemies and certain sucking insect pests infesting cotton plants at Sohag Governorate during 2018 and 2019 seasons.

Natural enemies	Parameter	Insect pests							
		2018 season				2019 season			
		<i>Aphis gossypii</i>	<i>Thrips tabaci</i>	<i>Bemisia tabaci</i>	<i>Empoasca spp.</i>	<i>Aphis gossypii</i>	<i>Thrips tabaci</i>	<i>Bemisia tabaci</i>	<i>Empoasca spp.</i>
<i>C.undecimpunctata</i>	"r" value	0.3491	0.2116	0.5116	0.4394	0.0038	0.2516	0.2535	0.2609
	P-value	0.0743	0.2894	0.0064	0.0218	0.9849	0.2056	0.2019	0.1888
<i>C. carnea</i>	"r" value	0.5328	-0.1997	0.7809	0.7888	0.3994	-0.0954	0.6681	0.7224
	P-value	0.0042	0.3181	0.0000	0.0000	0.0390	0.6361	0.0001	0.0000
<i>A. colemani</i>	"r" value	0.7820	-----	-----	-----	0.7678	-----	-----	-----
	P-value	0.0000	-----	-----	-----	0.0000	-----	-----	-----

r= Simple correlation P= probability

Karaman *et al.* (2007) reported that the highest density of predators was recorded earlier or later than the peaks of their preys. This may be due to the differences in the developmental life cycle of the predators and their preys. They added that the population of the predators always lagging behind the preys and thus having only a limited

chance in suppressing its activity. El-Khawas and Salwa (2010) mentioned that a positive correlation appeared among the three common predators, *C. carnea* Steph., *C. undecimpunctata* L. and *Scymnus interruptus* (Goeze) in relation to their main prey (*A. gossypii*) on paper plants.

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الوفرة الموسمية للآفات الحشرية الثاقبة الماصة التي تهاجم نباتات القطن والأعداء الحيوية المرتبطة بها وائل عبدالسميع الحضري¹ و شيماء يوسف أحمد² ¹معهد بحوث وقاية النباتات ²كلية الزراعة والموارد المائية جامعة أسوان

أجريت هذه الدراسة بحقول القطن بمركز المراجعة محافظة سوهاج ، وقد لوحظت الكثافة العددية لبعض الآفات الماصة التي تصيب نباتات القطن مثل حشرات من القطن. تريبس القطن ، الذبابة البيضاء ونطاطات الاوراق. -أوضحت الدراسة ان حشرة من القطن لها أربع قمم خلال الموسم الأول وثلاث قمم خلال الموسم الثاني. في حين أن حشرة تريبس القطن كان لهما قمتين خلال موسم الدراسة وحشرة الذبابة البيضاء سجلت قمتين خلال الموسم الأول وأربع قمم خلال الموسم الثاني ، بينما سجلت حشرات نطاطات الاوراق ثلاث قمم خلال الموسم الأول وقمتين خلال الموسم الثاني. أيضًا سجل مفترس ابو العبد ذو الاحدى عشر نقطة سبع قمم خلال موسمي الدراسة. في حين أن حشرة أسد المن سجلت سبع قمم خلال موسم ٢٠١٨ وثمانية قمم خلال موسم ٢٠١٩. وأوضحت الدراسة ان الطفيل *Aphidius colemani* ينشط على من القطن من ٢٤ أبريل حتى ٩ أكتوبر ، وكان له ثلاث قمم خلال موسم ٢٠١٨ وكان له خمسة قمم خلال موسم ٢٠١٩. سجلت الدراسة وجود ارتباط بين الآفات الحشرية والأعداء الحيوية حيث وجدت علاقة ارتباط موجبة غير معنوية بين أعداد حشرة ابو العبد ذو الاحدى عشر نقطة مع حشرة من القطن وتريبس القطن خلال موسمي الدراسة ، بينما كان الارتباط بين أعداد حشرة ابو العبد ١١ نقطة مع أعداد حشرة الذبابة البيضاء موجب و معنوي جداً خلال الموسم الأول فقط . وكان الارتباط بين حشرة ابو العبد ذو الاحدى عشر نقطة مع حشرة نطاط الاوراق موجب ومعنوي خلال الموسم الأول فقط. كما تم تسجيل ارتباط موجب معنوي جداً بين أعداد مفترس اسد المن مع حشرتي من القطن و الذبابة البيضاء ونطاط الاوراق في الموسم الأول ٢٠١٨ م ولكنه كان موجب معنوي جدا خلال الموسم الثاني ٢٠١٩ مع حشرة الذبابة البيضاء ونطاطات الاوراق فقط. بالإضافة الى ذلك كان الارتباط بين اعداد طفيل ال *A. colemani* واعداد حشرة من القطن ايجابي ومعنوي جداً خلال موسمي الدراسة.