



## Plant Protection and Pathology Research

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# THE MAIN SUCKING INSECT PESTS AND THEIR ASSOCIATED PREDATORS ON OKRA PLANTS

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Received: 02/04/2018 ; Accepted: 06/05/2018

**ABSTRACT:** The present study was conducted to survey and evaluate the population densities of the major sucking insect pests infesting okra plants and their common associated predators and its relation with the prevailing temperature and relative humidity at Diarb-Nigm district, Sharkia Governorate, Egypt during the two summer growing seasons of 2015 and 2016. *Bemisia tabaci* (Gennadius), *Oxycarenus hyalinipennis* Costa, *Aphis gossypii* Glover, *Empoasca lybica* (Bergevin) and *Thrips tabaci* Linde were the main sucking insect pests on okra plants. The most dominant predaceous insect species were *Metasyrphus corollae* (Fabricius), *Chrysoperla carnea* (Stephens), *Coccinella undecimpunctata* Linnaeus and *Coccinella septempunctata* Linnaeus. *B. tabaci* showed four peaks in the first and the fourth weeks of July and in the fourth week of August and September in the first season. In the second season, it peaked in the first week of August and September. Two peaks of activity for *A. gossypii* occurred in the fourth week of July and August during the first season and in the second one it peaked in the fourth week of July and third week of August. *T. tabaci* peaked in the fourth week of August and the second week of September during the first season. In the second season, it peaked in the fifth week of August. *E. lybica* peaked in the third week of July, the fourth week of August and the second week of September during 2015 growing season, while in the season of 2016 it peaked in the second week of August and the first week of September. *O. hyalinipennis* peaked once in the third week of October in both seasons of the study. *M. corollae* recorded one peak in both seasons, in the first season it was observed in the fifth week of August, while in the second one it was in the second week of August. *C. carnea* recorded its maximum number in the third and the fourth weeks of July during the first and second seasons of the study, respectively. *C. undecimpunctata* showed three peaks of activity in the fourth week of June, the second week of July and the second week of August in the first season, while in the second one it peaked in the fourth week of July. *C. septempunctata* recorded two peaks in the second week of July and August during the first season of the study. In the second season, it peaked in the second week of July. Temperature and relative humidity influenced the populations of *B. tabaci*, *O. hyalinipennis*, *A. gossypii*, *E. lybica*, *T. tabaci*, *M. corollae*, *C. carnea*, *C. undecimpunctata* and *C. septempunctata* by 18.76, 3.19, 18.21, 10.79, 6.23, 15.20, 2.45, 11.75 and 1.45% in the first season of the study and by 41.48, 54.31, 41.47, 53.70, 54.31, 24.86, 7.61, 11.22 and 12.95% in the second one, respectively. Also, the predator-prey ratios were estimated.

**Key words:** Sucking insect pests, associated predators, okra plants, temperature, relative humidity.

## INTRODUCTION

Okra (*Abdelmoschus esculentus* L. Moench) is highly nutritious vegetable belonging to the family Malvaceae. It contains carbohydrates, proteins, fat, vitamins A, C and B6, folic acid,

magnesium, potassium, iron,  $\beta$  carotene, riboflavin and fibre (Gopalan *et al.*, 2007; Varmudy, 2011). Okra is susceptible to the attack by many insect pests from vegetative to reproductive stages that cause considerable damage and reduce the productivity and an

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increase in farm cost (Ali *et al.*, 2015). These insect pests include sucking insect pests such as *Bemisia tabaci* (Gennadius), *Aphis gossypii* Glover, *Empoasca lybica* (Bergevin), *Oxycarenus hyalinipennis* Costa and *Thrips tabaci* Linde that reduce crop yield directly by piercing plant tissues and sucking cell sap from the phloem cells or from general tissues of foliage or fruits and secreting honeydew which disturbs the photosynthesis process. Moreover, indirectly injury caused by transmission diseases as Leaf Curl Virus and Yellow Vein Mosaic diseases. (Bhatangar and Sharma, 1991; Harrison *et al.*, 1997; Ahmad *et al.*, 2002; Asi *et al.*, 2008).

It is important to survey insect pests, because routine use of chemical control without taking into consideration the insect pest density is economically wasteful, also environmentally hazardous chemicals (which destroys natural enemies and other beneficial insects) and toxic contaminants are introduced into the soil thus causing insecticide resistance (Biological Control Task Force, 2005).

Therefore, the present work aims to survey and evaluate the seasonal abundance of the major sucking insect pests and their associated predators on okra plants in relation with the prevailing temperature and relative humidity.

## MATERIALS AND METHODS

The present investigation was carried out at Diarb-Nigm district, Sharkia Governorate, Egypt, during the two summer growing seasons of 2015 and 2016 to survey the major sucking insect pests attacking okra plants (*Abdelmoschus esculentus* L. Moench) and their common associated predatory insects. An experimental area of 350 m<sup>2</sup> was divided into three replicates (each about 115 m<sup>2</sup>). This area designed according to the complete randomized blocks design and sown by okra seeds variety Balady on 1<sup>st</sup> May in both growing seasons. Conventional agricultural practices were regularly performed according to the general program of okra cultivation without any insecticides application throughout the experimental period.

Hence the insects under investigation differed in their activities, living habits and

distributions on various parts of the host plants, it was necessary to use different sampling techniques for each species of the tested sucking insect pests and their associated predators.

The weekly sampling started after five weeks from cultivation date and continued till the end of the experimental period and all samples were taken in daytime between 8 a.m. and 12 p.m. Two sampling techniques were used for surveying and counting inhabitant plants, *i.e.* plant sample and insect sweep net.

### Plant Sample

Weekly samples of 10 leaves from each replicate were collected at random from different levels of plant height. The collected samples were transferred to the laboratory in tightly closed paper bages for inspection and counting the number of sucking insect pests (aphids, thrips and nymphs of white fly) and accompanied predators by the aid of binocular microscope. In the fruiting stage, 10 fruits were picked up randomly from each replicate till harvesting and also transferred to the laboratory in paper bags. Okra fruits were dissected and the numbers of both nymphs and adults of *Oxycarenus hyalinipennis* Costa were counted.

### Insect Sweep Net

To survey the flight insects infesting okra plants, an insect sweep net with a diameter of 30 cm and 60 cm in depth of the conical fine muslin was used. Each sample (consisted of 20 double strokes) was taken randomly at weekly intervals from both diagonal directions of the experimental area. Captured insects were transferred in well tied plastic bags to the laboratory for examination and counting.

### Effect of Prevailing Temperature and Relative Humidity

Daily records of mean temperature and relative humidity during the experimental periods were obtained from the Agro-Meteorological Station at Zagazig city, Sharkia Governorate. Values of simple correlation (r), partial regression (b) and coefficient of determination (CD%) were calculated and used to describe the relationship between population fluctuation of sucking insect pests and their

associated predators from one side and each of temperature and relative humidity according to **Costat Software Microcomputer Program Analysis (1990)**.

## RESULTS AND DISCUSSION

### Survey and Relative Densities of the Main Sucking Insect Pests and their Common Associated Predators

#### Insect pests

As shown in Table 1, five sucking insect species belonging to five families and two orders were recorded on okra plants during the two cropping seasons (2015 and 2016). The major counted sucking insect species were *Bemisia tabaci* (Gennadius), *Oxycarenus hyalinipennis* Costa, *Aphis gossypii* Glover, *Empoasca lybica* (Bergevin) and *Thrips tabaci* Linde with relative densities of 30.00, 30.36, 22.17, 10.47 and 7.00% during the first season of the study and 37.71, 26.10, 20.43, 8.80 and 6.96% for the second one, respectively.

These results are supported by those of **Imam et al. (2010)** who surveyed the main insect pests of some vegetables included okra in three selected areas in Nigeria and reported that the highest insect pests densities were obtained by aphid, bugs and thrips. **Ahmad et al. (2010)** reported that 13 pests were recorded on okra plants, among these pests leafhopper, whitefly and aphids were found to be major insect pests and inflicted heavy damage to okra during 2006 season. Also, **Pal et al. (2013)** reported that jassids, cotton white fly, cotton aphid and cotton seed bug were the major insect pests on okra in West Bengal, India during 2009 and 2010 growing seasons. Similar results were obtained by **Allam (2014)** who surveyed the phytophagous pests infesting okra plants in Assuit Governorate and found that *B. tabaci*, *A. gossypii*, *E. lybica*, *T. tabaci*, *O. hyalinipennis*, *Nezara viridula* L. and *Tetranychus urticae* Koch were the most important pests on okra plants. The obtained data also are in conformity with those of **Khan et al. (2015)** who indicated that the key insect pests that attacked okra plants at the new Development Farm of the University of Agriculture Peshawar, Pakistan during 2009 season were whitefly, aphid, leafhopper and red cotton bug.

#### Insect predators

Four predaceous species belonging to three families and three orders were recorded. The common predaceous species were *Metasyrphus corollae* (Fabricius), *Chrysoperla carnea* (Stephens), *Coccinella undecimpunctata* Linnaeus and *Coccinella septempunctata* Linnaeus representing 34.94, 22.89, 24.90 and 17.27% in the first season and 32.23, 28.91, 24.17 and 14.69% of the total number of insect predators in the second season, respectively.

These results are partially similar to the findings of **Singh et al. (2013)** who recorded *C. undecimpunctata* and *C. septempunctata* as an aphidophagous predators in the aphid colonies infesting okra agro-ecosystem in Chitrakoot region, India during 2008 and 2009 seasons. Also **Allam (2014)** reported that *C. undecimpunctata*, *Scymnus interruptus* Linnaeus, *C. carnea* and *Chrysopa vulgaris* Navas were the main predaceous insect species existing on okra plant. The present research findings differed from those of **Khan et al. (2015)** who found that the spider, *Dictyna* sp.; the ant, *Solenopsis invicta* (Burem) and *C. septempunctata* were the major natural enemies recorded on okra.

### Seasonal Abundance of the Main Sucking Insect Pests and their Common Associated Predators

#### Insect pests

Results presented in Table 2 show the seasonal abundance of the major sucking insect pests:

#### The cotton whitefly, *Bemisia tabaci* (Gennadius)

The immature stages of *B. tabaci* started to appear in the second week of June by 22 and 15 nymphs/sample during the two successive seasons of 2015 and 2016, consecutively. In the first season the population of *B. tabaci* increased gradually showing four peaks in the first and fourth week of June, in the fourth week of July, in the first week of August and in the fourth week of September with numbers of 114, 184, 353 and 268 nymphs/sample, subsequently. In the second season, *B. tabaci* peaked in the first week of both August and September by 203 and 536 nymphs/sample. Afterwards, a gradual decrease was observed till the end of both seasons.

**Table 1. Total numbers of main sucking insect pests and their associated predators on okra plants at Diarb-Nigm district, Sharkia Governorate using plant sample and sweep net in 2015 and 2016 growing seasons**

Insect species	2015				2016				General	
	PS	SN	Total number	(%)	PS	SN	Total number	(%)	Total number	(%)
<b>Insect pests</b>										
<i>Bemisia tabaci</i> (Gennadius) (Homoptera : Aleyrodidae)	2549	105	2654	30.00	2731	126	2857	37.71	5511	33.56
<i>Oxycarenus hyalinipennis</i> Costa (Hemiptera : Lygaeidae)	2237	449	2686	30.36	1723	254	1977	26.10	4663	28.39
<i>Aphis gossypii</i> Glover (Homoptera : Aphididae)	1914	47	1961	22.17	1514	34	1548	20.43	3509	21.37
<i>Empoasca lybica</i> (Bergevin) (Homoptera : Cicadellidae)	77	849	926	10.47	51	616	667	8.80	1593	9.70
<i>Thrips tabaci</i> Linde (Thysanoptera : Thripidae)	593	26	619	7.00	491	36	527	6.96	1146	6.98
<b>General total number</b>	7370	1476	8846	100.00	6510	1066	7576	100.00	16422	100.00
<b>Insect predators</b>										
<i>Metasyrphus corollae</i> (Fabricius) (Diptera : Syrphidae)	81	6	87	34.94	68	0	68	32.23	155	33.70
<i>Chrysoperla carnea</i> (Stephens) (Neuroptera : Chrysopidae)	48	9	57	22.89	53	8	61	28.91	118	25.65
<i>Coccinella undecimpunctata</i> Linnaeus (Coleoptera : Coccinellidae)	47	15	62	24.90	40	11	51	24.17	113	24.56
<i>Coccinella septempunctata</i> Linnaeus (Coleoptera : Coccinellidae)	37	6	43	17.27	29	2	31	14.69	74	16.09
<b>General total number</b>	213	36	249	100.00	190	21	211	100.00	460	100.00

PS : Plant sample SN : Sweep net

**Table 2. Seasonal abundance of the main sucking insect pests on okra plants at Diarb-Nigm district, Sharkia Governorate in 2015 and 2016 growing seasons**

Weekly sampling date	Number of <i>B. tabaci</i> / 30 leaves		Number of <i>A. gossypii</i> / 30 leaves		Number of <i>T. tabaci</i> / 30 leaves		Number of <i>E. lybica</i> / 60 double strokes		Number of <i>O. hyalinipennis</i> / 30 fruits	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
<b>June, 1<sup>st</sup></b>	0	0	14	7	0	0	17	0	-	-
2 <sup>nd</sup>	22	15	26	11	12	0	25	9	-	-
3 <sup>rd</sup>	24	24	28	16	15	2	35	13	-	-
4 <sup>th</sup>	49	37	29	23	18	7	37	15	-	-
<b>July, 1<sup>st</sup></b>	114	54	32	28	20	12	39	18	-	-
2 <sup>nd</sup>	111	60	43	34	24	14	42	23	-	-
3 <sup>rd</sup>	133	96	121	46	25	18	140	27	-	-
4 <sup>th</sup>	184	107	137	89	25	23	37	32	-	-
<b>Aug., 1<sup>st</sup></b>	63	203	120	75	27	29	29	38	-	-
2 <sup>nd</sup>	49	154	118	104	29	31	32	82	-	-
3 <sup>rd</sup>	57	187	122	268	15	44	45	58	-	-
4 <sup>th</sup>	353	265	497	234	97	48	143	35	-	-
5 <sup>th</sup>	79	322	117	183	23	71	42	39	-	-
<b>Sep., 1<sup>st</sup></b>	56	536	114	132	25	56	38	53	-	-
2 <sup>nd</sup>	97	271	104	97	83	51	80	44	-	-
3 <sup>rd</sup>	148	112	94	67	48	35	26	42	100	116
4 <sup>th</sup>	268	80	80	52	23	26	23	31	270	160
<b>Oct., 1<sup>st</sup></b>	255	57	65	22	21	16	10	26	320	233
2 <sup>nd</sup>	246	45	35	17	20	6	9	19	360	308
3 <sup>rd</sup>	93	41	18	9	19	2	0	12	433	368
4 <sup>th</sup>	56	26	0	0	13	0	0	0	335	221
<b>Nov., 1<sup>st</sup></b>	53	23	0	0	11	0	0	0	256	170
2 <sup>nd</sup>	39	16	0	0	0	0	0	0	163	147
<b>Total</b>	2549	2731	1914	1514	593	491	849	616	2237	1723
<b>Mean</b>	115.86	124.14	95.70	75.70	28.24	27.28	44.68	32.42	279.63	215.38

The mean numbers of the cotton whitefly were 115.86 and 124.14 nymphs/sample during both seasons, respectively.

These results are in harmony with the findings of **Khan and Ullah (1994)** who found that the population of whiteflies on okra started to build up on early July and reached its peak in the months of August and September. Similar trends were found by **Kumawat et al. (2000)**. The obtained results are also partially similar to the findings of **Abdel Hamed et al. (2011)** who studied the population fluctuation of *B. tabaci* on okra plants at Qalyubia Governorate during the plantation seasons of 2009 and 2010 and reported that the plants of okra were liable for infestation with *B. tabaci* throughout the whole period of plant growth. They also indicated that the population of *B. tabaci* showed three peaks of activity on the 6<sup>th</sup> and 27<sup>th</sup> of July and on the 31<sup>st</sup> of August then it decreased till the end of the experimental period during the two studied seasons.

#### **The cotton aphid, *Aphis gossypii* Glover**

In regard to *A. gossypii* the population appeared from the first week of June by 14 and 7 individuals/sample, respectively and continued to the third week of October during both investigation seasons. In the first season, the aphid population increased continuously recording its maximum in the fourth week of July and August with numbers of 137 and 497 individuals/sample, subsequently. The mean number of the aphid during the period of its occurrence was 95.70 individuals/sample. Also, in the second season the aphid population showed two peaks. The first one was recorded in the fourth week of July (89 individuals / sample). The second and highest peak was in the third week of August (268 individuals/sample). The mean number of *A. gossypii* during the period of its appearance was 75.70 individuals / sample. It was observed that *A. gossypii* nearly disappeared from the fourth week of October till the end of the experimental period.

Similar results were obtained by **Hammad and Mohsen (2000)** who concluded that the cotton aphid showed a high level of infestation on roselle plants during July and August in the two successive seasons of 1997 and 1998.

**Pathon et al. (2018)** studied the incidence of the major insect pests infesting okra in India during 2014 and 2015 seasons and reported that the highest activity of *A. gossypii* was observed in August in the two seasons of the study.

#### **The cotton thrips, *Thrips tabaci* Linde**

Concerning *T. tabaci*, the insect started to appear on okra plants in the second week of June by 12 individuals/sample. Then, the population was fluctuated giving two peaks. The first one (97 individuals/sample) was observed in the fourth week of August and the second peak (83 individuals/sample) took place in the second week of September. The mean number of the pest during the period of its appearance was 28.24 individuals/sample in the first growing season. While in the second season, the first appearance of the insect was in the third week of June with very few numbers (2 individuals/sample), then after the population of the insect increased gradually and reached its maximum in the fifth week of August by 71 individuals/sample, then the population decreased slightly and the insects nearly disappeared from the fourth week of October till the end of the experiment. The mean number of *T. tabaci* during the period of its occurrence was 27.28 individuals / sample.

The present findings agree in a great part with those of **Abdel Hamed et al. (2011)** who stated that the first appearance of *T. tabaci* on okra plants was on the 1<sup>st</sup> of June and the insect peaked on the 24<sup>th</sup> of August and the 7<sup>th</sup> of September during 2009 and 2010 growing seasons.

#### **The cotton leafhopper, *Empoasca lybica* (Bergevin)**

As for *E. lybica*, the obtained results cleared that the first presence of the insect in the first season was in the first week of June by 17 individuals/sample. Then, the population increased gradually and reached its maximum numbers with 140, 143 and 80 individuals / sample in the third week of July, fourth week of August and second week of September, respectively. The mean number of *E. lybica* during the period of its appearance was 44.68 individuals/sample. In the second season, *E. lybica* started to appear on okra plants with few numbers (9 individuals/sample) in the second week of June, then the insect numbers fluctuated

to record two peaks of activity in the second week of August and first week of September by 82 and 53 individuals/sample, consecutively. The mean number of the cotton leafhopper during the period of its occurrence was 32.42 individuals/sample. It was noticed that okra plants were nearly free from any infestation with *E. lybica* during the last inspections of both growing seasons.

These results relatively agree with those obtained by **Pal et al. (2013)** who found that there was a significant increase of jassids population on okra at the flowering and fruiting stages.

#### **The cotton seed bug, *Oxycarenus hyalinipennis* Costa**

It is obvious that the population of *O. hyalinipennis* was not encountered during the early growth stage of okra plants and it was almost occurred in fruiting stage. The initial incidence of the bug was recorded in the third week of September with 100 and 116 individuals/sample in the first and second seasons, respectively. Then the insect population increased gradually and peaked in the third week of October by 433 and 368 individuals/sample during 2015 and 2016 growing seasons, respectively. Thereafter, the insect population started to decrease again. The mean number of *O. hyalinipennis* during the period of its appearance in the first season was 279.63 individuals/sample, while in the second one it was 215.38 individuals / sample.

The present findings are in partial consonance with those of **Pal et al. (2013)** who reported that the population of the cotton seed bug increased slowly in the vegetative period but soon after development of fruits the population rapidly increased and attained maximum level just one week after fruiting. They added that the population gradually decreased later but caused considerable damage to the fruits till the maturity of the crop.

#### **Insect predators**

Results summarized in Table 3 show the seasonal abundance of the dominant predators associated with the major sucking insect pests infesting okra plants during the two seasons of the study.

#### **The syrphus fly, *Metasyrphus corollae* (Fabricius)**

The obtained results indicate that the first presence of *M. corollae* was in the third week of July by 6 and 3 individuals / sample in the first and second seasons, respectively. In the first season there was one peak of activity in the fifth week of August (18 individuals/sample), while in the second one the peak occurred in the second week of August (21 individuals/sample). The relative density of *M. corollae* as compared with the total numbers of considered predators were 38.03 and 35.79% in 2015 and 2016, respectively.

Such findings are relatively agree with those of **Hammad and Mohsen (2000)** who recorded *M. corollae* as one of the main predators that existing on roselle plant at El-Khattara district, Sharkia Governorate.

#### **The green lacewing, *Chrysoperla carnea* (Stephens)**

As for *C. carnea*, the population appeared during a short period that confined between the first week of July (4 individuals/sample) and the second week of August recording its maximum number (15 individuals/sample) in the third week of July in season of 2015. In the second season (2016), the population started with a few number (2 individuals / sample) in the first week of July and continued till the fourth week of August and peaked in the fourth week of July by 14 individuals / sample. The relative densities of *C. carnea* were 22.53 and 27.89% during the two studied seasons, successively.

The present work is supported by the findings of **Henn and Weinzierl (1990)** who reported that *C. carnea* larvae are active predators feed on many insect pests infesting field crops. **Hoffmann and Frodsham (1993)** stated that the green lacewings are common in agricultural fields and their adults feed only on nectar, pollen and aphid honeydew, but their larvae are active predators and they occur in a wide range of habitats.

#### **The eleven-spotted ladybird beetle, *Coccinella undecimpunctata* Linnaeus**

In the first season, *C. undecimpunctata* population was observed from the third week of

**Table 3. Seasonal abundance of the dominant predators associated with the main sucking insect pests on okra plants at Diarb-Nigm district, Sharkia Governorate during 2015 and 2016 growing seasons**

Weekly sampling date	<i>M. corollae</i>		<i>C. carnea</i>		<i>C. undecimpunctata</i>		<i>C. septempunctata</i>	
	2015	2016	2015	2016	2015	2016	2015	2016
<b>June, 1<sup>st</sup></b>	0	0	0	0	0	0	0	0
<b>2<sup>nd</sup></b>	0	0	0	0	0	0	0	0
<b>3<sup>rd</sup></b>	0	0	0	0	2	1	0	0
<b>4<sup>th</sup></b>	0	0	0	0	6	1	5	3
<b>July, 1<sup>st</sup></b>	0	0	4	2	3	2	6	6
<b>2<sup>nd</sup></b>	0	0	11	7	5	3	8	7
<b>3<sup>rd</sup></b>	6	3	15	11	4	5	4	4
<b>4<sup>th</sup></b>	6	7	8	14	1	9	2	4
<b>Aug., 1<sup>st</sup></b>	7	13	7	8	3	7	0	3
<b>2<sup>nd</sup></b>	10	21	3	6	6	4	6	1
<b>3<sup>rd</sup></b>	14	14	0	3	4	4	3	1
<b>4<sup>th</sup></b>	15	8	0	2	4	2	2	0
<b>5<sup>th</sup></b>	18	2	0	0	2	1	0	0
<b>Sep., 1<sup>st</sup></b>	5	0	0	0	2	1	1	0
<b>2<sup>nd</sup></b>	0	0	0	0	2	0	0	0
<b>3<sup>rd</sup></b>	0	0	0	0	2	0	0	0
<b>4<sup>th</sup></b>	0	0	0	0	1	0	0	0
<b>Oct., 1<sup>st</sup></b>	0	0	0	0	0	0	0	0
<b>2<sup>nd</sup></b>	0	0	0	0	0	0	0	0
<b>3<sup>rd</sup></b>	0	0	0	0	0	0	0	0
<b>4<sup>th</sup></b>	0	0	0	0	0	0	0	0
<b>Nov., 1<sup>st</sup></b>	0	0	0	0	0	0	0	0
<b>2<sup>nd</sup></b>	0	0	0	0	0	0	0	0
<b>Total</b>	81	68	48	53	47	40	37	29
<b>Relative density (%)</b>	38.03	35.79	22.53	27.89	22.07	21.05	17.37	15.26

June (2 individuals/sample) to the fourth week of September showing three peaks of activity in the fourth week of June, the second week of July and in the second week of August by 6,5 and 6 individuals / sample, respectively. The relative density of the predator was 22.07%. While in the second season, *C. undecimpunctata* was firstly recorded in the third week of June with one individual / sample and continued till the first week of September reaching its maximum number (9 individuals / sample) in the fourth week of July. The relative density of *C. undecimpunctata* was 21.05%.

Some earlier researchers had also reported that coccinellids are one of the natural enemies that contributed to the reduction of insect pests of okra (Solangi and Lahor, 2007).

#### **The seven-spotted ladybird beetle, *Coccinella septempunctata* Linnaeus**

As regards *C. septempunctata*, the population in the first season of the study appeared from the fourth week of June (5 individuals / sample) and continued till the first week of September recording two peaks of activity with 8 and 6 individuals / sample in the second week of both July and August, respectively. While in the second season the predator was observed on okra plants from the fourth week of June (3 individuals / sample) to the third week of August reaching its maximum in the second week of July by 7 individuals / sample. The relative densities of *C. septempunctata* were 17.37 and 15.26 during the first and the second seasons, successively.

Similar results were obtained by Khan *et al.* (2015) who found that the population of *C. septempunctata* started from mid June and reached to its highest number in July.

#### **Effect of Temperature and Relative Humidity on the Main Sucking Insect Pests and their Associated Predators**

Results presented in Table 4 clear the influence of the two ecological weather factors, temperature and relative humidity on the population of the main sucking insect pests and their common predators existing on okra plants.

##### **Insect pests**

#### **Cotton whitefly, *B. tabaci***

The correlation coefficient between *B. tabaci* population and mean temperature was positive

and significant ( $r_1 = 0.4238^*$ ) in the first season, while in the second one it was positive and insignificant ( $r_1=0.1341^{ns}$ ). In case of relative humidity it was negative and insignificant in the first season ( $r_2=-0.0622^{ns}$ ) and positive and insignificant in the second one ( $r_2= 0.3622^{ns}$ ). The coefficient of determination percentages were 18.76 and 41.48% during 2015 and 2016 growing seasons, respectively.

#### **Cotton seed bug, *O. hyalinipennis***

There was a negative correlation between temperature and the population density of the cotton seed bug on okra plants being insignificant in the first season ( $-0.1786^{ns}$ ) and highly significant in the second one ( $r_1=-0.7370^{***}$ ). As for relative humidity, it was positive insignificant in the first season of the study ( $r_2= 0.0651^{ns}$ ) and positive and significant in the second one ( $r_2= 0.5125^*$ ). The coefficient of determination clearly shows that the two considered weather factors affected the population density of *O. hyalinipennis* by 3.19 and 54.31% during the two mentioned seasons, respectively.

#### **Cotton aphid, *A. gossypii***

There were positive and insignificant correlation relationships between the weekly numbers of the cotton aphid and mean temperature in both seasons, whereas  $r_1$  valued 0.4117<sup>ns</sup> and 0.2770<sup>ns</sup> in the first and second seasons, successively. Relative humidity showed negative and insignificant effect, with ( $r_2$ ) value of  $-0.0368^{ns}$  in the first season, while in the second one it was positive and insignificant with ( $r_2$ ) value of 0.2284<sup>ns</sup>. The coefficient of determination percentages of the two tested weather factors were 18.21 and 41.47% for the two growing seasons, respectively.

#### **Cotton leafhopper, *E. lybica***

*E. lybica* population had positive and insignificant correlation with the mean temperature, where  $r_1=0.2954^{ns}$  and 0.4090<sup>ns</sup> during the two growing seasons, respectively. Also, relative humidity showed positive and insignificant correlation ( $r_2=0.0330^{ns}$  and 0.1564<sup>ns</sup>) in the experimented seasons, subsequently. The CD (%) for temperature and relative humidity were 10.79 in the first season and 53.70% in the second one.

**Table 4. Simple correlation, partial regression and coefficient of determination between certain weather factors and the weekly number of the main sucking insect pests and their associated predators on okra plants at Diarb-Nigm district, Sharkia Governorate during 2015 and 2016 growing seasons**

Insect species	Simple correlation				Partial regression				CD (%)	
	2015		2016		2015		2016		2015	2016
	r <sub>1</sub>	r <sub>2</sub>	r <sub>1</sub>	r <sub>2</sub>	b <sub>1</sub>	b <sub>2</sub>	b <sub>1</sub>	b <sub>2</sub>		
<b>Insect pests</b>										
<i>B. tabaci</i>	0.4238*	-0.0622 <sup>ns</sup>	0.1341 <sup>ns</sup>	0.3622 <sup>ns</sup>	0.0439	0.7779	0.5416	0.0894	18.76	41.48
<i>O. hyalinipennis</i>	-0.1786 <sup>ns</sup>	0.0651 <sup>ns</sup>	-0.7370***	0.5125*	0.4149	0.7678	0.0001	0.0124	3.19	54.31
<i>A. gossypii</i>	0.4117 <sup>ns</sup>	-0.0368 <sup>ns</sup>	0.2770 <sup>ns</sup>	0.2284 <sup>ns</sup>	0.0509	0.8677	0.2007	0.2944	18.21	41.47
<i>E. lybica</i>	0.2954 <sup>ns</sup>	0.0330 <sup>ns</sup>	0.4090 <sup>ns</sup>	0.1564 <sup>ns</sup>	0.1712	0.8812	0.0527	0.4760	10.79	53.70
<i>T. tabaci</i>	0.2491 <sup>ns</sup>	-0.1008 <sup>ns</sup>	0.2087 <sup>ns</sup>	0.3662 <sup>ns</sup>	0.2516	0.6473	0.3392	0.0857	6.23	54.31
<b>Insect predators</b>										
<i>M. corollae</i>	0.3637 <sup>ns</sup>	0.0065 <sup>ns</sup>	-0.0828 <sup>ns</sup>	0.3425 <sup>ns</sup>	0.0880	0.9764	0.7693	0.2114	15.20	24.86
<i>C. carnea</i>	0.1558 <sup>ns</sup>	-0.0384 <sup>ns</sup>	0.2185 <sup>ns</sup>	-0.0878 <sup>ns</sup>	0.4777	0.8617	0.4340	0.7558	2.45	7.61
<i>C. undecimpunctata</i>	0.3397 <sup>ns</sup>	-0.1604 <sup>ns</sup>	0.1654 <sup>ns</sup>	0.0248 <sup>ns</sup>	0.1127	0.4647	0.5558	0.9301	11.75	11.22
<i>C. septempunctata</i>	0.1160 <sup>ns</sup>	0.0103 <sup>ns</sup>	0.2690 <sup>ns</sup>	-0.0903 <sup>ns</sup>	0.5982	0.9627	0.3323	0.7489	1.45	12.95

r<sub>1</sub>, b<sub>1</sub>= Correlation and partial regression coefficients between mean temperature and number of species.

r<sub>2</sub>, b<sub>2</sub>= Correlation and partial regression coefficients between relative humidity and number of species.

CD = Coefficient of determination.

**Cotton thrips, *T. tabaci***

The correlations between *T. tabaci* population and mean temperature were positive and insignificant ( $r_1=0.2491^{ns}$  and  $0.2087^{ns}$ ) in both seasons, successively. In regard to relative humidity, the correlation was negative and insignificant in the first season ( $r_2= -0.1008^{ns}$ ) and positive and insignificant in the second one ( $r_2= 0.3662^{ns}$ ). The coefficient of determination percentages of the two studied weather factors were 6.23 and 54.31% for the two successive seasons, consecutively.

**Insect predators****Syrphus fly, *M. corollae***

The weekly number of *M. corollae* had positive and insignificant correlation with the mean temperature ( $r_1= 0.3637^{ns}$ ) in the first season, while in the second season it was insignificantly negative ( $r_1= -0.0828^{ns}$ ). Relative humidity showed positive and insignificant correlations ( $r_2= 0.0065^{ns}$  and  $0.3425^{ns}$ ) for both seasons, respectively. The CD (%) values for temperature and relative humidity were 15.20 in the first season and 24.86% in the second one.

**Green lacewing, *C. carnea***

The obtained results show positive and insignificant correlations between mean temperature and the population of *C. carnea* ( $r_1= 0.1558^{ns}$  and  $0.2185^{ns}$ ) during the two seasons, respectively. In case of relative humidity the correlations were negative and insignificant ( $r_2= -0.0384^{ns}$  and  $-0.0878^{ns}$ ) during the two seasons, respectively. The coefficient of determination percentages for temperature and relative humidity were 2.45 and 7.61% in 2015 and 2016 growing seasons, successively.

**Eleven-spotted ladybird beetle, *C. undecimpunctata***

The correlation relationships between *C. undecimpunctata* population and mean temperature were positive and insignificant ( $r_1= 0.3397^{ns}$  and  $0.1654^{ns}$ ) in the two experimented seasons, respectively. While the correlations respecting relative humidity proved to be insignificantly negative ( $r_2= - 0.1604^{ns}$ ) during the first season and insignificantly positive in the second one ( $r_2= 0.0248^{ns}$ ). The coefficient of determination percentages of the two studied

weather factors were 11.75 and 11.22% for the two growing seasons, consecutively.

**Seven-spotted ladybird beetle, *C. septempunctata***

The correlation coefficients between *C. septempunctata* population and mean temperature were positive and insignificant ( $r_1= 0.1160^{ns}$  and  $0.2690^{ns}$ ) in the two successive seasons, respectively. Relative humidity showed positive and insignificant influence ( $r_2= 0.0103^{ns}$ ) in the first season, while it was negative and insignificant in the second one ( $r_2= - 0.0903^{ns}$ ). The CD (%) values for temperature and relative humidity were 1.45% in the first season and 12.95% in the second one.

The obtained results indicated that weather factors are the most important variable factors affecting the population density of sucking insect pests and their associated predators on okra plants. The present findings are in consonance to those of **Rote and Puri (1992)** who stated that relative humidity is a contributing factor in the population changes of the phytophagous pests (insects and mites), as well as for their predators on okra and squash plants. Such finding are also in conformity with those of **Gogoi and Datta (2000)** and **Panickar and Patel (2001)** who reported that meteorological parameters play an important role in the population fluctuation of sucking insect pests. And those of **Bale et al. (2002)** who stated that the most important abiotic factor is temperature which has dominant role in insect pest population variation.

**The Ratios Between the Common Predators and the Main Sucking Insect Pests**

As seen in Table 5, the relationships between the previously mentioned common predators and the main sucking insect pests infesting okra plants during the two seasons of study were calculated as predators : preys ratios. The highest predators : preys ratio during the first season of the study (1 : 14.78) was recorded in July. In the second season, the highest predators: preys ratio (1 : 8.11) was obtained also during July. The seasonal predators : preys ratios were 1 : 38.23 and 1 : 37.02 during the first and second seasons, respectively. In general, the highest mean of predators : preys ratio during the two seasons of the study (1 : 11.43)

**Table 5. The ratios between the common predators and the main sucking insect pests on okra plants at Diarb-Nigm district, Sharkia Governorate during 2015 and 2016 growing seasons**

Month	2015			2016			General		
	No. of insect pests	No. of predators	Predator : prey	No. of insect pests	No. of predators	Predator : prey	No. of insect pests	No. of predators	Predator : prey
<b>June</b>	351	13	1 : 27.00	179	5	1 : 35.80	530	18	1 : 29.44
<b>July</b>	1227	83	1 : 14.78	681	84	1 : 8.11	1908	167	1 : 11.43
<b>August</b>	2057	104	1 : 19.78	2470	100	1 : 24.70	4527	204	1 : 22.19
<b>September</b>	1677	13	1 : 129.00	1961	1	1 : 1961.00	3638	14	1 : 259.86
<b>October</b>	2309	0	-	1386	0	-	3695	0	-
<b>November</b>	522	0	-	356	0	-	878	0	-
<b>Total number</b>	8143	213		7033	190		15176	403	
<b>Seasonal predator : prey</b>			1 : 38.23			1 : 37.02			1 : 37.66

was recorded during July. The general predators : preys ratio during the two seasons of the study was 1 : 37.66.

Such findings are partially agree with those of **El-Khawas and El-Khawas (2008)** who determined the predator : prey ratios between the major piercing sucking insect pests and their associated predators on eggplant and squash plants in Sharkia Governorate during 2006 and 2007 growing seasons. Similar trends were found by **Ghanim et al. (2010)** who calculated the ratio between certain piercing sucking insects and the predator, *C. undecimpunctata* on cotton plants in Dakahlia Governorate and found that the maximum ratio was recorded in September during both 2008 and 2009 growing seasons.

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## الآفات الحشرية الماصة الرئيسية والمفترسات المصاحبة لها على نباتات البامية

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معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقي - جيزة - مصر

أجريت هذه الدراسة بهدف حصر وتقدير الكثافة العددية للآفات الحشرية الماصة الرئيسية التي تصيب نباتات البامية وكذلك لأهم المفترسات المصاحبة لها وعلاقتها بدرجات الحرارة والرطوبة النسبية السائدة في منطقة ديرب نجم - محافظة الشرقية - مصر خلال موسمي الزراعة الصيفية ٢٠١٥ و ٢٠١٦، وقد أظهرت النتائج ما يلي: كانت ذبابة القطن البيضاء، بقعة بذرة القطن، من القطن، نطاط أوراق القطن وتربس القطن هي الآفات الحشرية الماصة الرئيسية على نباتات البامية، وكانت أكثر المفترسات الحشرية سيادة هي ذبابة السيرفس، أسد المن الأخضر العادي، أبو العيد ذو الإحدى عشر نقطة وأبو العيد ذو السبع نقاط، تم تسجيل أربع قمم نشاط للذبابة البيضاء وذلك في الأسبوعين الأول والرابع من شهر يوليو وأيضًا في الأسبوع الرابع من شهري أغسطس وسبتمبر خلال الموسم الأول، وفي الموسم الثاني تم تسجيل قمتي نشاط للحشرة في الأسبوع الأول من شهري أغسطس وسبتمبر، تم تسجيل قمتي نشاط لمن القطن في الأسبوع الرابع من شهري يوليو وأغسطس خلال الموسم الأول، وكذلك خلال الموسم الثاني في الأسبوع الرابع لشهر يوليو والأسبوع الثالث لشهر أغسطس، تم تسجيل قمتي نشاط لتربس القطن في الأسبوع الرابع لشهر أغسطس والأسبوع الثاني لشهر سبتمبر خلال الموسم الأول، وفي الموسم الثاني تم تسجيل قمة نشاط واحدة للحشرة وذلك في الأسبوع الخامس لشهر أغسطس. تم تسجيل ثلاث قمم نشاط لنطاط أوراق القطن في الأسبوع الثالث لشهر يوليو، الأسبوع الرابع لشهر أغسطس وفي الأسبوع الثاني لشهر سبتمبر خلال موسم الزراعة ٢٠١٥ بينما في موسم ٢٠١٦ تم تسجيل قمتي نشاط للحشرة في الأسبوع الثاني لشهر أغسطس وفي الأسبوع الأول لشهر سبتمبر، تم تسجيل قمة نشاط واحدة لبقعة بذرة القطن وذلك في الأسبوع الثالث من شهر أكتوبر خلال موسمي الدراسة، تم تسجيل قمة نشاط واحدة لذبابة السيرفس في كلا الموسمين، ففي الموسم الأول لوحظت القمة في الأسبوع الخامس لشهر أغسطس، بينما في الموسم الثاني كانت قمة التعداد في الأسبوع الثاني لشهر أغسطس، بالنسبة لأسد المن الأخضر فقد سجل قمة تعداد في الأسبوع الثالث والرابع لشهر يوليو خلال الموسم الأول والثاني للدراسة علي التوالي، تم تسجيل ثلاث قمم نشاط لأبي العيد ذو الإحدى عشر نقطة وذلك في الأسبوع الرابع لشهر يونيو، الأسبوع الثاني لشهر يوليو وفي الأسبوع الثاني لشهر أغسطس، بينما في الموسم الثاني تم تسجيل قمة واحدة للنشاط في الأسبوع الرابع لشهر يوليو. تم تسجيل قمتي نشاط لأبي العيد ذو السبع نقاط وذلك في الأسبوع الثاني لشهر يوليو وأغسطس خلال الموسم الأول للدراسة. وفي الموسم الثاني تم تسجيل قمة واحدة للنشاط في الأسبوع الثاني لشهر يوليو، وقد أثرت درجة الحرارة والرطوبة النسبية على تعدادات ذبابة القطن البيضاء، بقعة بذرة القطن، من القطن، نطاط أوراق القطن، تربس القطن، ذبابة السيرفس، أسد المن الأخضر، أبو العيد ذو الإحدى عشر نقطة وأبو العيد ذو السبع نقاط بمقدار ١٨,٧٦ ، ٣,١٩ ، ١٨,٢١ ، ١٠,٧٩ ، ٦,٢٣ ، ١٥,٢٠ ، ٢,٤٥ ، ١١,٧٥ و ١,٤٥%، خلال موسم الدراسة الأول وبمقدار ٤١,٤٨ ، ٥٤,٣١ ، ٤١,٤٧ ، ٥٣,٧٠ ، ٥٤,٣١ ، ٢٤,٨٦ ، ٧,٦١ ، ١١,٢٢ و ١٢,٩٥% في الموسم الثاني للدراسة على التوالي، وأيضًا تم تقدير نسب المفترسات إلى الفرائس.

### المحكمون:

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