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SURVEY OF CERTAIN INSECTS INFESTING MAIZE CROP AND BIOLOGICAL ASPECTS OF THE PARASITOID, *BRACON BREVICORNIS* WESM. (HYMENOPTERA: BRACONIDAE) REARED ON *SESAMIA CRETICA* LED. UNDER LABORATORY CONDITIONS.

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ABSTRACT

The present study was conducted during two successive seasons in the period from 2011 to 2012 to survey some aphids species *Rhopalosiphum maidis* (Fitch)., *Rhopalosiphum padi* (Linnaeus)., *Aphis gossypii* (Glover). , leafhoppers species *Empoasca decipiens* (Paoli), *Empoasca decedens* (Paoli) , *Cicadulina chinai* (Ghaui) , *Balclutha hortensis* (Lindb) and *Cicadulina bipunctella zeae* (China), planthoppers species namely *Sogatelle vibix* (Haupt) and *S. furcifera* (Horv.) and two stem borers *Sesamia cretica* Led, *Ostrinia nubilalis* Hun infesting maize plants and their associated predators.The ecto-larval parasitoid species, *Bracon brevicornis* Wesm . was reared in the laboratory on full grown larval of the corn borer, *S. cretica* Led. Some biological aspects of parasitoid were studied. Total developmental period of immature stages (egg – adult) lasted 16.05 days. Average number of deposited eggs / female was 209.08 eggs. Mean number of eggs deposited per host larva was 8.19 eggs. Sex ratio (male: female) was 1 : 0.54 when the parasitoid was reared on *S. cretica* grown larvae . The results indicated that increase of the parasitoid density, increased the number of host larva parasitized, fecundity and total progeny, while the sex ratio (female %) was decreased. Adult longevity was affected by temperature and food supplied. Four predators were associated with these insects on maize. These predators were *Coccinella undecimpunctata* , *Metasyrphus Corollae* , *Chrysoperala carnea* and true spiders

Keywords: Aphids, leafhoppers, planthoppers, predators, maize , *Bracon brevicornis,* biology, *Sesamia certica,*.

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops in Egypt. It is subjected to infestation with a variety of insect pests (Tawfik *et al.*, 1974). The homopterous insects (aphids, leafhoppers and planthoppers) and two stem borers are economic pests of many agricultural crops in Egypt. Maize plants are infested by these insect pests which affect the quantity of yield as results of their direct feeding on plant, in addition, The homopterous insects are responsible for natural spread of several virus diseases to maize plants (Nielson, 1968 and Hegab,Ola 2001). Among these pests, *Sesamia cretica* Led. is considered one of the most destructive agricultural pests which causes serious economic damage and reduces the crop yield. This pest species is difficult to be controlled by contact insecticides because the larvae bore into plant tissues shortly after hatching. In addition, pesticides residues in food are becoming increasingly unacceptable to consumers.

The parasitoid, *Bracon brevicornis* Wesm. is an indigenous, primary gregarious ectoparasitoid on *S. cretica, O. nubilalis* Hb.; *Chilo Agamemnon* Bles.; *Helicoerpa armigera* (Hubner) and *Pectinophora gossypiella* (Saunders.). The parasitoid is widely distributed over lower and upper Egypt and has 24 generations in the laboratory per year (Megahed *et al.*,1981 and Kares *et al.*, 2009). Several authors over the world have recorded the parasitoid on different hosts; In India and Srylanka the parasitoid was recorded parasitized *Opisina arenosella* Walker (Pillai and Nair 1995) and cashew leaf and blossom Webber *Lamida moncusalis* Walker (Mohapatra and Mohapatra 2003). In Iran (Habibpour *et al.*, 2002) surveyed insects and a mites associated with stored products and their parasitoids, *B. brevicornis* was among the natural enemies of these pests. In Germany (Politz *et al.*, 2007) detected parasitism of *O. nubilalis* by *B. brevicornis*. Several authors studied the biology of this parasitoid (Lutfallah and Kares 1989; El- Mandrawy 1997 and Kares *et al.*, 2009).

Aim of this investigation is to survey certain insects on maize and study some biological parameters of the parasitoid, *B. brevicornis* on full grown larvae of *S. cretica*

MATERIALS and METHODS

Sampling started when the age of maize plants reached about 21-28 days after sowing and continued at weekly intervals throughout the two growing seasons. The following procedures of sampling were adopted:

2. 1- a) Plant samples, six leaves representing different strata, viz. terminal, middle and bottom parts and tassel were taken from randomly chosen five plants. These leaves and tassels were examined in the laboratory using a binocular microscope and the total number of existing nymphs, aptera, and alate forms of aphids and their associated predators on both surfaces of the leaves and tassels were recorded.

b) Sweeping net, 30 cm diameter and 60 cm deep. Each sample consisted of 100 double strokes were taken from both diagonal directions of the experimental area. Each sample was kept in a tight closed paper bag and transferred to the laboratory for inspection by binocular microscope and the collected leafhoppers and planthoppers were killed by cyanide, sorted into species and identified according to the work of Ribaut (1952), Nielson (1968) and Hegab *et .al.* (1989). Counts of captured leafhoppers were recorded for each sample.

c) Plant sample survey of corn stem borers, this investigation was conducted to survey of stem borers, *S. cretica* and *O. nubilalis* on maize plants. Soon after 15 days from germination of plants, 5 plants were randomly chosen and dissected weekly to estimate the infested plants and calculate numbers, number of larvae and number of pupae on maize plants during the growing season.

The experimental of biology were carried out at Plant Protection Research Institute, Sharkia Branch, Agricultural Research Center.

Rearing of *S. cretica*

Full grown hibernated larvae of *S. cretica* was collected from stored corn stalks. Groups of 10 larvae, each were confined in glass jar (20×25cm) and provided with pieces of soft tissue papers to serve as pupation sites. Jars were covered on the top by muslin cloth and were kept until pupation. Pupae were separated and each group was kept in glass jar and provided at the bottom by moistened soft tissue papers and kept in position by rubber bands for moths emergence.

Ovipositional cage consisted a maize seedling in in a plastic pot *S. cretica* moths were placed in the ovipositional cage and covered with muslin. Within each cage, the moths were provided with a piece of cotton moistened with 10% honey solution for feeding. Deposited eggs were collected and placed into envelopes of fresh green maize ears, as suitable food supply for hatching larvae. The infested ears were placed into glass jar, cored with muslin cloths. Fresh green maize ears were renewed as the larvae grew older and so on until full grown larvae were obtained.

Rearing of the parasitoid, *B. brevicornis* :

Laboratory culture of *B. brevicornis* began with parasitized hibernated larvae of *S. certica*, collected from maize stalks. The parasitized larvae was separated individually in glass tubes (9×2 cm). Cocoons were confined in glass jar (1/2 kg), covered with muslin. After emergence, adults were paired and provided by small droplets of bee honey scattered on the inner wall of each jar for feeding. Emerged parasitoid was mounted and identified at the Department of Biological Control, Agriculture Research Center, Egypt.

Biological aspects of the parasitoid, *B. brevicornis*

The experiments were carried out under the laboratory conditions of 25°C ± 2 and 64 ± 4 % RH. to study the biology of *B. brevicornis* on the full grown larvae of *S. cretica*. One pair of fresh parasitoid adults emerged was confined in a glass jar and replicated ten times. After the full grown larvae of *S. cretica* were introduced for one day to the jar, the larvae were examined and those carried parasitoid eggs were removed individually and kept in Petri-dish (10cm) under the same controlled conditions. Fresh larvae were introduced again into the jars and this method was continued until death of the parasitoid adults. The numbers of deposited eggs were counted daily. The parasitized larvae of *S. cretica,* which were separated individually inside Petri – dishes, were daily examined till the emergence of the parasitoid adults. The parasitized larvae were observed under a dissecting stereomicroscope to estimate incubation period of eggs and duration periods of larvae and pupae. Sex ratio and male and female longevity were also estimated.

Effect of temperature and food supply on the adult longevity of *B. brevicornis*.

Forty pairs of mated females and males of the parasitoid *B. brevicornis* were obtained from the laboratory culture, (24 hours) after adults emergence. They were divided into four groups, each of ten individuals, group (A) starved females and males, group (B) both sexes were supplied daily with droplets of honey, gropes A and B were kept at room temperature

(average 23°C). Group(C) adult females and males were also starved and group (D) was supplied daily with droplets of honey. The two groups C and D were kept in a refrigerator at 10 °C however Stary (1970).

Effect of parasitoid densities on parasitization rate:

The experiments were carried out in glass jars, (20×10 cm) twenty larvae of *S. cretica* were placed in each jar, provided with moistened soft tissue paper. Using different densities of the parasitoid, (female and male) 1♂ + 1♀, 2♂ + 2♀, 4♂ + 4♀ and 8♂ + 8♀. The last parasitoid densities were gently introduced into each jar contained 20 full grown larvae of *S. cretica* . After one day, the parasitoids were removed, the host larvae (*S. cretica*) were left and the parasitized larvae were counted, calculated the number of parasitoid eggs, Adult emergence rate and sex ratio were estimated. Five replicates were performed for each parasitoid density. Costat software program (1990) was used for statistical analysis of the data.

RESULTS AND DISSCUSION

Survey of some homopterous insects on maize plants

a) Aphid species:

Survey studies on maize plants in Diarb-Nigm, district, Sharkia Governorate revealed the presence of the following aphid species *Rhopalosiphum maidis* (Fitch)., *Rhopalosiphum padi* (Linnaeus)., *Aphis gossypii* (Glover).

b)Leafhopper insects:

The data presented in Table (1) showed the incidence of five leafhopper species belonging to family Cicadellidae on maize crop. The collected leafhopper species were arranged descendingly according to their abundance as follows: *Empoasca decipiens* (Paoli), *Empoasca decedens* (Paoli) , *Cicadulina chinai* (Ghaui) , *Balclutha hortensis* (Lindb) and *Cicadulina bipunctella zeae* (China)

Table (1): Total number of aphids, leafhoppers, planthoppers, stem borers and predator insect species collected from maize plants by using plant samples and sweeping net traps in Diarb- Nigm district, Sharkia Governorate during 2011 and 2012 seasons

Insects		2011		2012	
		Plant S.	S.N.T.	Plant S.	S.N.T.
Aphids	*R. maidis*	39861	17	49752	10
	R. padi	20651	33	41852	17
	A. gossypii	4552	12	8721	5
Leafhoppers and planthoppers	*E. decipiens*	3	1550	7	2870
	E. decedens	6	1340	10	2041
	C. chinai	3	842	2	1055
	C. bipunctalla zeae	-	270	-	420
	B. hortensis (Lindb)	-	412	1	1174
	S. vibix (Haupt)	3	1052	4	2410
	S. furcifera (Horv)	2	971	5	2652
Stem Borers	*Sesamia cretica* Led.	510	-	460	-
	Ostrinia nubilalis Hun.	295	-	342	-
predators	*C. undecmpunctata*	81	6	103	3
	M. corollae F.	76	3	93	4
	Ch. carnea	119	2	107	5
	True spiders	71	10	87	8

c) Planthopper insects:

The following planthopper species namely *Sogatelle vibix* (Haupt) and *S. furcifera* (Horv.) were collected from maize plants during 2011 and 2012 seasons.

d) Two stem borers insects:

The following two stem borers insects *S. cretica* , *O. nubilalis* were collected from maize plants during 2011 and 2012 seasons. The total numbers of these species were *S. cretica* (510 and 460 individuals), *O. nubilalis* (295 and 342 individuals) in the two seasons respectively. Guofa *et al.*, (2002) ; Velasco (2004); Saeed *et al.*, (2009) and Alireza *et al.*, (2010).

e) Predators:

Data in Table (1) showed the predator species on maize plants during 2011 – 2012 seasons. These species were belonging order coleoptera, Diptera and Neuroptera. The total numbers of these species were *C. undecmpunctata*(81 and 103 individuals), *M. corollae* (76 and 93 individuals) and *Ch. carnea* (119 and 107 individuals). Mean while true spiders (71 and 87individuals) during the two seasons of study. However, Darwish and ali (1991) reported that predators comprised about 88% of the total natural enemies recorded in maize fields in upper Egypt.

The experiment of biological

Data in Table (2) showed some of the biological aspects of the parasitoid *B. brevicornis* under the laboratory conditions of 25 ± 2 ºC and 60 ± 4 RH. Incubation period of eggs lasted for 2 – 3 days, with an average of 2.72 ± 0.11 days. Percentage of hatchability was 95. 97%.

Larval stage lasted an average of 5.35 ± 0.47 days with a range of 4 - 7 days. Mortality percentage was 3.17%. The pupal period ranged from 7 – 9 days, with an average 7.98 ± 0.73 days. The total developmental period (egg – adult) lasted of14 – 18 days, with an average of 16.05 ± 1.44 days.

Mean percentage of adult emergence was 95.74%. Sex ratio was 1 male: 0.54 female. The pre -ovipositoinal period of adult females, supplied with *S. cretica* full grown larvae was 1.67 ± 0.33 days, with a range of 1 – 2 days. Ovipositoinal period was 21.17± 1.78 days, with a range of 13-25 days. Post-oviposition period was 2.67 ± 0.74 , days with a range of 2 – 4 days. The mean female longevity was 25.51 ± 2.20 with a range of 16 – 29 days. The mean male longevity was 12.67± 0.84 with a range of 9 – 15 days. Mean number of deposited eggs*B. brevicornis* was 209.08 eggs/ femal, with a range of 121 – 339 eggs, Mean number of eggs/ host larva was 8.19 egg when the parasitoid reared on *S. cretica* full grown larvae. Temerak (1984b) stated that the female of *B. brevicornis*, supplied daily with afresh *S. cretica* larva lived significantly longer than those kept with unchanged larvae. Obtained results are in agreement with the findings of Megahed *et al.*,(1981) who studied the effect of six different host species, including *S. cretica* and *A. ipsilon* , on sex ratio of *B. brevicornis* reared at 27ºC & 65 R.H. The sex ratio differed according to the species of host larva. Highest sex ratio (females : males) 2.06:1 was obtained in case of *A. ipsilon.* Lutfallah and Kares (1989) reported that laboratory rearing of *B. brevicornis* , at 27ºC & 65% R.H. on *S. cretica.* showed a sex ratio of 1 female : 1.37 male, at which a slight increase in the ratio of males was found comparing to that (1

female: 1.19 male) on *O. nubilalis.* On the other hand, Kares *et al.,* (2009) showed that mean number of parasitoid progeny / host larvae was 9.3 (on *S. cretica*) when the host larvae were exposed daily to the parasitoid female and 11.4 when the host larvae were exposed every two days. Sex ratio (male : female) was found to be 1 : 0.3 when the parasitoid was reared on *S. cetica* , also found that an ovipositional period of adult females of *B. brevicornis*, which were supplied daily and every two days with *S. cretica* larvae were 30.6 and 20.0 days, respectively.

Table (2): Biological aspects of the parasitoid *Bracon brevicornis* when reared on *S. cretica* under laboratory condition 25 ±2°C and 60 ± 4 % RH.

Stage		Duration in days	
		Range	Mean ± SE
Egg	Incubation period	2 – 3	2.72 ± 0.11
	Hatchability %	90 – 100%	95.97%
Larva	Duration	4 - 7	5.035 ± 0.47
	Mortality	—	3.17%
Pupal period		7 – 9	7.98 ± 0.73
Total developmental period (egg- adult)		14 – 18	16.05 ± 1.44
Adult emergence %		—	95.74%
Sex ratio (Male: Female)		—	1 : 0.54
Adult female	Pre-ovipositional period	1 – 2	1.67 ± 0.33
	Ovipositional period	13 – 25	21.17 ± 1.78
	Post-ovipositional period	2 – 4	2.67 ± 0.74
	Female longevity	16 - 29	25.51 ± 2.20
Male longevity		9 – 15	12.67 ± 0.84
No. of eggs / female		121 – 339	209.08 ± 4.1
No. of eggs / larva		2 - 21	8.19± 0.901

Gunduz and Gulel (2005) indicated that the developmental period of parasitoid *B. brevicornis* from egg to adult was 11 – 13 days when the parasitoid was reared on *Galleria mellonella* L. and 12 – 14 days on *E. kuehnielle.*

Table (3) shows effect of parasitoid densities on the number of host larvae parasitized, fecundity and sex ratio, reared on *S. cretica* under laboratory conditions. With increase of the parasitoid density parasitoids / jar 8♂ + 8♀, number of parasitized host larvae increased to 15.5 ±0.51 at and the minimum (5.4 ±0.49) was recorded at (1♂+1♀) parasitoid per jar. Significant differences were found among the larvae of *S. certica* parasitized with *B. brevicornis* at varying densities. Also, parasitized larva was increased of the parastoid density the total number eggs laid/ parasitized larvae were increased with amaximum of 202.2 ± 1.59 eggs at 8♂ + 8 ♀ and a minimum (86.4± 0.75 eggs at 1 ♀ + 1♀). Total progeny of parasitoids female increased as the parasitoid density increased. The mean sex ratio (female %) was decrease by the increase of the parasitoid density. The mean sex ratio (female %) were 44.78, 40.08, 29.94 and 25.0 at 1 ♂+ 1♀, 2♂ + 2♀, 4♂ + 4♀ and 8♂ + 8♀ respectively.

Obtained results are in agreement with the findings of Holling (1959) indicted that the number of hosts attacked (paralyzed and oviposited hosts) increased with host density increased. The parasitoid would spend more time traveling among hosts as the density increased. Consequently, the total time for ovipositoin could be decreased.

Fuester *et al.*,(2003) reported similar results for the braconid *Glypantales flavicoxis*. The male biased sex ratio may be the result of a varity of factors, including sperm depletion, sperm death, physiological aging, active sperm digestion by the female, sperm disintegration while stored in the sperm thecae, the number of copulations and the differential mortality of the sexes during larval development (Uckan and Gulel, 2002; Damiens *el al.*, 2003; Fuester *et al.*,2003). Differential mortality has been implicated in several studies of competition in gregarious parasitoids but typically female larvae suffer more than males. Taking into consideration that *B. hebetor* not only lays an average of 12.6 eggs when it is supplied with only one host per day (Yu *et al.*, 2003) , but also records increased mortality of immature when the number of eggs laid on a single host is more than eight (**Yu 1999**), it may be assumed that extreme immature mortality caused this significant decrease.

Table (3): Effect of parasitoid densities on the number of hosts larvae parasitized, number eggs laid/host larvae and sex ration of *Bracon brevicornis*, reared on *Sesmia cretica* under the laboratory condition (25 ±2°C and 64 ± 4 % RH.)

Mean ± SE						
Parasitoid density	No. of hosts larva parasitized	Total number of eggs laid/ hosts larva	Adult emergence			Females%
			Male	Female	Total progeny	
1 ♂ + 1♀	5.4 ± 0.49^{d}	86.4 ± 0.75^{d}	43.4±1.08^{d}	35.2±1.28^{c}	78.6±1.5^{d}	44.78±0.58^{d}
2 ♂ + 2 ♀	8.6 ±0.50^{c}	110.8 ± 2.74^{c}	62.2±0.97^{c}	41.6±1.08^{b}	103.8±1.59^{c}	40.08±1.16^{c}
4 ♂ + 4♀	11.2 ± 0.58^{b}	145.8 ± 2.19^{b}	90.8±1.07^{b}	38.8±1.16^{bc}	129.6±2.18^{b}	29.94±1.73^{b}
8 ♂ + 8♀	15.5 ± 0.51^{a}	202.2 ± 1.59^{a}	137.4±1.15^{a}	45.8±1.43^{a}	183.2±2.37^{a}	25.0±0.79^{a}
F	*** 66.933	** 652.31	*** 1455.127	** 12.989	*** 526.757	** 166.198

Effect of temperature and food supply on longevity of *Bracon brevicornis*

Data in Table (4) showed that adult longevity of starved female was longer than that of starved males, when both were kept, at room temperature of 23 °C ± (Group A). Also, the female lived longer than male when fed at the room temperature (Group B) Starved or fed females lived longer than males when kept in the refrigerator at 10 °C ± (Groups C and D) however Stary 1970 showed that the adult life span of parasitoid was affected by many factors such as temperature, humidity, food and presence or absence of hosts.

Table (4): Effect of temperature and food supply on the longevity of *Bracon brevicornis*, emerged from *Sesmia cretica*.

Groups	Treatment	Temp °C	Adult longevity in days			
			Female		Male	
			Range	Mean±S.E.	Range	Mean±S.E.
A	—	23	17 -22	19.3± 0.47^{d}	10– 17	13.6±0.40^{d}
B	+	23	25- 28	26.1±0.31^{c}	18-22	19.5±0.40^{c}
C	—	10	28 – 32	30.1±0.48^{b}	21-31	24.5±1.08^{b}
D	+	10	32 - 44	39.1±1.36^{a}	29-34	31.5±0.45^{a}
F				** 119.0122		** 116.047

– Unfed + supplied with droplets of honey * Means of the same letter

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حصر لبعض الحشرات التى تصيب محصول الذرة والخصائص البيولوجية للطفيل *Bracon brevicornis* Wesm. المربى على دودة القصب الكبيرة *Sesamia cretica* Led تحت الظروف المعملية

امل ذكريا نور الدين الحبشى ،عبد الله على عبد الصمد واحمد امين احمد صالح

معهد بحوث وقاية النباتات– مركز البحوث الزراعية – دقى– جيزة– مصر

تم حصر العديد من الافات الحشرية التى تصيب محصول الذرة منها حشرات المن *Rhopalosiphum padi* (Linnaeus) و من الذرة *Rhopaosiphum maidis* (Fitch) و من القطن *Aphis gossypii* (Glover) بينما نطاطات الاوراق المتواجدة كانت *Empoasca decipens* (Paoli) و *E. decedens* (Paoli) و *Cicadulina chinai* (Ghaui) و *C. bipunctella zeae* (China) و نطاطات النباتات فتوجد *Balclutha hortensis* (Lindb) و ثاقبات الذرة *Sogatelle vibix* (Haupt) and *S. furcifera* (Horv.) نوعين *Ostrinia nubilalis* Hun و *Sesamia cretica* Led كذلك تواجد الربعة مفترسات هم ابو العيد *Coccinella undecimpunctata* و *Metasyrphus Corollae* و *Chrysoperala carnea* و العناكب الحقيقية True Spiders ثم تم تربية الطفيل الخارجى *Bracon brevicornis* Wesm تحت الظروف المعملية على العمر اليرقى الرابع لحشرة دودة القصب الكبيرة *S. certica* يتم تعرض اليرقات (العمر الرابع) فرديا و تعرض لذكر و انثى الطفيل لمدة ٢٤ ساعة حتى موت الطفيليات . استغرقت دورة الحياة ١٢ – ١٨ يوم بمتوسط ١٤,٩٥ يوم و متوسط النسل للطفيل على اليرقة الواحدة ٨٠١٩ بيض و النسبة الجنسية ١ ذكر : ٠,٥٤ انثى عند فترة تعرض الطفيل لليرقة لمدة يوم واحد. و اشارت النتائج ان مع زيادة كثافة الطفيل يزداد عدد اليرقات المتطفل عليها و كذلك عدد البيض و النسل (ذكور و اناث) بينما تقل النسبة الجنسية .

و تتأثر مدة حياة الحشرة الكاملة للطفيل سواء ذكر او انثى بدرجة الحرارة و وفرة الغذاء.

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