

BIOLOGICAL ASPECTS OF THE TORTOISE BEETLE, *CASSIDA VITTATA* VILL., (COLEOPTERA: CHRYSOMELIDAE) AS AFFECTED BY FEEDING ON DIFFERENT SUGAR BEET VARIETIES

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Abstract

Effect of feeding the tortoise beetle, *C. vittata* Vill., females emerged from diapause (FED) and larvae on different sugar beet varieties on its reproductive capacity, oviposition period, incubation period & hatchability of eggs and the duration periods of larval and pupal stages were studied from February to August 2006. Results showed that the highest reproductive capacity (263 ± 68 eggs per female), the longest oviposition period (62 ± 15.8 days) and the highest feeding pores (10.6 ± 1 feeding pores /day) were recorded on Dema poly variety under laboratory conditions of 22.7 ± 4.1 C° and 42.7 ± 6.8 % R. H. There are significant differences when compared to Toro, Monte blanco and both varieties, respectively. Dema poly was the most preferred variety for oviposition and feeding. Feeding females or larvae on different sugar beet varieties had no significant effect on the incubation period and hatchability rate of eggs as well as the duration periods of larva and pupa. *C. vittata* has a single generation in a year. The ovipositional activities by (FED) and active females started in mid February and April and prolonged until late March and June, respectively. Its reproductive capacities were 213.3 ± 10 eggs per (FED) and 141.7 ± 25.3 eggs per active female fed on Monte blanco variety and the difference was significant, but 106.3 ± 60.6 eggs per female collected from the field was recorded when fed on the same variety during the period of active females. Active adults entered diapause by July which ceased for laying eggs and feeding , but not continued to over the winter which died under hot and dry conditions during August. Females lived longer than males where the averages of life span and life cycle were 110.9 ± 12.1 & 92.7 ± 8.6 and 147.4 ± 17.2 & 129.2 ± 15.5 days, respectively .

INTRODUCTION

Since the grandiose efforts to change multi-tillering wild forms of *Beta vulgaris* L. into high- productive hybrids with a single tiller and profitable crop number of herbivorous insects adapted to feeding on this crop Fedorenko, 2006. Willcocks (1924) reported that the tortoise beetle , *C. vittata* Vill., was found in small numbers in 1918 by Alfieri feeding on the leaves of the Egyptian chard or leaf-beet, *Beta cicla*. It became a very injurious and serious pest since invading the commercial sugar beet, *Beta vulgaris* L., plants in 1971 at Alexandria, Egypt (Hammad *et al*, 1980). Several authors contributed to survey the diapuse sites, biological aspects of the different

stages, life span and oviposition of *C. vittata* in Egypt (Abo-Aiana, 1991; Awadalla, 1991; Bassyouny & Maareg, 1992; El-Khouly, 1992, Mohamed, 1995; Abdel-Raheem, 2000 and Abo El-Naga, 2004. It had a single generation occurring during March / May on sugar beet plantations and diapausing adults were found among wild vegetations or dense crops like sugar cane in Morocco and Egypt (Laraichi *et al*, 1984 and Salama & Elnagar, 1992).

This work aimed to study some biological aspects of *C. vittata* as affected by: feeding adults emerged from diapause (AED) or rearing larvae on different sugar beet varieties and adults statues of (AED) or active (reared) (AA) compared to those collected from infested fields (ACF) at Shirbin in Daqahlyia governorate which fed on Monte blanco sugar beet variety under laboratory conditions during February- August 2006.

MATERIALS AND METHODS

To maintain the food supply of the experimental adults: three sugar beet, *Beta vulgaris* L., varieties; Dema poly, Toro and Monte blanco were planted in three replicates on September 25 in light infestation area at Bila in Kafr El-Sheikh governorate in 2005. Twenty leaves were collected randomly from each plot at weekly interval from February 7 to May 23, 2006. However, *C. vittata* adults emerged from diapause (AED) were randomly collected from untreated sever infested sugar beet fields at Shirbin in Daqahlyia governorate during February- May 2006.

1- Assessment the reproductive capacity and oviposition period as affected by

1-1 Feeding females from diapause (FED) on different sugar beet varieties

To assess the impact of feeding (FED) on different sugar beet varieties: adult (females and males) of *C. vittata* were kept in a petri dish (10 cm., in diameter) and were fed daily on Dema poly, Toro and Monte blanco leaf pieces. Each variety contained 3 and 5 replicates on February 19 and 26 in 2006, respectively. Daily deposited eggs and feeding pores on each leaf piece of the different varieties were recorded and changed by fresh one until the adults died.

1-2 Females statues

1-2-1 Females emerged from diapause

To assess the reproductive capacity of (FED): three pairs (females and males) of *C. vittata* adults were collected on February 7, 2006. Each pair were kept in a petri dish (10 cm) provided with a leaf piece of Monte blanco sugar beet variety. Deposited eggs on both sides of the leaf piece were recorded and changed daily with a fresh leaf

piece of Monte blanco variety and replaced by forage beet during June until all individuals died.

1-2-2 Active (reared) females (AF)

To assess the reproductive capacity of (AF): thirty six adults (females and males) reared from Monte blanco variety were emerged during March 21- April 30, 2006. Each pair were kept singly in a petri dish (10 cm) in six replicates during 21- 30 March, 13-22 and 24-30 April in 2006. Deposited eggs on the leaf piece were recorded and changed daily with a fresh leaf piece of Monte blanco variety and replaced by forage beet during June until adults died.

1-3 Females collected from infested fields (FCF) during the sugar beet growing season

To determine the potential reproduction and ovipositional period of (FCF) during the sugar beet growing season: ten adults (females and males) were randomly collected at two weekly interval from March, 26 to May, 21. Daily inspection was made; laid eggs were recorded as well as insects were provided with fresh a fresh leaf piece of Monte blanco variety and replaced by forage beet during June until adults died.

2- Assessment of the duration periods of the immature stages as affected by

2-1 Feeding (FED) on different sugar beet varieties

To study the impact of feeding of (FED) on different sugar beet varieties on incubation period and hatchability of eggs: daily deposited eggs by females fed on Dema poly, Toro and Monte blanco sugar beet varieties were counted.. Sixty eggs on the leaf pieces of each variety were placed in petri dishes (10 cm, each) at weekly interval from February 20 to March 26, 2006. Daily examination was made and the newly hatched larvae were counted. To assess the duration of larvae on each variety: every 5 newly hatched larvae were reared in a petri dish (10 cm) on the leaf pieces of each sugar beet variety in five replications weekly. Pupae transferred into petri dishes (5 cm) until adults emerged. Duration of larval and pupal stages were recorded.

2-2 Females statuses

2-2-1 Females emerged from diapause (FED)

To assess the incubation period and hatchability of eggs (FED) fed on Monte blanco variety: daily deposited eggs on the leaf pieces were counted and placed in a petri dish (10 cm) of total 100 and 50 at weekly interval from February 8 to March 1 and from 8 to 22 of March 2006, respectively. Daily examination was made and the newly hatched larvae were counted. To assess the duration of larvae: 50 and 25 of the newly hatched larvae were used , respectively. Every 5 newly hatched larvae were reared in a petri dishe (10 cm) on the leaf pieces of Monte blanco sugar beet variety until pupation. Pupae transferred into petri dishes (5 cm) until adults emerged. Duration of larval and pupal stages were recorded.

2-2-2 Active (reared) females (AF)

To assess the incubation period and hatchability of eggs by (AF) from Monte blanco variety: hundred deposited eggs on the leaf pieces were counted from 19 to 21 of April 2006 and placed in three petri dishes (10 cm, each). Daily examination was made and the newly hatched larvae were counted. To assess the duration of larvae: 50 of the newly hatched larvae were reared in 10 petri dishes (10 cm, each). on the leaf pieces of Monte blanco sugar beet variety until pupation. Pupae transferred into petri dishes (5 cm) until adults emerged. Duration of larval and pupal stages were recorded.

RESULTS AND DISCUSSION

During the sugar beet growing season 2005-2006: adults of *C. vittata* emerged from diapause appeared in early February and the ovipositional activity by females started at the end of the month in sugar beet fields at Shirbin, but undetected numbers were observed in late March where the same was continued until the end of the sugar beet growing season at Bila.

C. vittata adults often have a metallic coloration, but some of them were green and red. Specimens of these different colors were submitted to identification by Dr. C. S. Chaboo (Division of Invertebrate Zoology, American Museum of Natural History, New York, U. S. A.) in September 2006. She identified them as *C. vittata*. El-Torkey (2003), reported that colour changing in this species probably is a protective function.

1- The reproductive capacity and oviposition period as affected by

1-1 Feeding (FED) on different sugar beet varieties

Under laboratory conditions of 22.7 ± 4.1 C° and $42.7 \pm 6.8\%$ R. H. the overall general average of deposited eggs, oviposition period and fecundity were 229.7 ± 59.4 (range 144- 366) eggs per female, 47.8 ± 16.9 (range 24-84) days and 5.3 ± 2 (range 1-22) eggs per day, respectively (Table 1). Feeding (FED) on different sugar beet varieties affected reproduction and oviposition period. Females fed on Dema poly and Monte blanco varieties led higher numbers of eggs than those fed on Toro and the difference was significant at 0.01 % level. Significant interaction existed between variety and experimental date on number of deposited eggs; the highest average 321.7 ± 38.4 was recorded by females fed on Dema variety on February 19. The longest and the shortest oviposition periods ranged between 43-84 (average 62 ± 15.8) days and 24-45 (average 36.2 ± 7.4) days were recorded by females fed on Dema poly and Monte blanco varieties with significant difference at 0.05% level, but the differences were insignificantly and significantly when compared with those fed on Toro variety, respectively. Feeding females on different varieties had no significant effect on fecundity and ranged between 1-22 (average 5.3 ± 2) eggs / day. Adults preferred Dema poly variety for feeding than the two other varieties with significant

differences at 0.05% level (Table 1). Weekly general averages no. of deposited eggs / female and feeding pores / adult are represented in Fig.1 a. Both eggs and feeding pores started in low number about 9 eggs / female or feeding pores / adult in the third week of February at mean of 14.5 ± 1.5 C° and $54.1 \pm 3.6\%$ R. H., reached a peak about 53 eggs and 77 feeding pores at means of 20 ± 1.5 & 16 ± 2.8 C° with 50.5 ± 3.8 & 44.5 ± 2.7 % R. H. in the first and the second weeks of March, respectively. Eggs and feeding pores decreased gradually and lowered to less than an egg and about 8 feeding pores at mean of 22.8 ± 1.1 & 25.4 ± 1.4 C° with 37 ± 2.5 & $34.4 \pm 2.4\%$ R. H. in the second and the third weeks of May , respectively.

1-2 Females statuses

The reproductive capacity of (FED) fed on Monte blanco variety was higher than (AF) fed on the same variety and the difference was significant at 0.05% level, but its oviposition periods not varied where the difference was insignificant (Table 2). Deposited eggs and oviposition period of (FED) ranged between 203-223 (average 213.3 ± 10) eggs per female and 36-47 (average 43 ± 6.1) days at 20.1 ± 4.5 C° and 45.9 ± 6.2 % R. H. Such values being in respective ranged between 35-218 (average 141.7 ± 25.3) eggs per female and 17-71 (average 41.4 ± 8.5) days in the case of (AF) at mean of 27.2 ± 3.7 C° and $41.5 \pm 5\%$ R. H. The ovipositional activity by (AF) started after preoviposition period ranged between 13-29 (average 18.1 ± 2.4) days. Fecundities of (FED) and (AF) not varied and ranged between 1-23 (average 5 ± 0.5) eggs / day and 1-24 (average 3.7 ± 0.8) eggs / day, respectively.

1-3 Females collected from infested fields (FCF)

The reproductive capacity and oviposition period of (FCF) fluctuated greatly according to the collection date. The general average of deposited eggs was 106.3 ± 60.6 (range: 8-230) eggs per female and oviposition period was 33.6 ± 15.4 (range 6-61) days at mean of 27.4 ± 3.8 C° and $41.5 \pm 5\%$ R.H. (Table 2). The highest deposited eggs (average 170.2 ± 4.4) eggs per female and the longest oviposition period (average 48.6 ± 7.4) days were attained by the females collected on April 23 at mean of 28.5 ± 3 C° and $41.1 \pm 5.4\%$ R.H. These highest values are significantly varied when compared with those recorded by wild females collected on April 9 or May 21, but not varied than those obtained on May 7 and the differences were insignificant. Fecundities of the collected wild females during late March- the third week of May not varied and the difference was insignificant. It ranged between 1-19 (general average 3 ± 0.5) eggs / day at mean of 27.4 ± 3.8 C° and $41.5 \pm 5\%$ R.H. (Table 2).

Weekly averages no. of deposited eggs by (FED), (AF) and (FCF) are illustrated in Fig.1.b. Ovipositional activity by (FED) started in high no. of 38 eggs in the second week of February reached a peak of 54 in the next week at means of 13.2 ± 3.5 & 14.5 ± 1.5 C° and 49.5 ± 5.2 & $54.1 \pm 3.6\%$ R. H., respectively. It decreased

gradually and lowered to 7 eggs in late March at mean of 20.9 ± 2 C° and $47.8 \pm 3.9\%$ R.H. On the same week and two weeks later ovipositional activities by (FCF) and (AF) started in low number about 4 eggs and were continued until late June reached a peak about 17 and 27 eggs in the second and the third weeks of May at means of 22.8 ± 1.1 & 25.4 ± 1.4 C° and 37 ± 2.5 & $34.4 \pm 2.4\%$ R. H., respectively.

These results show that the reproductive capacity and oviposition period of *C. vittata* (FED) varied greatly by feeding on different sugar beet varieties. There are significant differences between Dema poly and Toro in number of deposited eggs and Monte blanco in oviposition period, but fecundities not varied among the three varieties. Adults preferred Dema poly variety for feeding than the two other varieties and the difference was significant. The reproductive capacity of (FED) fed on Monte blanco variety was significantly higher than those of (AF) reared from the same variety, whereas the differences between its ovipositional periods and fecundities were insignificant. Under field conditions, the susceptibility of sugar beet varieties to *C. vittata* infestation varied and the highest population density of adults and deposited eggs were recorded on Kewemira sugar beet variety (Awadalla *et al*, 1992 and Samy *et al*, 1992). The ovipositional activities by (FED) and (AF) started in the second week of February and after two months and continued until late March and June reached its maximum number in the third week of February and May, respectively. Deposited eggs by (FED) fed on the different sugar beet varieties overlapped with these laid by (AF) during mid April- mid May. The oviposition period of (FCF) prolonged from late March to late June and peaked in mid May. Females collected in the third week of April laid significantly higher eggs than those collected during late March- early April or in the third week of May. As a result, the oviposition period of *C. vittata* females prolonged from mid February to late June with an earlier peak occurred on the third week of February by (FED) collected in the second week of February and late peak in the third week of May by (AF). This result is in agreement with findings obtained by (Abo-Aiana, 1991, and Abo El-Naga, 2004) in sugar beet fields at Kafr El-Sheikh and Tanta.

2-The postoviposition period and longevity as affected by

2-1 Feeding (FED) on different sugar beet varieties

Under laboratory conditions of 22.7 ± 4.1 C° and 42.7 ± 6.8 % R.H. the postoviposition period was insignificantly affected by feeding females on Dema poly, Toro and Monte blanco sugar beet varieties with overall average 20.4 ± 17.1 (range 2-47) days (Table 1). Also, the longevities of females and males fed on these varieties were insignificantly different with overall average 68.2 ± 23 (range 36-115) days and 63.5 ± 20.4 (range 31-95) days, respectively

2-2 Females statuses

Active females reared from Monte blanco sugar beet variety suffered longer postoviposition period than (FED) fed on the same variety with significant difference at 0.05% level (Table 2). It ranged between 18-77 (average 51.4 ± 9.4) days and 22-39 (average 28.3 ± 9.3) days at means of 27.2 ± 3.7 & 20.1 ± 4.5 C° and 41.5 ± 5 & 45.9 ± 6.2 % R. H., respectively. Whereas, the longevity of both sexes was markedly fluctuated between adults emerged from diapause and active one. Active females and males harbored the longest life span with averages of 110.9 ± 12.1 and 92.7 ± 8.6 day at mean of 27.2 ± 3.7 C° and $41.5 \pm 5\%$ R.H. versus to 71.3 ± 3.2 and 56.3 ± 7.5 day for those emerged from diapause at mean of 20.1 ± 4.5 C° and 45.9 ± 6.2 % R. H. with significant difference at 0.01% level (Table 2).

2-3 Females collected from infested fields (FCF)

The postoviposition period of (FCF) ranged between 13-80 with an overall average of 45.9 ± 23 days at mean of 27.4 ± 3.8 C° and 41.5 ± 5 % R. H. (Table 2) It fluctuated greatly where the longest periods were attained by females collected during April 23- May 7 when compared to those collected early from March 26 to April 9 or late on May 21 and the difference was significant at 0.01% level (Table 2). Females collected from the field lived longer than males and were significantly different at 0.01% level (Table 2). The general averages were 79.5 ± 25.4 (range 35-123) days and 66.1 ± 27.6 (range 23-115) days, respectively. Both sexes were varied greatly according to the collection date. The highest and the lowest averages ranged between 100.2 ± 8.5 - 109.4 ± 13 and 51.6 ± 10.2 - 57.4 ± 8.5 but was 79 ± 7.3 days for females collected during April, 23 - May 7, March 26 – April 9 and May 21 with significant difference at 0.01% level (Table 2). Such averages of males being in respective were 91.4 ± 6.4 - 91.8 ± 20.7 , 35.8 ± 3.5 - 38.2 ± 14.1 and 73.2 ± 5.6 days with differences at the same level.

These results indicate that the postoviposition period of (AF), (FED) and (FCF) complex fluctuated greatly, but insignificantly affected by feeding females on different sugar beet varieties. The longest postoviposition periods occurred in females exposed to complete darkness than those of continuous light and for females fed on sugar beet when compared to those fed on forage beet (Awadalla, 1991 and El-Khouly, 1992). Generally, the adult females survived longer period than adult males. Similar results were recorded on sugar beet by (Bassyouny & Maareg, 1992 and Mohamed, 1995) .

3- Duration periods of the immature stages as affected by

3-1 Feeding (FED) and rearing larvae on different sugar beet varieties

Under laboratory conditions of 20.9 ± 3.8 C° and $45.8 \pm 6.3\%$ R. H.: the incubation period and hatchability% of deposited eggs by females fed on different sugar beet varieties were insignificantly affected with general averages of 9 ± 0.5 (range 7-11) days and $79.2 \pm 4\%$ (range 60.1-88.2 %), respectively (Table 3). The same result was obtained for the larval duration as well as pupae duration with general averages of 16.9 ± 0.3 (range 15-20) and 8.9 ± 0.2 (range 7-12) days, respectively, whereas the total duration period from egg to adult lasted an average of 34.8 ± 0.4 (range 29-43) days. The emergence period prolonged from the third week of March to late April reached a peak of 83 adults in mid April.

3-2 Feeding (FED) and (AF) or rearing larvae from Monte blanco variety

Under laboratory conditions of 19.8 ± 0.5 C° and $46.6 \pm 0.6\%$ R.H. the incubation period of deposited eggs by (FED) lasted 9.3 ± 1.4 (range 7.9-12) days and the average of hatching rate was 81.4 ± 6.7 (range 74.7-90.2) % (Table 4). The duration periods of larval and pupal stages ranged between 15.9-19.3 (average 17.4 ± 1.3) and 8.9-10.9 (average 9.8 ± 0.6) days, respectively. The total duration period from egg to adult ranged between 32.7-41.8 (average 36.5 ± 3.2). Duration period of the developmental different stages was generally shortened by increasing temperature and decreasing relative humidity. The longest averages of egg, larva and pupa were 12 ± 1 (range 11-14) days, 19 ± 1.4 (range 16-23) days and 10.9 ± 1.2 (range 9-14) days were attained at mean of 17.7 ± 0.6 C° and 49.3 ± 0.7 % R. H. opposite to 7.9 ± 0.5 (range 7-9) days, 15.9 ± 1.3 (range 14- 17) day and 8.9 ± 0.7 (range 8-10) days were recorded at mean of 22.7 ± 0.3 C° and 42.7 ± 0.8 % R. H. The total duration periods being in respective were 41.8 ± 1.3 (range 39.2-43.1) days and 32.7 ± 1.6 (range 30.3-33.7) days.

Under hot and dry conditions of 24.1 ± 0.4 C° and 37.7 ± 0.7 % R. H., the incubation period and hatchability of deposited eggs by (AF) ranged between 5-7 (average 5.5 ± 0.7) days and 68.2-78.6% (average 72.5 ± 5.4) % (Table 4). Also, the duration of larva and pupa ranged between 11-19 (average 14.4 ± 2.3) days and 5-9 (average 5.7 ± 1.1) days, respectively, whereas the total duration period (egg-adult) ranged between 21-30 (average 25.6 ± 2.3) days.

These results indicate that females or larvae fed on different sugar beet varieties had no significant effect on the duration periods of the different stages, but its periods shortened by increasing temperature and decreasing relative humidity. El-Khouly (1992), reported that the developmental periods of the different stages varied between sugar beet, forage and chard host plants.

DISCUSSION

The reproductive capacity and oviposition period of (FED) as well as the daily feeding pores fluctuated greatly as a result of feeding on different sugar beet varieties. Females fed on Dema poly variety harbored the highest number of deposited eggs and the longest oviposition period than on Toro and Monte blanco varieties with significant differences, respectively. Adults preferred Dema poly variety for feeding than the two other varieties with significant differences. However, fecundity and incubation period & hatchability of eggs were insignificantly affected by feeding females on different sugar beet varieties, also. The duration periods of both larvae and pupae as well as longevity of females and males were insignificantly affected by rearing larvae on all varieties. Feeding (FED) and (AF) on Monte blanco had no significant effect on fecundity, whereas (FED) laid significantly higher eggs than active one. The tortoise beetle, *C. vittata*, had an annual generation on sugar beet. The ovipositional activities by (FED) and (AF) fed on Monte blanco variety started in mid February and after two months, continued until late March and June and peaked in the third week of February and May, respectively. Deposited eggs by (FED) fed on different sugar beet varieties overlapped with laid by active one during mid April - mid May. The total duration period of the developmental stages from egg to adult lasted an average of 34.8 ± 0.4 day. The first emergence of active adults started in the third week of March and continued until late April. Active females deposited their eggs after preoviposition period of an average of 18.1 ± 2.4 day. Diapaused adults disappeared under sugar beet leaf pieces without feeding and females ceased to lay their eggs and not completed its life cycle and died under the hot and dry conditions at mean of 32 ± 2.3 C° and 48 ± 3.8 %R.H during August. Females lived longer than males where the averages of life span and life cycle were 110.9 ± 12.1 & 92.7 ± 8.6 and 147.4 ± 17.2 & 129.2 ± 15.5 days, respectively. In summer, obligatory diapause of *C. vittata* adults began in June and continues over the winter despite the availability of the sugar beet food plant (Hilal *et al*, 1983). In Egypt and Morocco, it has a single generation a year and diapausing adults were found among wild vegetations or dense crops like sugar cane (Laraichi *et al*, 1984; Awadalla, 1991 and Salama & Elnagar, 1992).

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Table1. Average no. of deposited eggs, life span in days and fecundity of *C. vittata* females emerged from diapause fed on different sugar beet varieties at mean of 22.7 ± 4.1 temperature C° and 42.7 ± 6.8 % relative humidity during February- May 2006

Expeimental date (D)		Variety (V)	Average no. of deposited eggs / female	Oviposition period (in days)	Postoviposition period (in days)	Longevity of		Eggs/day	Feeding pores / day /adult
Month	Day					Female	Male		
February	19	Dema poly	321.7 ± 38.4 (297-366)	74.3 ± 11.2 (62-84)	12.3 ± 1.5 (11-14)	86.7 ± 12.6 (73-98)	63 ± 4.3 (60-68)	4.4 ± 0.8 (1-11)	10.4 ± 1.1 (4-27)
		Toro	226.3 ± 23.7 (201-248)	42.7 ± 21.9 (30-68)	43.3 ± 4.9 (40-47)	86 ± 25.1 (70-115)	67 ± 18.6 (47-84)	6 ± 2.1 (2-14)	8 ± 1.7 (3-34)
		Monte blanco	245 ± 32.5 (213-278)	31.3 ± 6.4 (24-36)	16.7 ± 25.4 (2-46)	48 ± 19 (36-70)	47.3 ± 19.6 (36-70)	8 ± 2 (2-22)	7.2 ± 1.9 (4-33)
		Overall average	264.3 ± 50.5 (201-366)	49.4 ± 22.2 (24-84)	24.1 ± 16.7 (2-47)	73.6 ± 22.1 (36-115)	59.1 ± 10.4 (36-84)	6.1 ± 1.8 (1-22)	8.5 ± 1.6 (2-34)
	26	Dema poly	206 ± 7 (201-214)	49.7 ± 9.2 (43-56)	27.3 ± 21.9 (2-41)	77 ± 27.7 (45-95)	69.7 ± 22.1 (54-95)	4.2 ± 0.5 (1-16)	10.7 ± 1.1 (2-33)
		Toro	144 ± 26.2 (114-163)	48 ± 12.2 (39-62)	9.7 ± 7.5 (2-17)	57.7 ± 15.6 (41-72)	69.7 ± 31 (35-95)	3.1 ± 0.8 (2-18)	8.6 ± 1.2 (3-39)
		Monte blanco	235.3 ± 35.8 (194-258)	41 ± 5.2 (35-45)	13 ± 8.1 (6-22)	54 ± 12.1 (41-65)	64.3 ± 28.8 (31-81)	5.8 ± 1.4 (2-18)	8.6 ± 0.5 (2-39)
		Overall average	206.2 ± 46.6 (114-258)	46.2 ± 4.6 (35-62)	16.7 ± 9.3 (2-41)	62.9 ± 12.3 (51-95)	67.9 ± 3.1 (31-95)	4.4 ± 1.3 (1-18)	9.3 ± 1.2 (2-39)
General average		Dema poly	263.8 ± 68 (201-366)	62 ± 15.8 (43-84)	19.8 ± 16.1 (2-41)	81.8 ± 20 (45-98)	66.3 ± 14.7 (54-95)	4.3 ± 0.6 (1-16)	10.6 ± 1 (2-33)
		Toro	185.2 ± 50.3 (114-248)	45.3 ± 16.1 (30-68)	26.5 ± 19.1 (2-47)	71.8 ± 24.3 (41-115)	68.3 ± 22.9 (35-95)	4.6 ± 2.1 (2-18)	8.3 ± 1.4 (2-39)
		Monte blanco	240.2 ± 31 (194-278)	36.2 ± 7.4 (24-45)	14.8 ± 17 (2-46)	51 ± 14.6 (36-70)	55.8 ± 23.9 (31-81)	6.9 ± 1.9 (2-22)	7.9 ± 1.5 (2-39)
Overall general average			229.7 ± 59.4 (144-366)	47.8 ± 16.9 (24-84)	20.4 ± 17.1 (2-47)	68.2 ± 23 (36-115)	63.5 ± 20.4 (31-95)	5.3 ± 2 (1-22)	8.9 ± 1.7 (2-39)
L. S. D. values at levels: and		0.05% 0.01%	V 34.3 49.9	V x D 48.5	17.1	N.S.	N. S.	N. S.	1.99

Figures between brackets represent (the ranges).

Table 2. Average no. of deposited eggs, life span in days and fecundity of active *C. vittata* females (AF) and those emerged from diapause (FED) or collected from fields (FCF) under laboratory conditions during February-August 2006

Source of adults	Experimental period	Average no. of deposited eggs / female	Period in days			Longevity in days		Eggs / day	Mean values of	
			Pre oviposition	Oviposition	Post oviposition	Female	Male		Temp. C°	% R. H.
Active (reared)	March 21-August 12	158 ± 53.8 (91-213)	20.7 ± 4.7 (17-29)	51 ± 18.8 (27-71)	50.8 ± 13.9 (26-69)	122.5 ± 19.8 (90-142)	99 ± 12.6 (82-121)	3.4 ± 1.4 (1-21)	26.9 ± 3.5	41 ± 4.5
	April 13-August 5	112.5 ± 42.4 (35-151)	17.5 ± 3.5 (14-23)	38.3 ± 14.5 (21-61)	42.3 ± 14.4 (18-60)	98.2 ± 5.4 (89-108)	82.8 ± 13 (63-98)	3.1 ± 1.4 (1-24)	28 ± 2.6	40.6 ± 4.5
	April 24-August 22	154.7 ± 63.7 (73-218)	16 ± 6.4 (13-29)	34.8 ± 11.9 (17-49)	61.2 ± 15.6 (40-77)	112 ± 5.7 (105-117)	96.2 ± 14.5 (72-115)	4.7 ± 1.9 (1-16)	28.4 ± 2.9	41 ± 5
	Overall average	141.7 ± 25.3* (35-218)	18.1 ± 2.4 (13-29)	41.4 ± 8.5 (17-71)	51.4 ± 9.4* (18-77)	110.9 ± 12.1** (89-142)	92.7 ± 8.6** (63-121)	3.7 ± 0.8 (1-24)	27.2 ± 3.7	41.5 ± 5
Emerged from diapause	February 8-May 3	213.3 ± 10 (203-223)	-	43 ± 6.1 (36-47)	28.3 ± 9.3 (22-39)	71.3 ± 3.2 (69-75)	56.3 ± 7.5 (51-65)	5 ± 0.5 (1-23)	20.1 ± 4.5	45.9 ± 6.2
* and ** indicate significant difference at 0.05% and 0.01% according to t-test, respectively.										
Collected from field	March 26-June 2	103.4 ± 41.9 (63-167)	-	37 ± 12 (20-47)	20.4 ± 5.8 (14-27)	57.4 ± 8.5 (45-68)	38.2 ± 14.1 (23-56)	2.8 ± 0.6 (1-17)	24.1 ± 3.1	39.6 ± 5
	April 9-June 8	78.4 ± 31.4 (48-124)	-	29.6 ± 10.7 (22-45)	22.0 ± 7.8 (13-30)	51.6 ± 10.2 (35-60)	35.8 ± 3.5 (33-42)	2.7 ± 0.6 (1-16)	25.4 ± 2.7	38.4 ± 3.9
	April 23-August 24	170.2 ± 4.4 (106-218)	-	48.6 ± 7.4 (44-61)	60.8 ± 17.1 (33-76)	109.4 ± 13 (94-123)	91.8 ± 20.7 (63-115)	3.6 ± 1.1 (1-19)	28.5 ± 3	41.1 ± 5.1
	May 7-August 24	157.8 ± 61.1 (79-230)	-	43.8 ± 6 (37-53)	56.4 ± 12.8 (43-72)	100.2 ± 8.5 (97-109)	91.4 ± 6.4 (82 - 100)	3.5 ± 1.1 (21-17)	29 ± 2.7	41.5 ± 5.1
	May 21-August 15	21.6 ± 12.4 (8-38)	-	9.2 ± 3.4 (6-15)	69.8 ± 7.7 (60-80)	79 ± 7.3 (69-85)	73.2 ± 5.6 (67-80)	2.3 ± 0.8 (1-10)	29.2 ± 2.2	41.5 ± 4.2
	Overall average	106.3 ± 60.6 (8-230)	-	33.6 ± 15.4 (6-61)	45.9 ± 23 (13-80)	79.5 ± 25.4 (35-123)	66.1 ± 27.6 (23-115)	3.0 ± 0.5 (1-19)	27.4 ± 3.8	41.5 ± 5
L.S.D. values at levels: and	0.05% 0.01%	60.6 83.4	-	12.6 17.3	13.6 18.6	Sex 7.9 13.1	Date 10.1 13.6	N.S.		

Figures between brackets represent (the ranges).

Table 3. Effect of feeding of females and larvae of *C. vittata* on different sugar beet varieties on incubation and hatchability of eggs as well as the duration periods of larva and pupa at means of 20.9 ± 3.8 temperature Co and 45.8 ± 6.3 % relative humidity during February- April in 2006.

Variety	Duration (in days) of the developmental stages				Total duration period in days (egg-adult)	Weekly no. of emerged adults during						Total
	Egg		Larvae	Pupa		March		April				
	Incubation period	Hatchability %				3rd	4th	1st	2nd	3rd	4th	
Dema poly	9 ± 1 (7-11) [300]	81.5 ± 4.4 (77.4-87.3)	17 ± 1.2 (15-20)[125]	8.8 ± 0.9 (8-11)[94]	34.8 ± 2.3 (30-42)	18	25	28	16	5	2	94
Toro	9 ± 0.8 (7-11) [300]	77.1 ± 9.2 (60.1-88.2)	16.5 ± 1.2 (15-20)[125]	8.8 ± 0.5 (7-12)[98]	34.3 ± 1.8 (29-43)		19	12	33	27	7	98
Monte blanco	8.9 ± 1 (7-11) [300]	78.6 ± 4.2 (74.6-84.5)	17.1 ± 1.5 (15-20)[125]	9.2 ± 0.8 (7-12)[89]	35.2 ± 2.7 (29-43)		11	32	34	10	2	89
General average	9 ± 0.5 (7-11)	79.2 ± 4 (60.1-88.2)	16.9 ± 0.3 (15-20)	8.9 ± 0.2 (7-12)	34.8 ± 0.4 (29-43)							
Total						18	55	72	83	42	11	281

Figures between brackets represent (the ranges) and [no. of observations for each stage].

Table 4. Incubation period, hatchability of deposited eggs and durations of larvae & pupa of *C. vittata* females emerged from diapause (FED) and active one (AF) during February- May 2006.

Source of adults	Experimental period	Duration (in days) of the developmental stages				Total duration period in days (egg-adult)	Mean values of	
		Egg		Larva	Pupa		Temp. C°	% R. H.
		Incubation period	Hatchability %					
Emerged from diapause	February 8- March 24	12 ± 1 (11-14) [100]	90.2 ± 23.6 (36.8-100)	19 ± 1.4 (16-23) [50]	10.9 ± 1.2 (9-14) [41]	41.8 ± 1.3 (39.2-43.1)	17.7 ± 0.6	49.3 ± 0.7
	February 15- April 2	9.9 ± 0.7 (8-11) [100]	86.1 ± 17 (50-100)	19.3 ± 1.7 (16-22) [50]	10.1 ± 1.1 (9-12) [48]	39.2 ± 2.4 (35.9-43.8)	18.9 ± 0.5	49.0 ± 0.6
	February 22 April 8	8.4 ± 0.7 (8-10) [100]	78.5 ± 16.8 (50-100)	16.7 ± 1.5 (15-22) [50]	9.7 ± 0.4 (9-12) [45]	35.1 ± 2 (31.8-42.9)	19.9 ± 0.4	47.2 ± 0.7
	March 1- April 15	9.3 ± 0.6 (8-10) [100]	88.7 ± 11.6 (66.5-97.4)	17.5 ± 0.8 (16-19) [50]	10.1 ± 1.1 (9-13) [42]	37.2 ± 1.9 (34.4-41.3)	20.3 ± 0.4	45.4 ± 0.6
	March 8- April 19	9.9 ± 0.7 (9-11) [50]	74.7 ± 15.9 (58.5-91)	17.3 ± 1.1 (15-19) [25]	9.5 ± 1.1 (9-12) [21]	36.4 ± 1.6 (34-40.4)	20.9 ± 0.5	44.2 ± 0.6
	March 15- April 23	7.9 ± 0.5 (7-9) [50]	75.2 ± 3.7 (71.4-79.5)	16 ± 1.1 (14-18) [25]	9.4 ± 1.1 (7-12) [22]	33.4 ± 2.1 (30.9-38.1)	22.5 ± 0.8	43.8 ± 1.3
	March 22- April 25	7.9 ± 0.5 (7-9) [50]	76.1 ± 8 (74.4-81.8)	15.9 ± 1.3 (14-17) [25]	8.9 ± 0.7 (8-10) [21]	32.7 ± 1.6 (30.3-33.7)	22.7 ± 0.3	42.7 ± 0.8
	General average	9.3 ± 1.4 (7.9-12)	81.4 ± 6.7 (74.7-90.2)	17.4 ± 1.3 (15.9-19.3)	9.8 ± 0.6 (8.9-10.9)	36.5 ± 3.2 (32.7-41.8)	19.8 ± 0.5	46.6 ± 0.6
Active (reared)	April 19- May 21	5.5 ± 0.7 (5-7) [100]	72.5 ± 5.4 (68.2-78.6)	14.4 ± 2.3 (11-19) [50]	5.7 ± 1.1 (5-9) [43]	25.6 ± 2.3 (21-30)	24.1 ± 0.4	37.7 ± 0.7

Figures between brackets represent (the ranges) and [no. of observations for each stage].

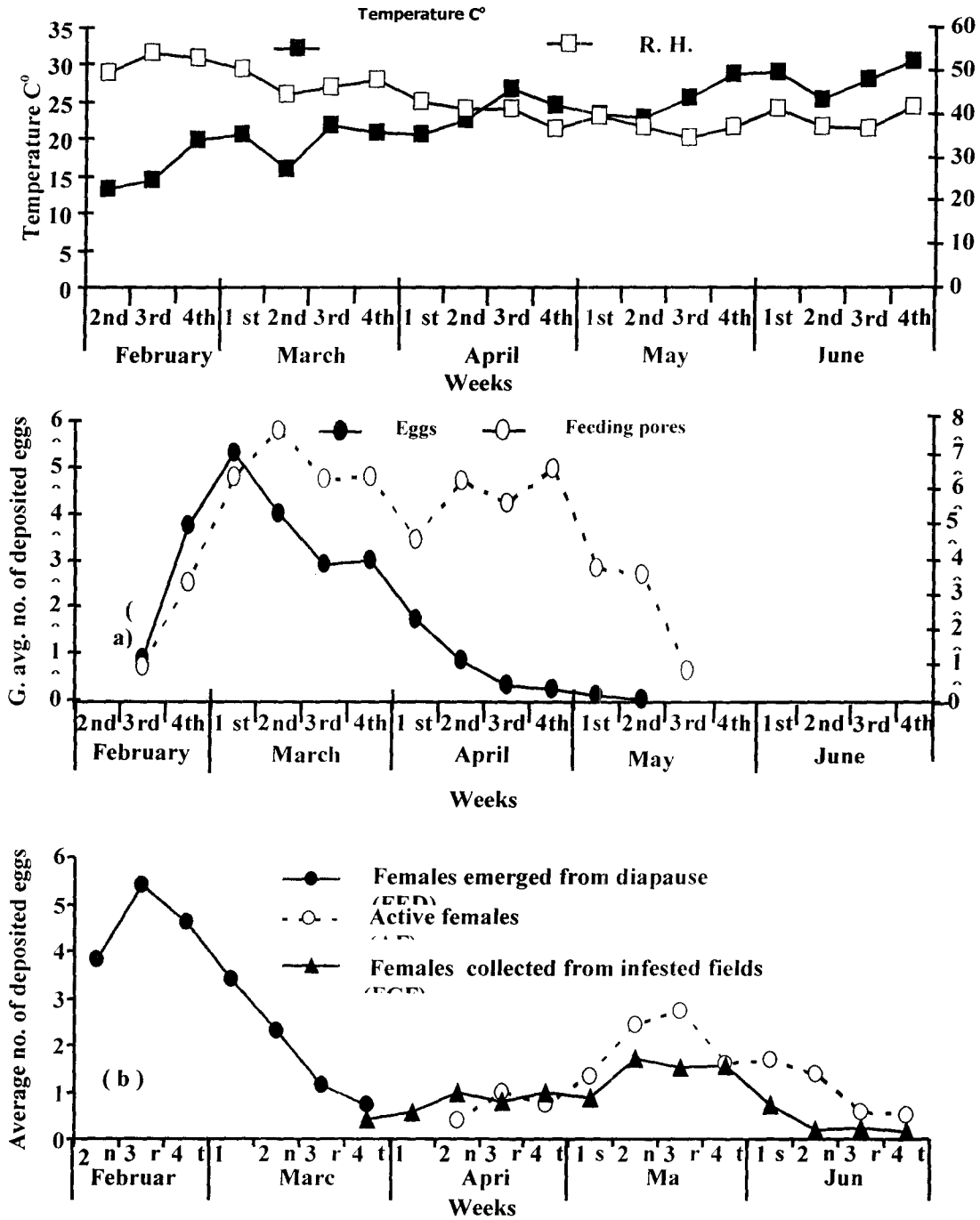


Fig.1. Weekly general average no. of deposited eggs per female and feeding pores per adult on different sugar beet varieties (a) and average no. of deposited eggs by active females (AF) of *C. vittata* and those emerged from diapause (FED) or collected from infested fields (FCF) (b) during February- June 2006.

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تأثر أجوانب الحيوية لخنفساء البنجر السلحفائية بتغذية الكاملات على أصناف البنجر المختلفة

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درس تأثير تغذية أنات خنفساء البنجر السلحفائية, *C. vittata* Vill., الخارجة من السكون واليرقات على أصناف البنجر المختلفة على قدرتها التناسلية ، فترة وضع البيض ، فترة حضانه ونسبة فقس البيض وكذلك فترات تطور طوري اليرقات والعداري خلال فبراير- أغسطس عام ٢٠٠٦. تشير النتائج المتحصل عليها أن أعلا قدرة تناسلية (263 ± 68) بيضة لكل أنثى ، أطول فترة وضع بيض ($62 \pm 15,8$) يوم و أعلا عدد لثقوب التغذية ($10,6 \pm 1$) ثقب تغذية/ يوم سجلت عل الصنف ديما بولى تحت الظروف المعملية وعلى متوسط درجة حرارة $22,7 \pm 4,1$ ورطوبة نسبية $6,8 \pm 42,7$ % . وجد فروق معنوية مقارنة بالصنف تورو، ومونتى بلانكو وكلا الصنفين، على التوالي. كما أنه الأكثر تفضيلا لوضع البيض والتغذية. ولا تؤدي تغذية الإناث واليرقات على أصناف البنجر المختلفة إلى اختلاف في فترة حضانه ومعدل فقس البيض وكذلك على فترات تطور اليرقات والعداري. وجد لتلك الخنفساء جيل واحد في العام. يبدأ نشاط وضع البيض للإناث الخارجة من السكون وكذلك النشطة في منتصف فبراير وأبريل ويمتد حتى أواخر مارس و يونيو، على التوالي. بلغت قدراتها التناسلية ($213,3 \pm 10$) بيضة لكل أنثى خارجة من السكون و ($25,3 \pm 141,7$) بيضة لكل أنثى نشطة عند تغذيتها على الصنف مونتى بلانكو وبفروق معنوية، لكن سجل ($6,60 \pm 106,3$) بيضة لكل أنثى جمعت من الحقل عند تغذيتها على نفس الصنف وخلال فترة الإناث النشطة. تدخل الإناث النشطة السكون في يوليو حيث تمتنع عن التغذية ووضع البيض وتؤدي الحرارة المرتفعة والجفاف في نهاية أغسطس إلى موتها قبل استكمال فترة سكونها حتى الشتاء. وجد أن الإناث تعيش فترة أطول من الذكور وبمتوسطات عمر $110 \pm 12,1$ و $92,7 \pm 8,6$ يوم كما بلغت فترة حياة الأنثى والذكر $147,4 \pm 17,2$ و $129,2 \pm 15,5$ يوم ، على التوالي.