

CONSUMPTION OF SUGAR-BEET LEAF AREA BY THE TORTOISE BEETLE, *Cassida vittata* VILL.

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ABSTRACT

Feeding experiment was carried out on *Cassida vittata* Vill. under out door conditions. Sugar-beet leaf area consumption of larval and adult stages was estimated. The mean sugar-beet leaf area consumption was 170.5 mm² per larva during 17 days. The 4th and 5th instars consumed 84.4% of the total leaf area consumption. The newly emerged adult consumed 754.3 mm² of sugar-beet foliage during 28 days, while reactivated adult consumed 2369 mm² for a period of 80 days, the mean sugar-beet leaf area consumed by one adult over mature stage (before and after diapause) was 3123.3 mm², represents Ca. 94.8% of the total consumption. The mean consumed by a single individual of *Cassida vittata* throughout its life span (larva and adult) was 3293.8 mm² for a period of 125 days. The adult female laid an average of 190.7 ± 7.44 eggs/female and oviposition period averaged 37.67 ± 3.06 days.

INTRODUCTION

The occurrence of the tortoise beetle, *Cassida vittata* Villers adults feeding on sugar-beet leaves and chard (Salq) in the field was reported for the first time by Willcocks (1922) in Egypt. It is considered one of the most defoliators insects pests attacking sugar-beet fields at Kafr El-Sheikh Governorate (Bassyouny, 1998). The adult beetle and larva usually feed on sugar-beet leaves causing serious damage and losses in the crop.

Although the biology of the tortoise beetle, *Cassida vittata* has been investigated by several authors (Shalaby 1974, Guirguis, 1985, Awadallah 1991 and Bassyouny and Maareg, 1992), but a few information is available on the total leaf area consumption over the duration of each instar throughout the larval development (Guirguis 1985 and Mostafa *et al.*, 1992).

No published data in details was also found on the total sugar-beet leaf area consumed by *Cassida vittata* adult, under out door conditions, throughout duration of its mature stage (about four months) before and after enters diapause phase, at least under natural conditions of North Delta region.

The present investigate aimed to estimate leaf area of sugar-beet foliage consumed by the tortoise beetle, *Cassida vittata* over duration of each stage of its life span, under out door conditions.

MATERIALS AND METHODS

Experiments were carried out, under out door conditions of 1998 and 1999 seasons, at Faculty of Agriculture, Kafr El-Sheikh, Tanta University, for estimation sugar-beet leaf area consumed by larva and adult of the tortoise beetle, *Cassida vittata*. Some biological aspects (number of oviposited eggs and oviposition period, under out door conditions) of mature stage were also recorded. Data obtained were statistically analyzed according to DHRT (Duncan, 1955).

1. Food consumption by larvae:

Sugar-beet leaves having eggs of the tortoise beetle were collected from sugar-beet fields. Eggs were kept in sterilized petri dishes until hatching. Hatched larvae were carefully transferred individually with a fine brush on designated and healthy sugar-beet plants. (variety Ras-Poly), planted in 30 cm pots, these plants were exactly kept from insect pest infestations. Plants aged 60 days, when infested with the new hatched larvae. Each larva of the tortoise beetle was separately placed on sugar-beet plant for feeding.

Infested plants were caged by using glass cages, pots were placed in out door conditions.

Consumption of sugar-beet foliage by a single larva was calculated daily, damaged leaves were cut and put on square paper for determining out lines for the eaten parts, consequence of daily larval feeding, then larva was replaced on another healthy leaf for the same plant or other new plant.

The records of molts were daily maintained. These procedures were daily repeated, until pupation. Ten replicates were daily used.

2. Food consumption by adults:

To estimate the leaf area of sugar-beet foliage consumed by *Cassida vittata* adults under out door conditions, an experiment was carried out by using newly emerged adults collected from pupae of the previous experiment and from out door culture which previously prepared. Adults were divided into three groups (sex males, sex females and sex couples of male and female), adults were placed individually on plants as obvious described with larval stage, except in the third group where each male was kept with one female on the plant. The experiment continued for a period extended about four weeks until adults stopped feeding and entered diapause (plant pots). The diapaused adults were carefully and separately kept in tubes with amount of soil throughout a period extend from June 1998 season to the end of January 1999 season. At the initial of February for 1999 season, diapaused adults precisely observed until resuming activity. These reactivated adults were used as above mentioned.

Calculation of the leaf area consumption was estimated every two days and continued whenever all of the adults dead in addition to the daily deposited eggs per couple were counted and handily removed.

RESULTS AND DISCUSSION

Food consumption by larvae:

Data presented in Table (1) and Fig. (1) show that the food consumption increased with the increasing of larval development under out door conditions. The tortoise beetle larva one day old consumed 0.5 mm² of sugar-beet leaf area, while the maximum consumption (35 mm²) was calculated at larval age of 16th day. At 18th day old no consumption was recorded.

On the other hand, data indicated that weight of larvae increased steadily as the larva grew older, till it reached a maximum of 14.500 mg at the 17th day of its development.

Data presented in Table (2) and Fig. (2) show that the total sugar-beet leaf area consumed by a single larva of the tortoise beetle, *Cassida vittata* throughout its larval stage which lasted 17 days, was 170.5 mm², 61% of this area was consumed over the duration of the fifth instar, while the total leaf area consumed by the first four instars (66.5 mm²) represents 39% of the total leaf area consumed during the entire larval stage. Data, also, revealed that the total leaf area consumed by the last two instars (144 mm²), represents 84.4% of the total consumption. This means that both of the fourth and fifth larval instars of *Cassida vittata* consume and inflict damage to sugar-beet plants represents 84.4% of the total leaf loss consumed by the entire larval stage.

Table (1): Daily means of sugar-beet leaf area consumption and larval weight of a single larva of the tortoise beetle throughout its larval stage under out door conditions (6-23 April, 1998).

Larval age in day	Leaf area consumption per larva (mm ²)	Larval weight per day (mg)
Newly hatched larva	0	0.220
1	0.5	0.380
2	1.0	0.760
3	1.5	1.500
4	0.5	2.500
5	2.0	3.300
6	4.0	3.900
7	3.0	5.100
8	6.0	7.300
9	8.0	9.100
10	11.0	9.700
11	13.0	10.000
12	16.0	11.100
13	14.0	12.300
14	16.0	12.600
15	22.0	13.600
16	35.0	14.300
17	17.0	14.500
18	0	14.400
Total	170.5	

Table (2): Records of larval weight and sugar-beet leaf area consumption at the end of each instar of the tortoise beetle, *Cassida vittata*.

Larva instar	Duration (day)	Av. larval weight (mg)	Av. leaf area consumption per larva/day (mm ²)	Consumption throughout the duration of each instar (mm ²)	% of total consumption
Newly hatched larva	0	0.2200	-		
1 st instar	3	1.500	1	3.0	1.76
2 nd instar	3	3.900	2.17	6.5	3.81
3 rd instar	3	9.100	5.67	17.0	9.97
4 th instar	3	11.100	13.33	40.0	23.46
5 th instar	5	14.500	20.80	104.0	61.00
Total larval stage	17			170.5	

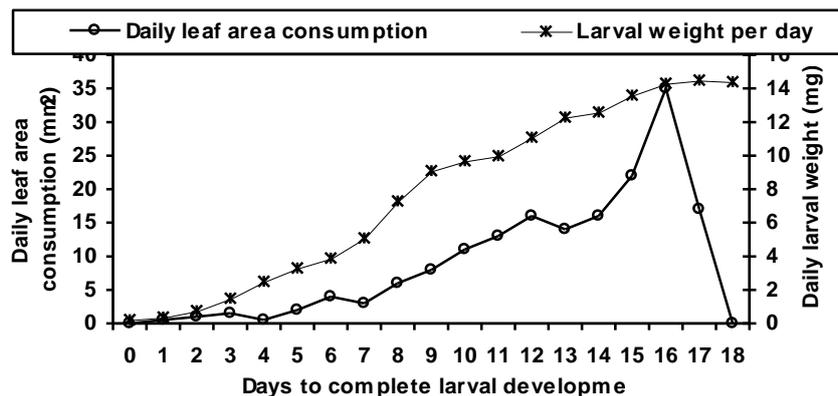


Fig. (1): Daily means of sugar-beet leaf area consumption and larval weight of a single larva of the tortoise beetle, *Cassida vittata* throughout its larval stage under out door conditions.

o shot hole (3 mm²)

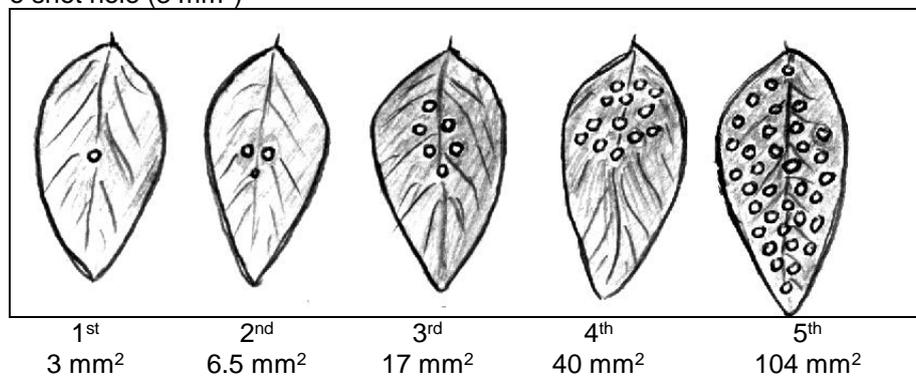


Fig. 2: Diagrammatic sketches show the leaf area (shot holes) consumed by a single larva of the tortoise beetle during each larval instar of its life span.

Food consumption by adults:

1. Newly emerged adults:

Data presented in Table (3) and illustrated in Fig. (3) show that the leaf area consumed by the newly emerged adults at the first two days of feeding were 56, 66 and 63 mm² for male, female and mean consumption for one couple of male and female, respectively. The maximum food consumption reached 112, 129 and 159 mm² for male, female and mean of one couple of male and female, respectively after 10 days from emergence. However, at the last ten days (20-30/5), food consumption by adults decreased steadily till reached 1, 1 and 3 mm² at 28th day from emergence then adults entered diapause and, no further feeding was done. The total of sugar-beet leaf area consumed by one female (782 mm²) was significantly more than those consumed by one male (730 mm²) or mean of one couple of male and female (751 mm²) for the same period (4 weeks) of feeding.

Table (3): Mean of sugar-beet leaf area consumed by the newly emerged adults of *Cassida vittata* under out door conditions before enter diapause (2-30/5/1998).

Adult age in days	Leaf area consumption per adult (mm ²)		
	Male	Female	Av. of MF
2/5	56	66	63
4	61	64	67
6	73	65	69
8	111	93	73
10	112	129	159
12	112	120	108
14	109	80	82
16	52	44	42
18	29	39	30
20	4	24	15
22	4	21	14
24	3	20	14
26	3	16	12
28	1	1	3
30/5	0	0	0
Total	730 a	782 b	751 a

Means followed by a common letter are not significantly different at the 5% level by DMRT.

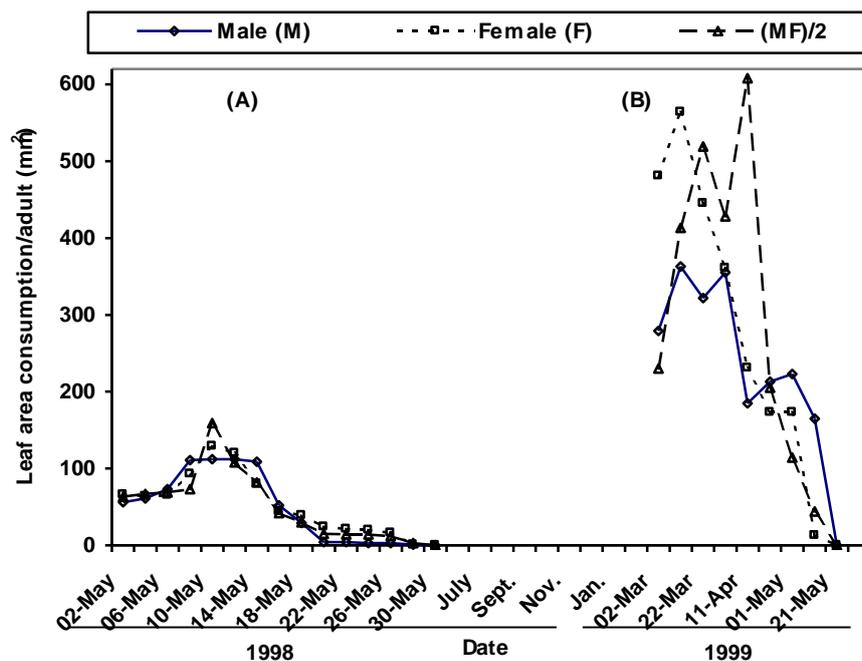


Fig. (3): Sugar-beet leaf area consumed by *Cassida vittata* adult, before enters diapause (A) and after reactivating (B), under out door conditions in 1998 and 1999 seasons

2.Reactivating adults:

In the present work, food consumption was calculated also for the adults after their reactivating. These adults continued feeding for about three months (2/3-21/5-1999). Data presented in Table (4) and Fig. (3) show that throughout a period extended for 80 days, the total leaf area of sugar-beet foliage consumed by one female (2441 mm²) was higher than recorded for one male (2105 mm²), the total consumption reached 2561 mm² when females were kept with males for the same period of feeding. Statistical analysis proved that there were significant differences among the three treatments.

Calculation of the total leaf area consumed by a single individual of, *Cassida vittata* throughout the whole life span.

Data presented in Table (5) and Fig. (4) show that total sugar-beet leaf area consumed by a single individual of *Cassida vittata* over its life span under out door conditions, was 32.9 cm². About 1.705 cm² of this area represents 5.2% of the total consumption, consumed by a single larva over its duration, while that consumed by one newly emerged adult, before enters diapause phase was 7.543 cm², which represents 22.9% of the total consumption. After reactivating a remarkable increase in food consumption was noted (23.69 cm²) which represents 71.9% of the total consumption.

Table (4): Mean of sugar-beet leaf area consumed by *Cassida vittata* adults, under out door conditions, after reactivating (2/3-11/5-1999).

Adult age in days	Leaf area consumption per adult (mm ²)		
	Male	Female	Av. of MF
2/3	279	481	230
12	363	564	413
22	322	445	519
1/4	355	361	428
11/4	185	231	608
21/4	213	173	205
1/5	223	173	114
11/5	165	13	44
21/5	0	0	0
Total	2105 a	2441 b	2561 c

Means followed by a common letter are not significantly different at the 5% level by DMRT.

Slaveshev (1979), in Bulgaria, reported that the total consumption of sugar-beet leaves during larval stage averaged 180.6 mm² for *Cassida nobulosa* and 122.6 mm² for *Cassida nobilis*. In the present work, results almost agree with those obtained by Guirguis (1985) in case of larval stage, but disagree with that consumed by adult stage, these results, also agree with those of Mostafa *et al.* (1992) who reported that 94% of foliage consumption was made by the adult, while it was only 6% by the larva. Bassyouny (1998) under laboratory conditions determined the sugar-beet leaf area consumption for a single insect of the tortoise beetle, *Cassida vittata* by 37.4 cm² during its life span.

Table (5): Calculation of the total sugar-beet leaf area consumed by a single individual of the tortoise beetle, *Cassida vittata* throughout its life span, under out door conditions of 1998 and 1999 seasons.

Stage	Duration in days	Mean of leaf area consumed by a single individual (cm ²)
Larva	17	1.705
Adult		
Before diapause	28	$7.30 (M) + 7.82 (F) + 7.51 (MF/2) = 22.63/3 = 7.543$
After reactivating	80	$21.05 (M) + 24.41 (M) + 25.61 (MF/2) = 7107/3 = 23.69$
Larva + adult	125	32.938

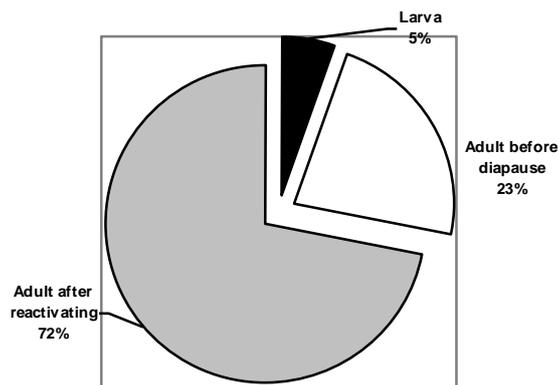


Fig. (4): Percentage of sugar-beet leaf area consumed by a single larva of *Cassida vittata* and its adult before diapause and after reactivating

Estimation of the total egg number deposited by *C. vittata* female:

Data presented in Table (6) indicated that throughout a period of ten days (1-10 March) the collected eggs averaged 20 eggs/female, then it gradually increased till reached a maximum of 49 eggs/female within ten days from March 31 to April 9, followed by a slight decrease in egg population (42 eggs/female) throughout the last ten days (10-19/4). Data also revealed that throughout the period ranged between 34-42 days, the number of produced eggs by a female varied from 178 to 205 with an average 190.7 ± 7.44 eggs/female.

Table (6): The calculated number of deposited eggs per female and oviposition period, under out door conditions.

Observation	Mean No. of deposited eggs within ten days/female				
	1-10/3	11-20/3	20-30/3	31/3-9/4	10-19/4
6 males x 6 females	20	38	42	49	42
Egg number	178 – 205				
Range:	178 – 205				
Average:	190.7 ± 7.44				
Oviposition period	34 – 42				
Range:	34 – 42				
Average:	37.33 ± 4.19				

As for the mean number of produced eggs per female, this result is in agreement with that of Bassyouny and Maareg (1992), but as for mean oviposition period, this result disagreed with that of the same authors, who carried out their experiments under laboratory conditions.

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مساحة أوراق نباتات بنجر السكر المستهلكه بواسطة خنفساء البنجر السلحفائية (*Cassida vittata*)

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- أجريت تجربة تغذية تحت الظروف الطبيعية ، لحساب مساحات أوراق نباتات بنجر السكر المستهلكه بواسطة كل من الحشرات الكاملة ويرقات خنفساء البنجر السلحفائية ، بالإضافة إلى حساب بعض القيم الهامة التي تدل على الكفاءة التناسلية مثل عدد البيض وفترة وضع البيض وقد أظهرت الدراسة النتائج التالية.
- 1- وجد أن متوسط مساحة أوراق نباتات بنجر السكر المستهلكه بواسطة يرقة واحدة 170.5 مم² ، خلال فترة نموها (17 يوم).
 - 2- بلغ ما استهلكه العمر البرقي الرابع والخامس معا من أوراق نباتات بنجر السكر حوالي 84.4% من جملة المساحة المستهلكه.
 - 3- وجد أن متوسط ما تستهلكه الحشرة الحديثة الخروج من أوراق البنجر حوالي 754.3 مم² خلال 28 يوم، بينما بلغ ما استهلكته الحشرة الكاملة بعد خروجها من البيات 2369 مم² وذلك في مدة 80 يوم.
 - 4- بلغ متوسط مساحة أوراق نباتات البنجر المستهلكة خلال فترة حياة الحشرة الكاملة (قبل وبعد البيات معا) حوالي 3123.3 مم² ، وهي تمثل حوالي 94.8% من جملة المساحة الكلية المستهلكه خلال الطور الكامل والغير كامل.
 - 5- وجد أن فردا واحدا من هذه الحشرة يستهلك خلال فترة حياته كلها (الطور الكامل والغير كامل) مساحة من أوراق نباتات بنجر السكر تبلغ 3293.8 مم² خلال مدة 125 يوم.
 - 6- وجد أن الأنثى البالغة تضع في المتوسط 190.7 بيضة في خلال 37.67 يوم (متوسط فترة وضع البيض).