

CANNIBALISM PHENOMENON BETWEEN *SPODOPTERA LITTORALIS* (BOISD.) (LEPIDOPTERA: NOCTUIDAE) LARVAE IN THE LABORATORY

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Abstract

Cannibalism phenomenon among *S. littoralis* larvae under starvation and crowding conditions was dealt, in this research, at $27 \pm 1^\circ\text{C}$. Four groups of larvae aged 9 days were individually starved for 1 day in the first group, 2 days in the second, 3 days in the third and 4 days in the fourth one. Thereafter, the larvae of each group were directly distributed under three densities of 5, 10, and 15 larvae / cup then allowed to develop with no feeding (complete starvation). Another four groups of the same old larvae were also solitary starved for the same periods and distributed by the same way then received normal feeding till pupation (partial starvation). In the same time, three groups of the same old larvae were completely fed (no starvation) under the same considered densities (control). Cannibalism rate was affected clearly with starvation, ranged 25.0 - 93.3% in case of the complete starvation treatment, decreased to 5.0 - 7.5 % with the partial starvation and became very limited (1.7 - 2.5%) in the control. The highest cannibalism (32.0 - 48.9%) was noticed after one day of the grouping starvation. Crowding factor revealed also a clear effect on the cannibalism rate especially with the complete starvation larvae. No remarkable effect was noticed with unstarved larvae. Starvation significantly elongated the larval developmental period and, in the same time, increased the pupal weights. On the other hand, crowding showed an insignificant effect in this respect except the weights of the 5 larvae density with 1 and 2 starvation days. The two factors, starvation and crowding, had a reverse effect either on pupation or on adult emergence percentages but in the same time, they had no clear effect on the pupal duration. Optimum and successful rearing for *S. littoralis*, with the least cannibalism, could be obtained when the normal feeding was done under 5 larvae / cup density, showing short larval duration and high pupation and adult emergence. In general, the cannibalism phenomenon is considered rare between *Spodoptera* larvae (9 days old) received suitable rearing and crowding conditions.

INTRODUCTION

Cannibalism phenomenon is known among larvae of certain insects such as *A. ipsilon*. This phenomenon is affected with starvation, crowding and other physical factors, Abdel - Salam *et al.*, (1992) and Khedr *et al.*, (1995). The authors of the present work also noticed this phenomenon among *S. littoralis* larvae in the laboratory. So, they aimed to study it under different conditions of starvation and crowding and, in the same time, clarify effects of these conditions on certain biological aspects of this insect.

MATERIALS AND METHODS

The culture of *S. littoralis* larvae used in the present research was maintained according to the method adopted by El – Darawy *et al.*, (1964). The culture was used to carry out the following experiments under a constant temperature of $27 \pm 1^{\circ}\text{C}$:

Complete starvation exp.: 150 larvae, aged 9 days, were individually kept in 1x3 inch glass vials without any food. One day later, the larvae were randomly distributed under three densities, 5, 10 and 15 larvae / cup (6 cm height x 10 cm diameter) with five replicates for each, with no food till pupation. Another similar three groups of larvae also were individually starved for 2, 3 and 4 days then transferred, under the same densities, into similar cups without any source of food.

Partial starvation exp.: Four groups, each 150 larvae (9 days old) were individually starved for the same mentioned periods, then transferred as described before into the cups represented the same three densities with feeding on fresh castor – oil leaves till pupation.

Free feeding exp.: A group of 150 larvae (9 days old) were directly transferred into the plastic cups in the 5, 10 and 15 larvae / cup densities, each replicated 5 times. All cups received fresh castor oil leaves for feeding till pupation.

Daily cannibalism and natural mortalities in addition to certain biological aspects were recorded. Differences between means were analyzed by using Analysis of variance (F – test and Least significant difference).

RESULTS AND DISCUSSION

Data obtained in Table (1) revealed that, regardless of the crowding, and cannibalism rate increased from 76.7% with one day solitary starvation to 83.6 and 81.9% with 2 and 3 days solitary starvation, respectively, natural larval mortality ranged 2.1 – 5.8%. This cannibalistic trend agreed with that recorded by El-Kifl *et al.* (1972) and El-Sherif (1994) on *A. ipsilon*. Increasing the starvation period to 4 days, cannibalism rate decreased drastically to 41.1% but natural mortality raised clearly to 46.7% between the larvae, this may be due to the larval weakness resulted from this long starvation. Also, the highest cannibalism percentages (32.2–48.9) were recorded after one day of the larval grouping, decreased gradually to reach about 0.5 – 0.8% only after 6 days. Data in the same table showed that, increasing the larval density raised the cannibalism range from about 60.0 – 75.0 with 5 larvae /cup to 77.5 – 87.5 and 88.3 – 93.3% with 10 and 15 larvae / cup, respectively. These results agreed those of El – Kifl *et al.*, (1972) who mentioned that, cannibalism percentage was higher with more crowded second – instar larvae.

Table (2) showed that, in the partial starvation treatment, cannibalism rate decreased sharply to 0.0 – 7.5% only. This percentage slightly differed with regarding the solitary starvation period, 3.9, 5.4, 6.5 and 5.6% opposite 1, 2, 3 and 4 days,

respectively. Also, they showed a similar slightly difference with regard to the larval density, 0.0 – 5.0, 5.0 – 7.5 and 6.3 – 7.0% opposite the same, respectively.

All previous results pointed to that, cannibalism rate increased clearly between the complete starvation larvae but decreased sharply between those of the partial starvation treatment. Thus, are in agreement with results of El – Kifl *et al.*, (1972), Abdel – Salam *et al.*, (1992) and Khedr *et al.*, (1995), food was the most essential factor affects the cannibalism rate between *A. epsilon* larvae.

As for the biological aspects of the partial starvation larvae, are shown in Table (3). It is appeared that, regardless of density, larval developmental period significantly elongated with more starvation, 16.0, 19.5, 18.3 and 20.0 days opposite 1, 2, 3 and 4 starvation days, respectively, comparing with 13.4 days only as a larval duration in the check. These findings agreed those recorded by El- Sherif (1994) on *A. epsilon* and El-Metwally *et al.*, (1996) on *S. littoralis*. On the other hand, the density had no significant effect on the larval stage duration within each starvation treatment, agreed the results recorded by Khedr *et al.*, (1995).

The pupal duration was nearly unaffected either with the starvation or with the crowding (7.5-8.9 days) when compared with that in the control (8.0 - 8.7 days). This result is similar to that obtained by EL-Sherif (1994), 10.3-11.3 days in the starvation treatments and 10.5 days in case of the control.

Table 1. Cannibalism and natural mortality percentages of 9-day old *S. littoralis* larvae exposed to the complete starvation under different densities.

SSP (days)	Larvae / cup	% cannibalism after grouping with:							Natural mortality %
		1	2	3	4	5	6 days	Total	
1	5	30.0	10.0	15.0	5.0			60.0	2.0
	10	37.5	22.5	20.0	0.0			80.0	1.0
	15	40.0	25.0	16.7	8.3			90.0	3.3
	mean	35.8	19.20	17.2	4.4			76.7	2.1
2	5	30.0	30.0	30.0	0.0	0.0	0.0	75.0	5.0
	10	30.0	20.0	20.0	15.0	0.0	2.5	87.5	2.5
	15	36.7	23.3	15.0	8.3	5.0	0.0	88.3	5.0
	mean	32.2	19.4	21.7	7.8	1.7	0.8	83.6	4.2
3	5	55.0	10.0	10.0		0.0	0.0	75.0	5.0
	10	45.0	30.0	2.5		0.0	0.0	77.5	12.5
	15	46.7	25.0	16.6		3.4	1.6	93.3	0.0
	mean	48.9	21.7	9.7		1.1	0.5	81.9	5.8
4	5	20.0	5.0					25.0	55.0
	10	55.0	0.0					55.0	35.0
	15	41.7	1.6					43.3	50.0
	mean	38.9	2.2					41.1	46.7

SSP= Solitary starvation period.

Table 2. Cannibalism and natural mortality percentages of 9-day old *Spodoptera* larvae exposed to the partial starvation under different densities.

SSP (days)	Larvae / cup	% Cannibalism after grouping with:							Total	Natural mortality%
		1	2	3	4	5	6	7days		
1	5								0.0	0.0
	10					5.0			5.0	1.3
	15						5.0	1.7	6.7	1.7
	mean					1.7	1.7	0.6	3.9	1.0
2	5					5.0			5.0	1.0
	10		5.0						5.0	1.8
	15	1.7		4.6					6.3	2.7
	mean	0.6	0.7	1.5		0.7			5.4	1.8
3	5						5.0		5.0	4.1
	10	2.5					5.0		7.5	7.5
	15	3.7						3.3	7.0	5.0
	mean	2.1					3.3	1.1	6.5	5.5
4	5			5.0					5.0	15.0
	10			5.0					5.0	32.5
	15			3.4		3.4			6.8	27.1
	mean			4.5		1.1			5.6	24.9
Control	5								0.0	0.0
	10				2.5				2.5	10.0
	15					1.7			1.7	30.5
	mean				1.4				1.4	13.5

The pupation percentages negatively suffered with elongation of the fasting period, 66.7, 63.3, 65.0 and 54.6% opposite 1, 2, 3 and 4 days, respectively (72.9% in the control). This negative effect was previously recorded by El-Shrif (1994) on *A. ipsilon*. A similar trend was detected with the larval density, 60.0 – 75.0, 52.5 – 67.5 and 51.4 – 61.7% pupation in case of 5, 10 and 15 larvae / cup, respectively. Adult emergence was also affected by the same way, 88.2, 79.7, 76.5 and 73.6% opposite the same starvation treatments, respectively, Table (3).

Mean pupal weight was generally heavier in the starvation treatments (199.9 – 288.6 mg) than that in the control (188.6 – 218.7 mg), this may be due to that, the starvation pupae resulted from longer larval stage in which they could eat more food than those of the control. Starving larvae for one day, produced the heaviest pupae (283.2 mg/pupa). Lengthening this period to 2, 3 and 4 days, the weights decreased to 247.2, 206.6 and 215.8 mg / pupa, respectively, may be due to that, more starvation means more hunger and weaker larvae ate, relatively, less food so produced light pupae. These pupae were, in the same time, still heavier (206.6 – 283.2mg) than those had the shortest larval stage in the control (202.9 mg / pupa). Similar results were reported by El - Sherif (1994), mean pupal weight ranged 386 – 534 mg in case of starved *Agrotis* larvae (about 14-58% increasing) compared with 338 gm only in case of unstarved ones. Also, El-Metwally *et al.*, (1996) noticed a slight increase (3-14 %) in the pupal weight with fasting *S. littoralis* larvae 2-4 days. It was also noticed from Table (3) that, the light pupae were generally gained with more

crowded larvae either in the treatments or in the control. This result is in a harmony with that of Zaher and Moussa (1962).

Regardless of the density, pupation percentages were similarly decreased (63.3-66.7) when the larvae were starved for 1-3 days, 72.9 % in the control, Table (3). Starving for 4 days, the percent decreased sharply to 54.6%. This negative relation was also noticed in *Agrptis* by El-Sherif (1994). The starvation also effected reversely on the adult emergence, 88.2% in case of one day starvation lowered to 73.6% in case of 4 days. The crowdedness factor, also affected negatively both of the pupation and adult emergence, 60.0-75.0, 52.5-67.5 and 51.4-60.0% as pupation and 76.3-100.0, 73.3-84.6 and 69.4-80.0% as emergence opposite 5, 10 and 15 larvae/cup, respectively.

These previous results showed that, starving *Spodoptera* larvae, even for one day, gave abnormal biological data especially as longer larval duration and heavier pupae.

Table 3. Partial starvation in relation to certain biological aspects of *S. littoralis*.

SSP (days)	Larvae / cup	Larval Duration (days)	Pupation %	Pupal wt. (mg)	Pupal duration (days)	Adult emerg. %
1	5	16.4*	75.0	288.6*	7.7	100.0
	10	15.2	65.0	230.0	7.7	84.6
	15	16.3*	60.0	230.9*	7.8	80.0
	mean	16.0	66.7	283.2	7.7	88.2
2	5	19.1*	65.0	265.6*	7.7	88.9
	10	19.6*	67.0	236.4	8.0	77.8
	15	19.8*	58.3	239.5*	7.5	72.5
	Mean	19.5	63.3	247.2	7.7	79.7
3	5	18.3*	65.9	213.0	7.6	83.3
	10	18.5*	67.5	206.9	7.8	73.3
	15	18.1*	61.7	199.9	7.7	73.0
	mean	18.3	65.0	206.6	7.7	76.5
4	5	20.3*	60.0	222.0	8.9	76.3
	10	20.2*	52.5	218.1	8.2	75.0
	15	19.5*	51.4	207.2*	7.9	69.4
	mean	20.0	54.6	215.8	8.3	73.6
Control	5	13.6	80.0	218.7	8.0	95.0
	10	13.3	77.5	201.5	8.1	88.6
	15	13.3	61.1	188.6	8.7	84.9
	mean	13.4	72.9	202.9	8.3	89.5
L.S.D _{0.05}	5	2.7		26.8		
	10	2.8		29.9		
	15	2.8		24.1		

Mean treatments with a star, statistically differed with the similar in the control.

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ظاهرة الافتراس بين يرقات دودة ورق القطن في المعمل

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تناولت هذه الدراسة ظاهرة الافتراس بين يرقات دودة ورق القطن على درجة 27 ± 0.1 م في المعمل. جوعت أربعة مجاميع من اليرقات (عمر ٩ يوم) انفرادياً لفترات مختلفة، الأولى لمدة يوم، الثانية لمدة يومين، الثالثة لمدة ثلاثة أيام والمجموعة الرابعة لمدة أربعة أيام- وزعت بعد ذلك مباشرة يرقات كل مجموعة تحت ثلاث كثافات عديدة ١٥،٥،١٠ يرقة/ عليّة وتركت بدون تغذية (تجويج كامل). جوعت أربعة مجموعات أخرى من اليرقات لنفس العمر وبنفس الطريقة ثم وزعت تحت نفس الكثافات المذكورة مع تغذيتها حتى التعذر (تجويج جزئى)- تم فى نفس الوقت تغذية ثلاثة مجاميع من اليرقات بنفس العمر وتمثل الكثافات العددية الثلاثة حتى التعذر (المقارنة). اتضح من الدراسة أن درجة الافتراس قد تأثرت بوضوح بالتجويج حيث تراوحت بين ٢٥،٠-٩٣،٣% فى التجويج الكامل وانخفضت إلى ٥،٠- ٧،٥% فى التجويج الجزئى وإلى ١،٧- ٢،٥% فقط فى المقارنة- كانت أعلا نسبة افتراس (٣٢،٠-٤٨،٩%) بعد يوم واحد من توزيع اليرقات فى كثافات عديدة. كان للتزام أيضاً تأثير واضح على درجة الافتراس بين اليرقات خاصة مع التجويج الكامل.

أدى التجويج إلى اطالة مدة الطور اليرقى بدرجة معنوية فى حين لم يكن للتزام مثل هذا التأثير الواضح. اظهر كل من التجويج والتزام تأثيراً عكسياً على النسبة المئوية لكل من التعذر وخروج الفراشات ، ولم يكن لهما تأثير واضح على مدة طور العذراء هذا وقد تأثرت اوزان العذارى وازدادت مع التجويج خاصة مع اقل الكثافات العددية (٥ يرقة) بتجويجها ١ ، ٢ يوم. هذا وتشير الدراسة إلى أنه يمكن تربية دودة ورق القطن بصورة ناجحة وبأقل درجة افتراس مع التغذية المعتادة مع الكثافة العددية ٥ يرقة / عليّة (٥ سم ارتفاع $10 \times$ سم قطر). وعموماً فإن ظاهرة الافتراس بين يرقات دودة ورق القطن تكاد تكون معدومة اذا ما توفرت الاحتياجات المناسبة من تغذية وعدم التزام.