J. Plant Prot. and Path., Mansoura Univ., Vol. 3 (1): 35 - 41, 2012

SOME BIOLOGICAL STUDIES ON THE COTTON LEAFWORM, *Spodoptera littoralis* (BOISD.) REARED ON NATURAL AND ARTIFICIAL DIETS

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ABSTRACT

The cotton leafworm, *Spodoptera littoralis* (Boisd.) (Noctuide : Lepidoptera) was reared on two artificial diets (kidney bean and broad bean) and natural diet comparable with feeding on (castor oil bean leaves) under laboratory conditions at. 27±1°C and 70±5% R.H. The biological aspects were evaluted thorough eight generations. The two artificial diets were more preferred to the insect than the natural diet . The results revealed that the mean weight of the larval instars of S*. Littoralis* reared on the diets were significantly higher than that reared on the natural diet . The deposited eggs per female were slightly higher on artifical diet than those laid on natural diet. Moreover, the duration of generations were affected by the rearing on the two diets (33 and 32 days), respectively, while not affected when rearing on the castor oil bean leaves (42 days). Larval stage duration was significantly higher when reared on board bean than rearing on the castor oil bean leaves. The adult females of longevity was 7, 9 and 6 when feeding on kidney bean, broad bean and castor oil bean leaves, respectively. It be concluded that brood bean diet is the best to conduct out the different bio assays for the cotton leafworm , *S littoralis*

INTRODUCTION

The cotton leafworm, *Spodoptera littoralis* occasionally is a serious pest on cotton in Egypt is considered one of the most serious and destructive lepidopterous insect pests, not only for cotton plants but also other field crops and vegetables. Rearing insects on artificial diets is generally easier and life histories and behavior can be precisely studied with less effort (Hafez and Hassan,1969& Ibrahim and Tawfik,1975).

The logistics of rearing insects is facilitated and large number may be reared simultaneously and economically in a limited space. Insects can often be reared throughout the year irrespective of food source and season giving uniform specimens of know age manipulated. Thus insects with special trials can be developed and quality of test insects can be controlled.

Laboratory reared insects are useful for insects of uniform size and age may be produced in relatively great numbers under controlled conditions. Therefore ,the present study was aims to find a suitable diet to maximize the population of *S. littoralis* under laboratory conditions on artificial and natural diets. Several modification were add to the artificial medium of (Shorey and Hall, 1965) based on ingredients available in Egyptian local market to find a suitable laboratory diet for rearing *S. Littoralis.* The effect of the artificial (kidney bean and brood bean) and natural diet (castrol oil bean leaves)on *S. Littoralis* development was evaluated under laboratory condition at (27±1°C and 70±5% R.H.). The criteria used for evaluation in the current study were larval , pupal and adult spans , generation period ,larval and pupal weight , adult emergic and fecundity .

MATERIALS AND METHODS

This experiments aims to use food ingredients available in the Egyptian market to prepare artificial diets to rear cotton leafworm at low cost. These diets were prepared based on the method of preparation diet of Shorey and Hall (1965).

In the present study several modification were add to the artificial medium of Shory and Hall (1965) diet.

The effect of the artificial (kidney bean and broad bean) and natural (castor oil leaves) diets on *S. littoralis* development was evaluated under laboratory conditions

The criteria used for evaluation in the current study were larval, pupal and adult spans, generation period, larval and pupal weight adult energic and fecundity.

Two diets were prepared; the first was based on kidney beans *Phaseolus vulgaris,* while the second was based on broad bean, *Vicia faba.*

Artificial diets:

Kidney bean diet:

Dry kidney bean (500g) are soaked in water (4 liter) for bring soft about 12 h., then boiled to cooking it, Dried Brewer's yeast (15 g), ascorbic acid (4.5 g), sorbic acid (6 g) were mixed into the cooked kidney beans with amount of water required for blending, formaldehyde (5 ml) was added. In the remaining water, agar (30 g) was dissolved at 100c. The agar solution was cooled to less than 70c and was mixed with the blended ingredients. The stock diet was held for 2 h. to allow cooling and fermented and kept in a refrigerator with needed.

Broad bean diet:

Dry shell broad bean (500 g.) are soaked in water (2 liter) and cooked. Agar (30 g.) solution, dried Brewer's yeast (15 g.), ascorbic acid (4.5 g.), sorbic acid (6 g.) and methyl-P-hydroxy benzoate (15 g.) formaldehyde (5 ml) were blended with the cooked broad bean. The diet was held for 2 h. to allow cooling and fermented then kept in a refrigerator until needed.

Natural diet:

Castor bean leaves were chosen as natural host plants since they are available all the year round and are most convenient for larval feeding.

Rearing technique:

To establish a culture, newly hatched larvae were collected from the cotton fields booth kidney bean and broad bean diets were distributed into ice plate provided with approximately (10 g.) each diet. 4 replicates of the ice plate were conducted for both the two diets, 100 newly hatching larvae were placed/replicate using a fine hair brush.

Ice plate was covered with glass plate. The newly hatched larvae were collected to fed on each diet till their pupation. The diet was renewed every 3 days to prevent feces contamination.

The developed pupae were sexed and pairs were kept in suitable cages as planned for mating. The emerged moths were fed on 10% sugar

solution, leaves of *Nerium oleander* placed in the rearing cages served as oviposition sites.

Table (1): The components of the two artificial diets.

Contents (gm)	Shory and Hall diet	Kidney bean diet	Broad bean diet
Agar	128 g	30 g	30 g
Yeast*	320 g	15 g	15 g
Kidney bean	233	500 g	-
Broad bean	-	-	500 g
Asorbic acid*	32 g	4.5 g	4.5 g
Methyl-P-hydroxy benzoate*	20 g	15 g	15 g
Sorbic acid*	10 g	6 g	6 g
Water	6400 ml	4 Liter	4 Liter
Formaldehyde (40%)*	20 ml	20 ml	5 ml

*** Yeast: supplies the insect with the vitamin B group Wigglesworth (1972) stated that vitamin deficiencies in the diet may cause generally a delayed effect on the insect growth. George *et al.* (1960) used brewers yeast for rearing *A. ipsilon* larvae.**

*** Ascorbic acid: Supplies the insect with vitamin C with is important for normal development and egg production of insets (Vanderzant *et al.*, 1962).**

***Methyl-p-hydroxy benzoate and sorbic acid: Both chemicals have no nutritional values, but they act as microbial inhibitors to prevent contamination of the diet.**

***Formaldehyde (40%): Although using protective methods for Resistance (polyhydros is virus)**

Statistical analysis:

All experiments were in 3-5 replicates. The values were shown as means ± standard deviations. Data were subjected to analysis of variance (ANOVA), and Duncan's multiple range tests to differentiate between the means at $P< 0.05$ (SAS Institute, 1988).

RESULTS AND DISCUSSION

When the modified broad bean and kidney bean artificial diet was held in comparison with castor oil leaves for laboratory rearing of *S. littoralis* the development and survival rate of the larvae seemed to be not only as well as but also better than castor oil leaves (Tables 2&3). Successful rearing of the insect was continued for 8 generations on the artificial diet without any deterioration in the survival rate or larval weights. Data in Table (2) shows that the mean weight of full ground larvae on the artificial diet was 0.186 g kidney bean diet and 0.202 g of broad bean diet always significantly higher than on castor oil leaves (0.125 g). Likewise, the larvae which reared on both kidney and broad bean diets was produced high weights pupal in comparison to the other reared on castor oil leaves (Table, 2).

The deposited eggs by females on the both artificial diets (kidney and broad bean diets) slightly more (1042 and 1165 eggs/female) than those on castor oil leaves (890 eggs/female) (Table, 2).

Statistical analysis demonstrated highly significant differences between weight of larvae, % pupation, weight of pupae, %adult emergency and No. of eggs/female when feeding on kidney bean diet, broad bean diet and castor oil

leaves treatments (F= 43.0, 88.59, 31.0, 97.14 and 94.14, P<0.05 and LSD = 0.019, 0.31, 0.02, 0.35 and 49.13, respectively)

Table (2): Comparison between the kidney and broad bean diets and castor oil leaves on rearing the cotton leafworm, *Spodoptera littoralis*.

Evaluation criteria	Kidney bean diet	Broad bean diet	Castor oil leaves	LSD	F
Weight of larvae (g)	0.19±0.006	0.20±0.029	0.13±0.006	0.019	43.0***
%Pupation	80.10±0.088	92.25±0.144	71.92±0.012	0.31	88.59***
Weight of pupae	0.29±0.006	0.34±0.006	0.28±0.009	0.02	31.0***
%Adult emergency	83.30±0.173	94.85±0.029	75.62±0.012	0.35	97.14***
No. eggs/female	1042±1.155	1165±2.887	890±0.577	49.13	94.14***

(Table, 2). Not only larvae, pupal weight and the number of eggs were affected by the type of diet, but also both larval, pupal duration and female longevity were also affected (Table, 3).

The larval period reared on broad and kidney bean diets (15 and 9 days) were less 6 and 2 days. In addition, the pupation period on the two artificial diets were (8 and 6 days) compared to 10 days for insects were reared o castor oil leaves (Table, 3).

On the other hand, the adult females longevity on both kidney bean and broad bean diets ranged from 7 and 9 days in comparison to 6 days for adult female produced from castor oil leaves (Table, 3).

The percent pupation obtained from the kidney bean and broad bean diets was enhanced than the same stages produced from castor oil leaves this due to Table (3).

Statistical analysis demonstrated significant or highly significant differences between Incubation period, 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, 5^{th}, 6^{th} larval instars, larval duration, pupation, longevity/female and duration when feeding on kidney bean diet, broad bean diet and castor oil leaves treatments (F= 28.0, 12.0, 9.1, 8.01, 7.78, 13.0, 10.0, 14.8, 12.6, 16.9 and 19.1, P<0.05 and LSD = 0.998, 0.997, 0.984, 0.974, 1.45, 0.981, 1.99, 1.65, 0.879, 0.787 and 11.12, respectively) (Table, 3).

Table (3): The biological aspects of the cotton leafworm, *Spodoptera littoralis* reared on different artificial and natural diets.

Evaluation criteria	Kidney bean diet	Brood bean diet	Castor oil leaves	LSD	F
Incubation period	3	2	5	0.998	28.0***
1^{st}	3±0.06	2±0.12	4±0.35	0.997	12.0 ***
2^{nd}	2±0.17	3±0.17	3±0.17	0.984	9.1**
3^{rd}	3±0.23	2±0.23	2±0.12	0.974	8.01*
4^{th}	4±0.12	2±0.29	3±0.18	1.45	7.78**
5^{th}	3±0.29	2±0.18	4±0.23	0.981	13.0***
6^{th}	4±0.18	4±0.06	5±0.29	1.99	10.0**
Larval duration	19±0.58	15±0.58	21±0.58	1.65	14.8***
Pupation	8±0.52	6±0.17	10±0.29	0.879	12.6***
Longevity/female	7±0.17	9±0.46	6±0.35	0.787	16.9***

Lifespan	37±1.15	32±1.15	42±1.15	11.12	19.1***

The results showed that the increase in the average numbers of eggs/female (fecundity), low duration of both larval and pupation phase and increase the lifespan of the female may due to feeding on the tested diets.

As shown in Table (4) the sex ratio of female to male pupale were approximately 1:1 in all studied generation of *S. littoralis* on the experimented diets .Sex ratio of female to male were 1 : 0.63 , 1 : 0.57 , 1 : 0.67 for pupae developed on Kidney bean diet ; 1 : o.60 , 1 : 0.61 , 1 : 0.58 on Brood bean diet and 1 : 0.65 , 1: 0.58 , 1 : 0.66 on Castor oil leaves for the 3^{RD}, 5^{th} , 8^{th} generations , respectively .

These results can be concluded by based on successive generations that feeding on diet of broad bean was the least impact on the biological development and vitality of cotton leafworm compared to feeding on a diet of kidney bean and so is with the feeding on castor oil leaves.

Table (4): Life span ratio of the cotton leafworm, *Spodoptera littoralis* pupae reared on different diets.

Diet	Generation	No. of pupae	Pupal sex		Sex ratio	
			Female	Male	Female	Male
Kidney bean diet	**3**	35	22	13	1	0.63
	5	47	27	20	1	0.57
	8	43	29	14	1	0.67
Broad bean diet	**3**	42	25	17	1	0.60
	5	57	35	22	1	0.61
	8	69	40	29	1	0.58
Castor oil leaves	**3**	33	20	11	1	0.65
	5	41	25	18	1	0.58
	8	40	27	14	1	0.66

El-Guindy *et al.* (1979) recorded nearly similar results with *S. littoralis* using artificial diet of Shorey and Hall (1965) and castor oil leaves as a natural diet. Dimetry (1970) reared *S. littoralis* on the same artificial diet of Shory and Hall (1965) using horse beans instead of pinto beans. The results revealed no significant differences in the pupal durations and weight by rearing on this diet and castor oil leaves the fecundity and longevity were similar in both cases. Cabello *et al.* (1984), reared *Spodoptera littoralis* (Boisd.) for one generation on eight diets based on four meals (made from: dried alfalfa leaves, corn kernels, broad beans or soyabeans) offered with and without a vitamin-aminoacid supplement. The length of development, percentage of pupae and adult longevity changed according to the basic meal used in the diet. The weight of pupae and adult fecundity were affected by both: the kind of meal and the presence or absence of the vitamin-aminoacid additive. Diets based on soyabean meal reduced percentage of pupae, adult longevity and fecundity.

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بعض الدراسات البيولوجية لدودة ورق القطن المرباه علي تغذية طبيعية وصناعية

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تم تربية دودة ورق القطن على ٢ بيئة صناعية (بيئة الفاصوليا، بيئة الفول البلدي)، مقارنة بالتربية علي بيئة طبيعية (أوراق الخروع) تحت الظروف المعملية (درجة حرارة ٢٧±١°م ورطوبة نسبية ٧٠±٥%).

اتضح من الدراسات المعملية من خلال ٨أجيال أن بيئة الفاصوليا وبيئة الفول البلدي هما البيئتان الأفضل لتربية دودة ورق القطن عن التغذية على أوراق نباتات الخروع. كما اتضح من النتائج أن متوسط وزن يرقات دودة ورق القطن الناتجة من التغذية على بيئة الفاصوليا وبيئة الفول البلدي أكثر معنوية من وزن اليرقات التي غذيت على أوراق نباتات الخروع. ووجد أيضـــا أن معدل وضع البيض للإناث الناتجة من يرقات مغذاة على بيئة الفاصوليا وبيئة الفول البلدي يزيد بوضوح عن معدل وضع البيض للإناث الناتجة من يرقات غذيت على أوراق نباتات الخروع. وتأثرت أيضا مدة الجيل لليرقات التي غذيت على البيئة الصناعية (٣٧ ، ٣٢ يوما) على الترتيب، بينما وصلت إلى ٤٢ يومًا عند التربية على أوراق نباتات الخروع. وظهرت فروق معنوية لفترة الطور اليرقي لليرقات التي غذيت على البيئة الصناعية (الفول البلدي – ١٥ يوما) عن التي غذيت على نباتات الخروع (٢١ يوما). على الجانب الآخر، وجد أن طول عمر الإناث وصل إلى ٧، ٩، ٦ أيام وذلك للإناث المنتجة من يرقات تم تغذيتها على بيئة الفاصوليا، وبيئة الفول البلدي؛ وأخيرًا على أوراق نبات الخروع على التوالي. . ويستخلص من هذة الدراسة أن بيئة الفول البلدى هى الأنسب لتربية دودة ورق القطن بهدف إجراء الدراسات المعمليه المختلفه.

قام بتحكيم البحث

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