THE POTENTIAL OF THE PREDATOR ORIUS ALBIDEPENNIS ON AGROTIS YPSILON AS AFFECTED BY BACILLUS THURINGIENSIS

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SUMMARY: The relation between the pathogen Bacillus thuringiensis and the predator Orius albidepennis (Hemiptera: Anthocoridae) associated with the greasy cutworm Agrotis ypsilon (Lepidoptera) has been investigated.

The biology of the predator showed to be affected in terms of nymphal duration, rate of food consumption and egg production when the predator larvae were fed on treated eggs or neonate larvae of the host (A. ypsilon). The effect of B-exotoxin (thuringiensin) on the predator has been also demonstrated.

Key Words: Bacillus thuringiensis, orius albidepennis, agrotis ypsilon.

INTRODUCTION

The relation between the bacterial pathogen Bacillus thuringiensis and the predators of some insect species was carried out by several authors (1-5,9,16). In Egypt, Salama and Zaki (10,11), explored the interrelation between B. thuringiensis, some lepidopterous cotton insect pests and some of their predators.

Orius albidepennis is a minute pirate bug. It is a common predator where it feeds on thrips, aphids, eggs and small larvae of lepidoptera. The mean number of eggs deposited by a single female ranged between 41.33 and 91.4. The total nymphal duration (five) lasted between 9.6-15.3 days. The life span averaged 26.9 days for the female and 17.3 days for the male (15).

The present paper includes a detailed study on the interrelation between the pathogen B. thuringiensis S-endotoxin and B-exotoxin (thuringiensin) and the predator O. albidepennis, associated with the greasy cutworm Agrotis ypsilon.

No work, has been carried out on the effect of B-exotoxin (thuringiensin) on A. ypsilon. The biology of other lepidopterous spp, as affected by B-exotoxin was reported by Ignofo and Gregory (7), on Trichoplosiani and Heliothis zea, Wayne *et. al.* (17), on Spodoptera frugiperda and Morris (8), on Mamestra configurata.

MATERIALS AND METHODS

a) Effect of S-endotoxin on O. albidepennis

To investigate the effect of endotoxin Bacillus thuringiensis and B-exotoxin, thuringiensin and the predator Orius albidepennis of Agrotis ypsilon. The commercial product Dipel 2X (B. thuringiensis var. kurstaki, 32.000 IU/mg) and

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Table 1: Duration and consumption of O. albidepennis nymphs fed on eggs and neonate larvae of A. ypsilon treated with B. thuringiensis.

Con. of B.t. Ug/ml	Av. nymphal duration in days mean ± S.E.		Av. consumption of nymphs mean ± S.E.	
	host eggs	neonate larvae	host eggs	neonate larvae
Control	11.21 ± 0.27[a] (10-12)	11.98 ± 2.03[a] (11-15)	22.8 ± 0.27[a] (10-12)	32.42 ± 2.51[a] (17-57)
156.25	12.13 ± 0.98[a] (7-18)	12.61 ± 2.91[a] (7-20)	12.13 ± .89[a] (7-18)	30.80 ± 2.70[a] (18-56)
312.50	12.63 ± 1.39[a] (8-17)	14.72 ± 2.07[a] (13-17)	12.63 ± 1.39[a] (8-17)	27.32 ± 2.61[a] (17-53)
625.00	13.94 ± 0.96[a] (11-16)	15.92 ± 1.99[a] (14-17)	13.94 ± 0.96 (11-16)	25.63 ± 2.10[a] (20-41)
1250.0	16.35 ± 1.98[b] (11-21)	18.11 ± 2.13[b] (10-26)	16.35 ± 1.98[b] (11-21)	20.91 ± 2.06[b] (11-44)

Means of each column followed by the same letter are not significantly different at 5% level.

thuringiensin preparation (1.5% solution of thuringiensin ABG-6162, Abott Laboratories), were tested. Adults of the predator were housed in 9 cm diameter acrylic tubes covered with fine-mesh nylon screen. Each container housed 25 to 50 adults of O. albidepennis and two cabbage leaves which served as sites for oviposition. Sheats with 300-400 eggs of A. ypsilon (or neonate larvae) were provided per adult container every 4 days. A piece of moistened cotton was provided. The oviposited Orius eggs were transferred to petridishes (4*15 cm) provided with egg sheets of Agrotis for feeding the emerged nymphs of Orius. Newly eclosed adults of the predator were removed.

The newly hatched nymphs of the predator were allowed to feed 7 days on A ypsilon sprayed with B.t. suspension eggs or on neonated larvae of A. ypsilon previously fed on diet containing B. thuringiensis at concentrations of 1250, 625, 312.5 and 156.25 Ug/ml. Untreated eggs or neonate larvae were provided to the predator nymphs after 7 days till the adult stage. In the control, nymphs were fed on the untreated eggs or neonate larvae. The newly emerged males and females of the predator were fed for 7 days on eggs and neonate larvae that received the for mentioned concentrations of pathogen.

b) Effect of B-exotoxin on O. albidepennis

To detect the effect of B-exotoxin, thuringiensin on the nymphs and adults of the predator, was also determined adopting the same procedure using the concentrations 150, 75, 37.5 and 18.75 ppm of the exotoxin.

RESULTS

a) Effect of S-Endotoxin on Orius albidepennis

Data (Table 1), show that the nymphal duration of the predator was significantly increased after feeding on the eggs of A. ypsilon treated with B. thuringiensis being 16.35±1.98 days at a concentration of 1250 Ug/ml compared to 11.21±0.27 days in the control. The nymphal durations decreased with the decrease in the concentration of B. thuringiensis. The average consumption of the predator nymphs from the treated host eggs, was significantly lower compared to the control. The nymphal duration was insignificantly affected when fed on host larvae that received diet containing concentrations of B.t., 625, 312.5 and 156.25 Ug/ml. At 1250 Ug/ml, the nymphal duration was significantly prolonged being 18.11±2.13 days (Table 1). The average consumption of the nymphs from the treated neonate host larvae was significantly reduced to 20.9±2.06 larvae at concentration of 1250 Ug/ml of B.t. as compared to 32.42±2.51 larvae in the control. On the other hand, consumed neonate larvae treated with low concentrations of B.t. showed more or less insignificant differences as compared to the control.

Table 2 shows the average consumption of the male predator fed on the host eggs sprayed with the same concentrations of B.t. It appears that the male longevity was insignificantly prolonged when fed on host eggs

Table 2: Effect of feeding O. albidepennis adults on eggs and newly hatched larvae of A. ypsilon treated with B. thuringiensis on the longevity and amount of food consumed of both sexes.

Conc. of Sex B.t. (Ug/ml)	Individuals fed on host eggs		Individuals fed on neonate larvae	
	Longevity in days	No. of consumed eggs	Longevity in days	No. of neonate larvae consumed
	mean ± s.e.		mean ± s.e.	
Males Control	10.72 ± 0.97a (5-19)	43.22 ± 5.20a (35-59)	7.15 ± 0.68a (6-9)	29.38 ± 2.61a (22-48)
156.25	10.93 ± 1.32a (5-16)	40.97 ± 5.30a (31-57)	7.51 ± 0.69a (6-9)	26.79 ± 2.83a (23-33)
312.50	11.27 ± 1.76a (6-27)	37.26 ± 3.95a (22-61)	7.87 ± 1.50a (4-14)	25.26 ± 2.69a (19-31)
625.00	12.16 ± 1.82a (7-20)	34.35 ± 4.07b (23-42)	8.09 ± 0.49a (7-9)	2.81 ± 2.43b (15-26)
1250.99	12.84 ± 1.69a (7-18)	28.61 ± 3.03c (15-43)	8.66 ± 0.96a (8-10)	19.69 ± 2.35b (16-32)
Females control	16.52 ± 1.98a (13-27)	73.96 ± 8.95a (42-96)	8.62 ± 0.73a (8-10)	42.80 ± 3.61a (35-59)
156.25	17.23 ± 2.41a (8-30)	61.69 ± 5.12b (33-80)	8.72 ± 1.10a (8-11)	37.95 ± 4.51a (17-49)
312.50	17.68 ± 2.36a (10-26)	56.27 ± 4.20b (50-61)	9.00 ± 0.28a (8-10)	32.84 ± 2.87b (27-38)
625.00	18.10 ± 2.11a (10-31)	50.54 ± 6.12b (29-82)	9.73 ± 0.78a (6-11)	29.22 ± 1.41b (24-45)
1250.99	19.80 ± 2.04a (13-24)	42.32 ± 3.79b (29-62)	10.91 ± 1.41a (6-17)	23.67 ± 3.71c (10-39)

Means of each column followed by the same letter are not significant at 5% level.

sprayed with B.t. Similar results were obtained for the female. Also, the female longevity was in significantly affected when fed on neonate host larvae that received a diet containing B.t. at any of the tested concentrations. On the other hand, the average consumption of the female predator decreased when the host larvae received a diet containing 312.5 Ug/ml and above of B.t.

The average numbers of larvae consumed during the life of the male and female predator were 29.38±2.61 and 42.80±3.60, respectively, in the control individuals, showing a marked difference between either sex and this may be attributed to the fact that the longevity of the female was longer than that of the male. The male longevity was insignificantly prolonged when fed on host eggs sprayed with B.t.

Data in Table 3, show that the reproductive capacity of O. albidepennis females fed on treated host eggs or neonate larvae was markedly decreased with increasing the tested B.t. concentration.

b) Effect of B-exotoxin (thuringiensin) on O. albidepennis

The results obtained (Table 3) indicate that the nymphal duration of O. albidepennis was significantly prolonged when fed on eggs treated with B-Exotoxin at concentrations of 150 and 75 ppm being 17.33±0.45 and 14.33±0.42 day, respectively compared to an average of 11.5±0.41 days in the control.

The average consumption of the predator nymphs from the treated eggs was significantly reduced to 10.7±0.20 at 150 ppm, compared to an average of 23.9±0.65 in the control. The nymphal duration was also significantly prolonged when fed on neonate larvae that received a diet containing high concentra-

Table 3: Reproductive capacity of O. albidepennis when nymphs and female adults were fed on eggs and neonate larvae treated with B. thuringiensis (Dipel2x) or B-exotoxin.

Egg production / female					
B. thuringiensis			B-exotoxin		
Conc. in Ug./ml	Eggs	Neonate larvae	Conc. in ppm	Eggs	Neonate larvae
	Mean ± S.E.			Mean ± S.E.	
Control	62.52 ± 7.06[a] (52-74)	39.97 ± 3.71[a] (33-56)	Control	70.40 ± 6.90[a] (42-96)	47.6 ± 3.21[a] (27-67)
156.25	44.94 ± 5.10[b] (39-60)	26.36 ± 3.10[b] (12-46)	18.75	49.20 ± 5.63[b] (39-63)	29.8 ± 3.28[b] (25-43)
312.50	37.67 ± 4.07[b] (28-46)	21.23 ± 2.61[b] (11-43)	37.50	33.41 ± 4.23[c] (28-39)	22.3 ± 1.19[b] (20-29)
625.00	29.78 ± 3.41[c] (28-42)	14.82 ± 0.99[c] (13-16)	75.00	27.32 ± 1.93[c] (23.33)	19.9 ± 0.98[c] (15-31)
1250.0	12.33 ± 2.04[d]	5.21 ± 0.67[d]	150.0	0.0	0.0

Means of each column followed by the same letter are not significantly different at 5% level.

tions of B-exotoxin.

The average consumption of the predator nymphs from treated neonate larvae was significantly reduced at 75 and 150 ppm, being 26.3±1.1 and 21.56±0.96 larvae/predator nymph. At lower concentrations, the average consumption was insignificantly affected compared to the control (Table 3).

The reproductive potential of the female predator produced from nymphs fed on eggs or neonate larvae treated with B-exotoxin was markedly reduced. When the adult predators fed on eggs or neonate larvae treated with 150 ppm of the exotoxin, they failed to lay any eggs (Table 4).

The male longevity was insignificantly prolonged when fed on eggs treated with B-exotoxin at all tested concentrations compared to control.

The average consumption of the male from the treated eggs was significantly reduced being 18.72±2.3

Table 4: Duration and consumption of O. albidepennis one day old nymphs fed on eggs and neonate larvae of A. ypsilon treated with B-exotoxin.

Conc of exotoxin ppm	Av. nymphal duration in days on host eggs	on neona larvae	Av. consumption per nymph on host eggs	on neona larvae
	Mean ± S.E.		Mean ± S.E.	
Control	11.50 ± 0.41[a] (9-15)	12.00 ± 0.46[a] (8-15	23.9 ± 0.65[a] (8-46)	36.60 ± 1.41[a] (20-48)
18.75	13.00 ± 2.23[a] (8-15)	13.70 ± 0.54[a] (8-20)	19.3 ± 0.48[a] (11-38)	31.90 ± 0.91[a] (20-53)
37.50	12.90 ± 0.39[a] (9-18)	15.10 ± 0.53[a] (10-22)	16.5 ± 0.48[b] (8-30)	30.20 ± 0.44[a] (20-41)
75.00	14.33 ± 0.42[b] (8-22)	16.60 ± 0.48[b] (9-23)	13.4 ± 0.23[b] (6-27)	26.30 ± 1.10[b] (19-35)
150.0	17.33 ± 0.45[b] (14-22)	19.26 ± 0.61[b] (12-23)	10.7 ± 0.20[b] (6.26)	21.56 ± 0.96[b] (16-30)

Table 5: Effect of feeding of O. albidepennis on eggs and newly hatched larvae of A. ypsilon treated with B-exotoxin on longevity and food consumption of both sexes.

Conc. of exotoxin ppm	Fed on host eggs		Fed on neonate larvae	
	Longevity in days	Consumed eggs	Longevity in days	Consumed eggs
	Mean ± S.E. Males		Mean ± S.E. Males	
Control	10.20 ± 1.10[a] (9-13)	40.20 ± 4.12[a] (10-61)	6.7 ± 0.59[a] (3-11)	27.30 ± 3.21[a] (19-31)
18.75	11.00 ± 1.02[a] (8-20)	29.73 ± 3.32[b] (24-35)	7.1 ± 0.61[a] (6-9)	20.02 ± 2.11[b] (6-30)
37.50	11.30 ± 1.55[a] (6-17)	26.71 ± 3.12[b] (17-53)	7.6 ± 0.70[a] (6-10)	18.91 ± 1.91[b] (9-29)
75.00	12.90 ± 1.92[a] (7-18)	22.31 ± 2.90[b] (20-29)	7.9 ± 0.76[a] (6-11)	15.65 ± 1.72[b] (9-17)
150.0	13.30 ± 0.45[a] (13-14)	18.72 ± 2.30[c] (11-29)	8.2 ± 0.81[a] (6-14)	12.11 ± 1.41[b] (8-17)
	Females		Females	
Control	16.32 ± 1.72[a] (10-20)	70.40 ± 1.90[a] (64.81)	8.2 ± 0.75[a] (6-11)	47.60 ± 3.91[a] (40-61)
18.75	17.30 ± 2.55[a] (8-30)	50.30 ± 7.21[b] (26.69)	9.8 ± 1.68[a] (5-24)	24.40 ± 2.50[b] (28-38)
37.50	18.50 ± 1.95[a] (10-42)	42.10 ± 4.56[b] (33-57)	10.0 ± 1.13[a] (5-16)	30.67 ± 1.70[b] (26-44)
75.00	17.90 ± 0.56[a] (14-24)	31.00 ± 1.04[c] (25-43)	10.4 ± 1.23[a] (4-15)	28.60 ± 2.64[b] (23-40)
150.0	19.10 ± 2.17[a] (8-33)	26.30 ± 2.42[c] (22-33)	11.1 ± 1.32[a] (6-14)	20.60 ± 0.51[b] (11-40)

Means of each column followed by the same letter are not significantly different at 5% level.

at 150 ppm, compared to an average of 40.2±4.12 eggs in the control. The longevity of the male predator was significantly affected when fed on neonate larvae fed on diet containing B-exotoxin, compared with the control. The average consumption of the male was significantly reduced when fed on neonate larvae previously fed on a diet containing B-exotoxin at all tested concentrations compared to the control. Similar results were also obtained for the female (Table 5). The longevity of the female was insignificantly prolonged when fed on eggs treated with B-exotoxin compared to the control. The average consumption of adult female from treated eggs was significantly reduced, being 26.3±2.42 and 31.5±5.04 at 150 and 75 ppm, respectively, compared to an average of 70.4±1.90 eggs in the control. The longevity of the female was significantly prolonged when fed on neonate larvae previously fed on a diet containing B-exotoxin.

The average consumption of the female was significantly reduced when fed on neonate larvae fed on a diet containing B-exotoxin, being 20.6±0.5 at 150 ppm, compared to 47.6±3.91 larvae in the control.

The pathogen B. thuringiensis was used successfully to control the greasy cutworm A. ypsilon in vegetable fields (12) and in soybeans (14). In the field the predator O. albidepennis was found associated with A. ypsilon (15). So, the interrelation between the pathogen and the predator was investigated. Some adverse effects on the biology of albidepennis was recorded as a result of using B. thuringiensis. Thus, the nymphal duration of the predator was significantly increased after feeding on eggs or neonate larvae of the host treated with the pathogen and the consumption of the nymphs was significantly decreased. The longevity of the adult predator was insignificantly changed when fed on treated eggs or neonate larvae of the host, while their consumption was reduced markedly. Also a marked reduction was observed in the egg production of the females. The same results were obtained on the predators, Chrysopa carnea, Coccinella undecimpunctata, Paederus alfierii, Scymnus spp and Xylocoris flavipes (9,10,13).

With respect to the effect of B-exotoxin (thuringiensin), the present investigations indicate that the nymphal duration of the predator was significantly prolonged when fed on eggs or neonate larvae of A. ypsilon treated with B-exotoxin. Consumption of the predator nymphs from the treated host eggs or larvae was also reduced. The reproductive potential of the females produced from nymphs fed on eggs or neonate larvae treated with thuringiensin showed a significant reduction. Similar effects were also obtained when the adults were treated with thuringiensin with few exceptions. The potential impact of B-exotoxin on the predator Geocoris punctipes was reported by Herbert and Harper (6). They discussed the adverse effects of the pathogen on the predator.

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