Egypt. J. Agric. Res., 80 (2), 2002.

BIOLOGICAL ACTIVITY OF CERTAIN INSECTICIDES AGAINST THE TORTOISE BEETLE, *CASSIDA VITTATA* VILL. AND ASSOCIATE NATURAL ENEMIES IN SUGAR BEET FIELDS

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(Manuscript received July 2001)

Abstract

The biological effectiveness of some insect growth regulators [the anti-moulting agent (teflubenzuron) and the neem seed kernel extract (azadirachtin)] were evaluated against all stages of the tortoise beetle *Cassida vittata* Vill. infesting sugar beet plants at Kafr El-Sheikh Governorate during two successive seasons (1999/2000 and 2000/2001). This evaluation was conducted in comparison with one of the recommended organophosphorus insecticide namely, profenofos.

The obtained results showed that, profenofos was the most effective compound against *C. vittata* under field conditions, but was very harmful against its associated natural enemies. Teflubenzuron and azadirachtin exhibited sufficient effectiveness as biorational compounds in controlling *C. vittata* and showed much lower toxicity against its associated predators.

These biorational compounds could therefore be involved in integrated pest management program against this pest on sugar beet.

INTRODUCTION

The tortoise beetle *Cassida vittata* de Villers is a serious pest threatens sugar beet plantations. It's population ecology and behaviour were studied, specially in Kafr El-Sheikh Governorate where it causes severe damage to sugar beet plantations. It causes considerable decrement in root length, root diameter, root weight, root-sucrose content, weight of foliage and number of plant leaves (El-Khouly, 1998). Most of the damage caused by the larvae which fed on the leaves of the plants (Ali *et al.*, 1993).

The population density of *C. vittata* increases gradually with the increase of plant age. Also, there is a positive correlation between the population size of the pest and its biotic predators *Paederus alfierii* (L.), *Coccinella undecimpunctata* (L.) and *Chrysoperla carnea* (Steph.) prevailing with the insect in sugar beet fields (Samy *et al.*, 1992).

Looking for alternative control measures less hazardous to the environment and the beneficial insects, several new effective controlling agents were tested, such as repellents, antifeedants and insect growth regulators against larval stage of *Hyper poticae* Gyllenn (Oroumchi and Lorra, 1993). The egg production of *C. septempunctata* was not negatively influenced by topical treatment of adults with neem seed kernel extracts (Schmutterer *et al.*, 1981). Also, many predaceous coccinellids exhibited no mortality during exposure to Margosan-O (neem extract) (Hoelmer *et al.*, 1990). Moreover, there is no any negative effect of Margosan-O in the predaceous carabid beetle *Platynus dorsalis* (Forster, 1991).

The present study aims to evaluate the biological efficiency and environmentally acceptable of some formulations of antifeedants and chitin-synthesis inhibitors against *C. vittata* and its natural enemies in sugar beet plants at Kafr El-Sheikh Governorate.

MATERIALS AND METHODS

The present studies were carried out at Farag El- Shamy village, kafr El-Sheikh Governorate during 1999/2000 and 2000/2001 seasons to evaluate the role of some recent control measures on biological aspects of *Cassida vittata* in sugar beet fields.

1. Experimental design : The experimental areas were cultivated with sugar beet (*Beta vulgaris* L.) on 31 September, 1999/2000 in the first season, and on 15 October, 2000/2001 in the second season. Normal agricultural practices were applied as recommended by the Ministry of Agriculture of Egypt.

The experimental area was divided into equal plots of 42 m^2 replicated four times, treated and untreated plots were arranged in a complete randomized block design.

2. Tested chemicals : Profenofos (Profecron 72 % EC) : O-4-bromo-2- chlorophenyl O-ethyl-S-propyl phosphorothioate was chosen as a standard insecticide for comparison with the anti-moulting compound, Nomolt and the neem tree extract azadirachtin. Profenofos was used at the rate of 750 cc/feddan. Source : Kafr El-Zayat Insecticides Co.

The phenylthiourea derivative teflubenzuron (Nomolt 15 % SC) : 1-(3, 5-dichloro-2,4-difluorophenyl)-3-(2,6-difluorobenzoyl) urea was used at the rate of 100 cc/feddan. Source : American Cyanamide Co., Cairo.

The seed kernel extract of the neem tree, azadirachtin : Detigloyl-(6-[2,4-dinitrophenylamino hexanoyl]=22,23-dihydroazadirachtin, was used as Sharachtin 1 % EC formulation at the rate of 300 cc/feddan. Source : Jacob Co., Cairo.

3. Field application : The rate of applications used for each of the indicated chemical was applied with knapsack-sprayer (CP-3) equipped with one nozzle in 200 liter water per feddan. Spraying in the first season was carried out at 5 April, 2000 and at 15 April, 2001 for the second season, after 150 days of plantation at the peak of *C. vittata* on sugar beet (Ali *et al.*, 1993).

3.1. Efficiency estimation of the chemicals used : Precounting was conducted 24 hr before spraying and continued after 2, 5, 10 and 15 days from spraying to evaluate the reduction percentages of each stage of *C. vittata* using Henderson and Tilton (1955) formula. These estimations were carried out through the following steps:

3.1.1. Insect sampling : Sampling was carried out at the mentioned intervals as soon as the time of newly vegetative growth of sugar beet was completed and just after the appearance of beetles and signs of infestation. Each sample consisted of 100 sugar beet plants which were chosen randomly from five replicates, 20 plants each. The numbers of the different insect stages (eggs, larvae, pupae and adults) were counted on the selected standing plants in the field (Anonymous, 1993).

3.1.2. Predators sampling : The population density of the predators, *C. undecimpunctata*, *P. alfierii* and *C. carnea* was estimated in the same sugar beet fields, where *C. vittata* existed. Samples of 20 sugar beet plants were chosen randomly from the field borders and the field center (100 plants). Plants were inspected in the field and the numbers of the developmental stages of the predators were counted and recorded.

RESULTS AND DISCUSSION

A. Effectiveness of tested compounds against *Cassida vittata*

As shown in Table 1, the average of population densities of *C. vittata* immature and mature stages before spray were about 78, 160, 65 & 53/10 plants in 1999/2000 season and 91, 166, 76 & 42/10 plants in 2000/ 2001 season for eggs, larvae, pupae and adults, respectively. Profenofos was the most potent compound in reducing the population size of *C. vittata* eggs on sugar beet plants, after 2 days of application (92.7 % reduction) in 1999/2000 season. It was followed by teflubenzuron and azadirachtin, their reduction percentages were 67.9 and 61.4 %, respectively. After 15 days (period of evaluation), profenofos induced the highest egg reduction (89.7 %), followed by azadirachtin and teflubenzuron (77.5 and 66.3 %, respectively). Significant differences were also observed in 2000/20001 season. The highest effect was found after treatment with profenofos followed by azadirachtin and teflubenzuron. Reduction percentages were 86.1, 74.9 and 65.8, respectively. Similar results were obtained by El- Khouly (1998) who found that selecron insecticide and neemazal (neem tree extract) were successful in controlling eggs of the tortoise beetle.

Table 2 showed that the averages of initial reduction in insect larvae infestation (after 2 days) were 85.7, 39.97 & 36.5 % in 1999/2000 season compared with 87.0, 49.0 & 47.0 % in 2000/2001 season, for profenofos, teflubenzuron and azadirachtin, respectively. Profenofos was superior after 15 days from application against the larval stage in 1999/2000 and 2000/2001 seasons. Teflubenzuron and azadirachtin showed moderate effect in this respect. Reduction percentages between treatments were statistically significant, they were 83.4, 61.3 and 57.7 % for profenofos, azadirachtin and teflubenzuron, respectively. These results confirm those obtained by Saleh (1994) who stated that profenofos was the most potent insecticide to 3*rd* and 5*th* instar larvae of *C. vittata*. El-Khouly (1998) found that neemazal and selecron were the most effective insecticides against the immature stages of *C. vittata*.

Table 3 demonstrated that, the organophosphate (profenofos) caused significant pupal mortality during 1999/2000 and 2000/2001 seasons when sprayed on sugar beet plants to control *C. vittata*. Its mean reduction percentages in *C. vittata* pupal stage population were 87.1 and 84.6 %. Teflubenzuron and azadirachtin were less

Table 1. Effects of some insecticides on eggs of *Cassida vittata* infesting sugar beet plants at Kafr El-Sheikh Governorate during two successive seasons (1999/2000 and 2000/2001).

Insecticide	Rate/ fed.	Mean no. of eggs per 10 plants (% Reduction in infestation)*												
		1999/2000						2000/2001						* *
		Before spray	Days after spray				Mean	Before spray	Days after spray				Mean	General mean
			2	5	10	15			2	5	10	15		
Profenofos (Profecron 72 % EC)	750 cc	77.0	6.3 (92.7)	10.3 (88.8)	11.5 (88.2)	12.3 (89.2)	(89.7)	89.8	11.3 (88.7)	16.5 (86.0)	25.3 (80.0)	32.8 (74.9)	(82.4)	(86.1) a
Teflubenzuron (Nomolt 15 % SC)	100 cc	76.8	27.5 (67.9)	24.5 (73.3)	34.8 (64.1)	45.8 (59.7)	(66.3)	89.0	33.0 (66.8)	33.5 (71.4)	44.5 (64.5)	53.8 (58.6)	(65.3)	(65.8) b
Azadirachtin (Sharachtin 1 % EC)	300 cc	77.3	33.3 (61.4)	18.5 (80.0)	17.3 (82.3)	15.5 (86.4)	(77.5)	91.3	37.8 (62.9)	26.0 (78.4)	36.3 (71.8)	34.0 (74.5)	(71.9)	(74.7) b
Control	- -	78.0	87.0	93.3	98.3	115.3	-	91.0	101.5	119.8	128.3	132.8	-	-

* The numbers in parentheses indicate the reduction percentages of the laid eggs of *C. vittata*.

** Means followed by the same letter are not significantly different according to Duncan's multiple range test (F value = 38.8 at 5 % L.S.D. = 9.9 %).

Table 2. Effects of some insecticides on the larval population density of *Cassida vittata* infesting sugar beet plants at Kafr El-Sheikh Governorate during two successive seasons (1999/2000 and 2000/2001).

Insecticide	Rate/ fed.	Mean no. of larvae per 10 plants (% Reduction in infestation)*												
		1999/2000						2000/2001						**
		Before	Days after spray					Before	Days after spray					General
		spray	2	5	10	15	Mean	spray	2	5	10	15	Mean	mean
Profenofos (Profecron 72 % EC)	750 cc	155.3	23.3 (85.7)	34.5 (80.8)	33.8 (82.4)	44.5 (77.6)	(81.6)	161.3	22.5 (87.0)	31.0 (83.5)	34.8 (82.2)	23.3 (88.3)	(85.2)	(83.4) a
Teflubenzuron (Nomolt 15 % SC)	100 cc	158.3	99.5 (39.9)	86.0 (53.0)	76.8 (60.8)	57.5 (71.6)	(56.3)	162.3	88.8 (49.0)	81.5 (56.8)	82.0 (58.4)	56.5 (71.8)	(59.0)	(57.7) c
Azadirachtin (Sharachtin 1 % EC)	300 cc	156.5	104.0 (36.5)	72.8 (59.7)	63.8 (67.7)	49.0 (75.5)	(59.9)	160.0	91.0 (47.0)	62.0 (66.7)	75.5 (61.1)	47.8 (75.8)	(62.6)	(61.3) b
Control	- -	159.3	166.8	184.0	197.0	203.5	-	163.0	174.8	189.5	197.8	201.5	-	-

* The numbers in parentheses indicate the reduction percentages in the larval population density of *C. vittata*.

** Means followed by the same letter are not significantly different according to Duncan's multiple range test (F value = 99.9 at 5 % L.S.D. = 1.6 %).

Table 3. Effects of some insecticides on pupae of *Cassida vittata* infesting sugar beet plants at Kafr El-Sheikh Governorate during two successive seasons (1999/2000 and 2000/2001).

Insecticide	Rate/ fed.	Mean no. of pupae per 10 plants (% Reduction in infestation)*												
		1999/2000						2000/2001						**
		Before spray	Days after spray 2	5	10	15	Mean	Before spray	Days after spray 2	5	10	15	Mean	General mean
Profenofos (Profecron 72 % EC)	750 cc	63.3	6.8 (91.2)	8.3 (90.3)	11.8 (83.4)	16.3 (83.6)	(87.1)	75.3	11.0 (87.2)	14.3 (84.5)	16.0 (84.5)	32.0 (72.3)	(82.1)	(84.6) a.
Teflubenzuron (Nomolt 15 % SC)	100 cc	65.0	43.3 (45.3)	31.5 (64.2)	28.3 (70.5)	16.5 (83.8)	(65.9)	75.5	38.5 (55.4)	30.3 (67.2)	19.0 (82.1)	17.3 (85.1)	(72.4)	(69.2) a
Azadirachtin (Sharachtin 1 % EC)	300 cc	63.0	35.0 (54.4)	18.8 (77.9)	16.0 (82.8)	14.8 (85.0)	(75.0)	74.3	33.5 (60.6)	22.0 (75.8)	17.5 (83.3)	15.3 (86.6)	(76.5)	(75.8) a
Control	- -	62.0	75.5	83.8	91.5	97.3	-	74.8	85.5	91.5	105.3	114.8	-	-

* The numbers in parentheses indicate the reduction percentages in the pupal population density of *C. vittata*.

** Means followed by the same letter are not significantly different according to Duncan's multiple range test (F value = 7.2 at 5 % L.S.D. = 17.5 %).

potent, the first compound had moderate effect at first then gradually increased to reach 83.8 % reduction of pupal population after 15 days during 1999/2000 season. This compound exhibited the same trend in 2000/2001 season.

Table 4 showed that, profenofos caused significant adult mortality compared to teflubenzuron and azadirachtin. Profenofos caused 95.0 % initial kill in 1999/2000 season, while azadirachtin and teflubenzuron induced only 62.7 and 49.4 %, respectively. The same trend was also obtained in 2000/2001 season. After 15 days from treatment, the reduction percentages in the population of the adult *C. vittata* were 81.1, 66.4 and 56.4 % for profenofos, azadirachtin and teflubenzuron, respectively. The general mean of reduction percentages in adult populations were 84.9, 56.9 and 65.9 % with the same compound, teflubenzuron and azadirachtin, respectively during the two successive seasons (1999/2000 - 2000/2001). The obtained high mortality after profenofos application may be due to the high sensitivity of *C. vittata* adults to organophosphate insecticides (Saleh, 1994). Also, azadirachtin reduced the populations of all stages (eggs, larvae, pupae and adults) of *C. vittata* with about 75, 61, 76 and 66 %, respectively. The corresponding percentages after the application of teflubenzuron were 66, 58, 69 and 57 %.

B. Effects of the tested compounds on beneficials

Although profenofos was the most potent against *C. vittata*, the obtained results of teflubenzuron and azadirachtin revealed that they could serve as environmentally acceptable controlling tools for incorporation in integrated pest management (IPM) program against this pest.

For example, Table 5 showed that, profenofos was drastically toxic against the larval instar of *C. undecimpunctata* than teflubenzuron or azadirachtin, either for initial or residual effects in the two successive seasons. The general means of reduction percentages in the larvae of *C. undecimpunctata* were 91.9, 31.6 and 30.0 % for profenofos, teflubenzuron and azadirachtin, respectively.

Table 6 showed that profenofos was the most harmful in both seasons against the adult stage of *C. undecimpunctata*. This was exemplified by 92.7 compared to 29.7 and 3.4 % for teflubenzuron and azadirachtin, respectively.

Table 4. Effects of some insecticides on adults of *Cassida vittata* infesting sugar beet plants at Kafr El-Sheikh Governorate during two successive seasons (1999/2000 and 2000/2001).

Insecticide	Rate/ fed.	Mean no. of adults per 10 plants (% Reduction in infestation)*												
		1999/2000						2000/2001						** General mean
		Before spray	Days after spray 2	5	10	15	Mean	Before spray	Days after spray 2	5	10	15	Mean	
Profenofos (Profecron 72 % EC)	750 cc	50.5	4.3 (95.0)	4.0 (94.1)	17.3 (78.2)	19.8 (76.7)	(85.9)	40.3	8.0 (85.5)	9.3 (84.4)	17.3 (83.4)	13.8 (82.4)	(83.9)	(84.9) a
Teflubenzuron (Nomolt 15 % SC)	100 cc	47.8	40.8 (49.4)	35.3 (45.0)	30.3 (59.6)	22.8 (71.7)	(56.4)	40.5	32.8 (40.8)	32.5 (45.7)	24.5 (64.1)	16.8 (78.6)	(57.3)	(56.9) c
Azadirachtin (Sharachtin 1 % EC)	300 cc	49	30.8 (62.7)	27.0 (59.0)	25.5 (66.9)	19.0 (77.0)	(66.4)	41.3	31.3 (44.6)	25.0 (59.0)	18.3 (73.7)	13.0 (83.8)	(65.3)	(65.9) b
Control	- -	50.3	59.5	67.5	79.0	84.8	-	41.5	56.8	61.3	70.0	80.5	-	-

* The numbers in parentheses indicate the reduction percentages in the adult population density of *C. vittata*.

** Means followed by the same letter are not significantly different according to Duncan's multiple range test (F value = 37.2 at 5 % L.S.D. = 4.5 %).

Table 5. Reduction percentages in *Coccinella undecimpunctata* larval population density after spraying with some insecticides on sugar beet plants at Kafr El-Sheikh Governorate during two successive seasons (1999/2000 and 2000/2001).

Insecticide	Rate/ fed.	Mean no. of larvae per 10 plants (% Reduction in infestation)*												
		1999/2000						2000/2001						**
		Before spray	Days after spray				Mean	Before spray	Days after spray				Mean	General mean
			2	5	10	15			2	5	10	15		
Profenofos (Profecron 72 % EC)	750 cc	20.7	1.0 (95.9)	1.5 (94.3)	2.0 (92.8)	2.7 (91.7)	(93.6)	20.5	0.7 (96.3)	1.7 (91.7)	2.5 (88.3)	3.2 (84.7)	(90.2)	(91.9) a
Teflubenzuron (Nomolt 15 % SC)	100 cc	18.2	16.5 (24.3)	14.7 (36.8)	13.0 (46.8)	11.7 (59.6)	(41.8)	25.2	22.5 (10.1)	21.7 (17.0)	20.0 (24.3)	17.2 (34.2)	(21.4)	(31.6) b
Azadirachtin (Sharachtin 1 % EC)	300 cc	23.5	21.3 (24.3)	19.2 (36.0)	17.0 (46.0)	15.7 (58.0)	(41.0)	28.0	27.2 (2.2)	25.0 (14.0)	22.0 (24.9)	18.7 (35.5)	(19.1)	(30.0) b
Control	- -	20.5	24.5	26.2	27.5	32.7	-	32.2	32.0	33.5	33.7	33.5	-	-

* The numbers in parentheses indicate the reduction percentages in *C. undecimpunctata* larval population.

** Means followed by the same letter are not significantly different according to Duncan's multiple range test (F value = 47.1 at 5 % L.S.D. = 31.2 %).

Table 6. Reduction percentages in *Coccinella undecimpunctata* adults population density after spraying with some insecticides on sugar beet plants at Kafr El-Sheikh Governorate during two successive seasons (1999/2000 and 2000/2001).

Insecticide	Rate/ fed.	Mean no. of adults per 10 plants (% Reduction in infestation)*												
		1999/2000						2000/2001						**
		Before spray	Days after spray				Mean	Before spray	Days after spray				Mean	General mean
			2	5	10	15			2	5	10	15		
Profenofos (Profecron 72 % EC)	750 cc	20.7	0.8 (97.0)	1.5 (94.6)	2.0 (93.7)	2.7 (92.1)	(94.3)	18.7	1.0 (95.1)	1.7 (91.6)	2.5 (89.4)	2.5 (88.8)	(91.2)	(92.7) a
Teflubenzuron (Nomolt 15 % SC)	100 cc	18.7	18.0 (20.7)	17.5 (29.5)	17.2 (38.8)	16.5 (46.7)	(33.9)	19.7	19.0 (11.7)	17.5 (21.1)	16.2 (35.1)	15.5 (34.1)	(25.5)	(29.7) b
Azadirachtin (Sharachtin 1 % EC)	300 cc	17.7	17.7 (39.2)	16.5 (48.3)	16.0 (55.9)	14.5 (63.6)	(51.7)	20.5	20.0 (10.4)	20.0 (13.1)	19.2 (26.0)	17.7 (27.3)	(19.2)	(35.4) b
Control	- -	21.5	26.7	29.2	33.2	36.5	-	22.2	24.2	25.0	28.2	26.5	-	-

* The numbers in parentheses indicate the reduction percentages in the population density of the adult *C. undecimpunctata*.

** Means followed by the same letter are not significantly different according to Duncan's multiple range test (F value = 19.8 at 5 % L.S.D. = 47.7 %).

Table 7 indicate the side effect of profenofos, teflubenzuron and azadirachtin on the population density of the larvae of *C. carnea*. Again, profenofos was the most toxic against the larval stage of this predator, as shown by 93.8 for profenofos and 31.6 and 28.2 % for teflubenzuron and azadirachtin, respectively.

Table 8 indicated that, profenofos was the most potent compound against the population density of the adult *P. alfierii*. This compound reduced adult density by 88,5 and 87.4 % in the two seasons. However, teflubenzuron and azadirachtin caused the lowest toxic effects on the adult *P. alfierii*, their reduction percentages during the two studied seasons were 46.4 and 47.7 % (1999/2000) and 10.1 and 14.2 % (2000/2001), respectively.

In conclusion, the organophosphate compound, profenofos was the most harmful compound against the predators of *C. vittata* in sugar beet fields in comparison with teflubenzuron and azadirachtin. This compound was very effective in controlling *C. vittata,* but at the same time it was highly toxic to the associated predators. However, teflubenzuron and azadirachtin exhibited sufficient effectiveness (> 75 % in average) in controlling *C. vittata*, while showed the lowest toxic effects on the associated predators. It is coincide with many other studies on the repellents or insect growth regulators which caused different percentages of mortality and growth disturbing effects against many insects pests such as *Hyper poticae* (Oroumchi and Lorra, 1993). Repellents and insect growth regulators were also found less harmful against the natural enemies associated with many insects such as *Coccinella septempunctata* which was not influenced by topical application to their adult with neem seed kernel extracts. Moreover, there was no negative effect of Margosan-O in the predaceous carabid beetle *Platynus dorsalis* (Forster, 1991).

Table 7. Reduction percentages in *Chrysoperla carnea* larval population density after spraying with some insecticides on sugar beet plants at Kafr El-Sheikh Governorate during two successive seasons (1999/2000 and 2000/2001).

Insecticide	Rate/ fed.	Mean no. of larvae per 10 plants (% Reduction in infestation)*												
		1999/2000						2000/2001						**
		Before spray	Days after spray 2	5	10	15	Mean	Before spray	Days after spray 2	5	10	15	Mean	General mean
Profenofos (Profecron 72 % EC)	750 cc	30.0	0.5 (98.5)	2.5 (93.8)	3.2 (92.6)	3.7 (91.8)	(94.1)	28.5	0.7 (97.4)	1.5 (94.7)	2.2 (92.6)	3.0 (89.4)	(93.5)	(93.8) a
Teflubenzuron (Nomolt 15 % SC)	100 cc	22.5	20.5 (19.9)	17.5 (42.6)	16.0 (51.4)	15.2 (55.8)	(42.4)	30.5	27.7 (11.5)	26.5 (13.1)	23.7 (27.3)	20.7 (31.9)	(20.9)	(31.6) b
Azadirachtin (Sharachtin 1 % EC)	300 cc	23.2	21.2 (19.7)	20.5 (34.9)	78.2 (46.4)	16.7 (53.0)	(38.5)	34.5	33.2 (6.3)	31.0 (10.1)	27.5 (25.6)	24.2 (29.7)	(17.9)	(28.2) b
Control	- -	25.2	28.7	34.2	37.0	38.7	-	35.0	36.0	35.0	37.5	35.0	-	-

* The numbers in parentheses indicate the reduction percentages in the larval population density of *C. carnea*.

** Means followed by the same letter are not significantly different according to Duncan's multiple range test (F value = 39.1 at 5 % L.S.D. = 35.9 %).

Table 8. Reduction percentages in the population density of *Paederus alfierii* adults after spraying with some insecticides on sugar beet plants at Kafr El-Sheikh Governorate during two successive seasons (1999/2000 and 2000/2001).

Insecticide	Rate/ fed.	Mean no. of adults per 10 plants (% Reduction in infestation)*												
		1999/2000						2000/2001						* *
		Before	Days after spray					Before	Days after spray					General
		spray	2	5	10	15	Mean	spray	2	5	10	15	Mean	mean
Profenofos (Profecron 72 % EC)	750 cc	19.0	2.5 (90.7)	3.2 (88.8)	4.0 (87.7)	4.5 (87.0)	(88.5)	22.5	0.5 (97.7)	1.5 (93.3)	2.7 (88.9)	2.2 (90.0)	(92.4)	(90.4) a
Teflubenzuron (Nomolt 15 % SC)	100 cc	20.5	18.5 (36.3)	17.7 (43.4)	17.0 (51.8)	17.2 (54.1)	(46.4)	24.2	22.7 (3.4)	22.0 (9.2)	21.7 (18.6)	22.0 (9.2)	(10.1)	(28.2) b
Azadirachtin (Sharachtin 1 % EC)	300 cc	20.5	18.0 (38.0)	16.7 (46.6)	17.5 (50.4)	16.5 (56.1)	(47.7)	26.0	24.5 (3.0)	23.2 (10.5)	22.0 (23.2)	20.7 (20.1)	(14.2)	(30.9) b
Control	- -	19.7	28.0	30.2	34.0	36.2	-	26.7	26.0	26.7	29.5	26.7	-	-

* The numbers in parentheses indicate the reduction percentages in the population density of the adults *P. alfierii.*

** Means followed by the same letter are not significantly different according to Duncan's multiple range test (F value = 9.8 at 5 % L.S.D. = 8.3 %).

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النشاط البيولوجى لبعض المبيدات الحشرية ضد حشرة خنفساء البنجر السلحفائية وأعدائها الطبيعية فى حقول بنجر السكر

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تم تقييم فعالية أحد منظمات النمو الحشرية من مانعات الانسلاخ (تفلوبنزيورون) ومستخلص شجرة النيم (الأزاديرختين) ضد أطوار حشرة خنفساء البنجر السلحفائيه على محصول بنجر السكر بمحافظة كفر الشيخ خلال موسمين متتالين (١٩٩٩-٢٠٠١) مقارنة بأحد المركبات الفوسفورية وهو (البروفينوفوس) كمبيد قياسى ضد هذه الآفة .

أوضحت النتائج المتحصل عليها أن البروفينوفوس كان أكثر فعالية ضد هذه الافة تحت الظروف الحقلية ولكنه كان ضاراً جداً بأعدائها الطبيعية. أما مانع الانسلاخ (التفلوبنزيورون) ومانع التغذية (الآزاديراختين) فقد أظهرا فاعلية كافية كمركبات امنة بيئيا فى مكافحة هذه الآفة، وسمية منخفضة ضد أعدائها الحيويه.

وعموماً فإن هذه المركبات غير التقليدية يمكن إدخالها فى برنامج المكافحة المتكاملة ضد هذه الآفه مقبولاً بيئيا.