FIELD EVALUATION OF CERTAIN INSECTICIDES ON *PEGOMYA MIXTA* VILL. AND RELATED PREDATORS INHABITING SUGAR BEET FIELDS

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Abstract

The role of insecticides, profenofos, diazinon and thiamethoxam, was evaluated against *Pegomya mixta* infesting sugar beet plants at Kafr El-Sheikh Governorate during two successive seasons 1999/2000 and 2000/2001. The undesirable effect of these insecticides was estimated on certain associated predators, *Coccinella undecimpunctata, Chrysoperla carnea* and *Paederus alfierii.*

Diazinon demonstrates the highest toxic effect expressed as mortality percentage averages for the immature stages of *P. mixta*, after 15 days from treatment. The average of reduction percent was 80.9 % for the 1*st* and 81.3 % for the 2*nd* season, followed by profenofos (80.4 and 78.5 %). Thiamethoxam, however demonstrates the least averages (69.2 and 70.5 %).

On the other hand, diazinon and profenofos demonstrate the highest toxic figures to the related predators, where the reduction averages were 56.9 & 62.5 %, 64.9 & 63.9 % and 35.0 & 59.5 % for *C. undecimpunctata, Ch. carnea* and *P. alfierii* for the 1*st* and 2*nd* seasons, respectively. Thiamethoxam ranks next in this respect. The average reduction percentages were 27.7, 31.0 and 25.6 % for *C. undecimpunctata, Ch. carnea* and *P. alfierii*, respectively.

INTRODUCTION

The sugar beet fly, *Pegomya mixta* Vill., is the most destructive leaf miner infesting sugar beet plants in Egypt. *Pegomya* larvae eat a reliable part of the leaf blade, thus causing significant damage to sugar beet seedlings (Zarif and Hegazi, 1990). The importance of *Pegomya* spp. as a key insect pest of sugar beet plants has been emphasized in Egypt.The largest area of sugar beet cultivation are commonly occurred at Kafr El-Sheikh Governorate. These fields, plants are heavily attacked by the beet fly, therefore the present field investigations were carried out to evaluate the efficiency of three different insecticides on this insect pest and the harmful effect on its associated predators in the field.

MATERIALS AND METHODS

Sugar beet was planted on 31/9/1999 and on 10/10/2000 during 1999/2000 and 2000/2001 seasons, respectively, at El-Ryiadh, Kafr El-Sheikh Governorate. Three formulated insecticides were tested against the beet fly, *P. mixta* Vill. as follows :

1. **Profenofos** (Selecron 72 % EC) : O-4-bromo-2- chlorophenyl O-ethyl-S-propyl phosphorothioate, at the rate of 750 ml/feddan.

2. **Diazinon** (Diazinox 60 % EC) : O,O-diethyl O-2- isopropyl-6-methylpyrimidin-4-yl phosphorothioate, at the rate of 1 liter/feddan.

3. **Thiamethoxam** (Actara 25 % WG) : 3-(2-chloro-thiazol- 5-yl methyl)-5-methyl-[1, 3, 5] oxadiazinan-4-ylidene-N-nitroamine, at the rate of 40 g/feddan.

The insecticides used were sprayed in a complete randomized block design using knapsack sprayer (CP3). Four plots each of 84 m^2 received the same agricultural practices. Dates of application are shown in Tables (1-4).

Sampling procedure : Ten plants from each experimental plot were examined directly in the selected field before insecticidal application and after 2, 5, 10 and 15 days.

Reduction percentage averages as indicated by number of alive insect stages were determined according to Henderson and Tilton (1955) formula. Analysis of variance was calculated and means were grouped according to Student-Newman Keuls test.

RESULTS AND DISCUSSION

Data presented in Table 1 show that profenofos has highly significant effect in reducing the population density of *P. mixta* larvae. The reduction percentages were 96.5 and 95.4 % after 2 days from application during tested sugar beet growing seasons, respectively. This effect continued after 15 days of treatment, the general mean of reduction percentage was 91.6 % for the two successive seasons. A moderate initial effect was achieved on eggs of *P. mixta*, profenofos gave 74.3 and 71.1 %, whereas its residual effects were 65.7 and 68.8 % reduction in eggs population during 1999/2000 and 2000/2001, respectively.

The integration of the data in Table 1 reveal the side effect of profenofos on the associated predators of *P. mixta*. The obtained data showed that, profenofos exhibited high reduction percentage averages in the predator populations. The average reduction percentage in the larval and adult populations of *Coccinella undecimpunctata* were 69.8 & 69.2 % and 52.1 & 57.9 % during 1999/2000 and 2000/2001 seasons, respectively.

The data in Table 2 indicate that diazinon showed significant reduction in eggs and larval instars of *P. mixta* population density. The reduction percentage averages for eggs were 88.3, 85.5, 83.9 and 75.0 % and 86.2, 84.4, 82.6 and 71.7 % after 2, 5, 10 and 15 days of treatment during 1999/2000 and 2000/2001 seasons, respectively. The same trend was also observed when reduction in larval populations during the two tested seasons. Omar (1999) found that diazinon reduced the larval population of *P. mixta* by 79.68- 80.15 % 15 days after foliar application.

The toxic effect of diazinon on the predators are also shown in Table 2. The data showed that, diazinon reduced the larval population of *C. undecimpunctata* by 70.2 and 75.5 % after two days of application during 1999/2000 and 2000/2001 seasons, respectively. The reduction percentages were 67.4 % in 1999/2000 and 65.6 % in 2000/2001. Diazinon demonstrates less toxic effect against the adult individuals of *C. undecimpunctata*, the reduction percentages were 49.5 and 45.3 % during 1999/ 2000 and 2000/20001 seasons, respectively. The effect of diazinon on the larval population of *Ch. carnea* are also presented in Table 2. The data indicate that diazinon was harmful to the larvae of *Ch. carnea*, the reduction percentages in their population after 15 days after application was 75.6 % in 1999/2000 season and 65.9 % in 2000/2001 season. The adults of *P. alfierii* were more tolerant to the application of diazinon, which induced the lowest reduction percent in the population of *P. alfierii*, the mean percentages of reduction were 36.0 and 35.3 % during 1999/2000 and 2000/2001 seasons, respectively. Data in Table 3 show the initial and residual effects of thiamethoxam on the population of *P. mixta* and its associated predators on sugar beet during 1999/ 2000 and 2000/2001 seasons. The results indicate that the initial reduction on the eggs numbers of *P. mixta* was 72.2 % in 1999/2000 and 74.7 % in 2000/2001 season, while the reduction percent of the larval population was 94.1 % during 1999/ 2000 and 93.0 % during 2000/2001 season. The mean percent of reductions were

Table 1. Corrected reduction percentage averages of *Pegomya mixta* and related predators in sugar beet fields treated with profenofos (Kafr El-Sheikh Governorate during 1999/2000 and 2000/2001 seasons).

Insect species	Stage	No. of individuals/10 plants (% Reduction of infestation)											
		10/4/2000					15/4/2001						General mean
		Before spray	Days after spraying			Mean	Before spray	Days after spraying			Mean		
			2	5	10	15			2	5	10	15		
Pegomya mixta	Egg	192.5	49.5 (74.3)	59.0 (69.5)	68.3 (64.5)	87.3 (54.8)	(65.7)	198.3	57.0 (71.1)	59.5 (69.4)	62.8 (68.1)	66.0 (66.7)	(68.8)	(67.2)b
	Larva	154.8	5.3 (96.5)	6.3 (95.8)	7.8 (94.9)	10 (93.5)	(95.1)	166.8	7.6 (95.4)	18.5 (88.9)	23.6 (85.8)	28.3 (83)	(88.2)	(91.6)a
Coccinella undecimpunctata	Egg	26.5	7.5 (71.7)	8.7 (67.1)	9.8 (63.2)	5.9 (77.5)	(69.8)	28.0	7.3 (74.0)	7.8 (72.0)	8.6 (69.2)	10.7 (61.8)	(69.2)	(69.5)b
	Larva	24.3	8.5 (64.9)	9.8 (59.5)	13.5 (44.3)	14.6 (39.8)	(52.1)	29.5	10 (66)	11.3 (61.5)	13.2 (55.2)	15 (49.0)	(57.9)	(55.0)d
Chrysoperla carnea	Larva	32.3	10.8 (66.5)	10.6 (66.9)	12.7 (60.5)	14.5 (54.8)	(62.1)	35.2	8.1 (76.9)	12.2 (65.3)	13.5 (61.4)	17 (51.6)	(63.8)	(62.9)c
Paederus alfierii	Adult	29.0	9.5 (67.1)	11.3 (61.1)	11.7 (59.6)	13.3 (54.2)	(60.5)	30.5	10.6 (65.0)	12.5 (58.7)	12.7 (58.2)	14.5 (52.4)	(58.5)	(59.5)c

L.S.D. at 0.05 = 3.8.

Table 2. Corrected reduction percentage averages of *Pegomya mixta* and related predators in sugar beet fields treated with diazinon (Kafr El-Sheikh Governorate during 1999/2000 and 2000/2001 seasons).

Insect species	Stage	No. of individuals/10 plants (% Reduction of infestation)											General mean
		10/4/2000						15/4/2001					
		Before spray	Days after spraying				Mean	Before spray	Days after spraying				Mean	
			2	5	10	15			2	5	10	15		
Pegomya mixta	Egg	194.5	22.7 (88.30)	28.2 (85.50)	31.3 (83.90)	48.6 (75.00)	(83.10)	196.5	26.5 (86.20)	30.6 (84.40)	34.4 (82.60)	55.6 (71.70)	(81.20)	(82.1)a
	Larva	156.2	24.8 (84.10)	26.8 (82.80)	35.4 (77.30)	45.6 (71.00)	(78.80)	160.8	17.8 (88.90)	20.4 (87.30)	38.4 (76.10)	42.7 (73.40)	(81.40)	(80.1)a
Coccinella undecimpunctata	Egg	25.8	7.6 (70.20)	7.7 (70.10)	7.9 (69.40)	10.3 (60.00)	(67.40)	27.1	6.6 (75.50)	8 (70.30)	10.3 (61.80)	12.2 (54.90)	(65.60)	(66.5)b
	Larva	23.8	8.5 (64.00)	9.5 (59.70)	13.6 (42.70)	16.2 (31.60)	(69.50)	28.5	11 (61.30)	14.4 (49.20)	18 (37.20)	18.9 (33.50)	(45.30)	(47.4)c
Chrysoperla carnea	Larva	30.1	7.3 (75.60)	8.9 (70.10)	11.9 (60.30)	15 (50.00)	(64.00)	33.4	7.5 (77.40)	11.1 (66.60)	12.1 (63.70)	14.6 (56.00)	(65.90)	(64.9)b
Paederus alfierii	Adult	31.2	16.2 (48.00)	18.6 (40.10)	20.3 (34.90)	24.6 (21.10)	(36.00)	31.0	16.9 (45.20)	20.0 (35.30)	20.8 (32.60)	22.2 (28.40)	(35.30)	(35.6)d

L.S.D. at 0.05 = 2.2.

Table 3. Corrected reduction percentage averages of *Pegomya mixta* and related predators in sugar beet fields treated with thiamethoxam (Kafr El-Sheikh Governorate during 1999/2000 and 2000/2001 seasons).

Insect species	Stage	No. of individuals/10 plants (% Reduction of infestation)												
		10/4/2000						15/4/2001						General mean
		Before spray	Days after spraying				Mean	Before spray	Days after spraying				Mean	
			2	5	10	15			2	5	10	15		
Pegomya mixta	Egg	193.3	53.7 (72.2)	80.6 (58.3)	115.4 (40.3)	119.0 (38.4)	(52.3)	193.8	49.0 (74.7)	81.2 (58.1)	102.1 (47.3)	115.1 (40.6)	(55.1)	(53.7)b
	Larva	151.8	8.9 (94.1)	18.5 (87.8)	23.8 (84.3)	33.1 (78.2)	(86.1)	164.5	11.5 (93.0)	21.8 (86.7)	25.5 (84.5)	33.5 (79.6)	(85.9)	(86.0)a
Coccinella undecimpunctata	Egg	24.7	14.3 (41.8)	16.5 (33.1)	17.9 (27.4)	19.4 (21.3)	(30.9)	26.3	13.3 (49.4)	16.9 (35.4)	19.8 (24.7)	21.4 (18.5)	(32.0)	(31.4)c
	Larva	24	16.5 (31.1)	18.4 (23.0)	19.2 (19.8)	19.7 (17.6)	(22.8)	28.2	18.6 (33.7)	19.3 (31.4)	22.4 (20.5)	23.8 (15.3)	(25.2)	(24.0)d
Chrysoperla carnea	Larva	31.6	18.4 (41.5)	20.0 (36.5)	22.4 (28.9)	24.2 (23.2)	(32.5)	32.6	18.2 (43.9)	22.8 (30.0)	24.4 (25.1)	26.1 (19.7)	(29.6)	(31.0)c
Paederus alfierii	Adult	30.3	18.7 (38.0)	21.1 (30.1)	22.7 (24.9)	26.9 (11.1)	(26.0)	32.4	21.0 (35.2)	24.2 (25.3)	25.0 (22.6)	26.4 (18.4)	(25.3)	(25.6)d

L.S.D. at 0.05 = 1.8.

52.3, 55.1 % and 86.1, 85.9 % for egg and larval populations during 1999/2000 and 2000/2001 seasons, respectively.

After two weeks of thiamethoxam application on sugar beet plant, the means of reduction percentages were 30.9, 22.8, 32.5 and 26.0 % & 32.0, 25.2, 29.6 and 25.3 % for the larvae and adults of *C. undecimpunctata*, larvae of *Ch. carnea* and adults of *P. alfierii* during the seasons of 1999/2000 and 2000/2001, respectively.

Data presented in Table 4 show that diazinon has the highest significant effect in reducing the population density of *P. mixta* (eggs + larvae) after the two tested seasons, followed by profenofos and thiamethoxam. The general percentage reduction averages were 81.2, 78.3 and 68.1 %, respectively. On the other hand, profenofos demonstrates the highest significant toxic effect on the total predator individuals followed by diazinon. However, thiamethoxam is the least toxic compound in this respect. The general percentage averages were 61.9, 53.5 and 28.2 %, respectively.

From the foregoing results, it can be concluded that the organophosphates diazinon and profenofos demonstrate the highest toxic effect against *P. mixta* infesting sugar beet plants, but in contrary to that they showed strong toxic effect on the associated predator individuals. For thiamethoxam (neonicotinoid group), the case was the other way round i.e. a mild toxic effect on *P. mixta* and the related predators was achieved.

These findings were in harmony with that obtained by Vincinaux *et al.* (1992), Wauters (1993) and Mains *et al.* (1994) who mentioned that the nicotinoid insecticide (imidacloprid) tested as seed treatment for sugar beet demonstrated excellent systemic control for parameters *P. betae*. On the other hand, Schneider and Buess (1983) found that granular preparation containing 5 % carbosulfan (Marshal) was more effective against *P. betae*. But, larvae of *P. betae* were greatly reduced by the application of granular insecticides, carbofuran, carbosulfan, terbufos and aldicarb at the time of sowing. Band sprays of lindane, quinalphos and oxamyl were ineffective (Winder and Dunning, 1986). It is worth to mention out here that, Berim and Novikov (1983) stated that the insecticides applied to control sugar beet pests did not adversely affect the dominant carabid species, *Anisodactylus signatus, Pterostichus cupreus* and *Harplus rufipes*.

Table 4. Corrected reduction percentage averages of *Pegomya mixta* and total predators in sugar beet fields sprayed with insecticides (Kafr El-Sheikh Governorate during 1999/2000 and 2000/2001 seasons).

Insecticide	Insect species	No. of individuals/10 plants (% Reduction of infestation)											
		10/4/2000						15/4/2001					General mean
		Before spray	Days after spraying			Mean	Before spray	Days after spraying			Mean		
			2	5	10	15			2	5	10	15		
Profenofos	*P. mixta* (eggs + larvae)	347.3	54.8 (84.2)	65.3 (81.2)	76.1 (78.1)	97.3 (71.9)	(78.8)	365.1	64.6 (82.3)	78 (78.6)	86.4 (76.3)	94.3 (74.1)	(77.8)	(78.3)b
	Total predators	112.1	36.3 (67.6)	40.4 (63.9)	47.7 (57.4)	48.3 (56.9)	(61.4)	123.2	36 (70.7)	43.8 (64.4)	48 (61.0)	57.2 (53.5)	(62.4)	(61.9)d
Diazinon	*P. mixta* (eggs + larvae)	350.7	47.5 (86.4)	55 (84.3)	66.7 (80.9)	94.2 (73.1)	(81.1)	357.3	44.3 (87.6)	51 (85.7)	72.8 (79.6)	98.3 (72.4)	(81.3)	(81.2)a
	Total predators	110.9	39.6 (64.2)	44.7 (59.6)	53.7 (51.5)	66.1 (40.3)	(53.9)	120	42.0 (65.0)	53.5 (55.4)	61.2 (49.0)	67.9 (43.4)	(53.2)	(53.5)e
Thiamethoxam	*P. mixta* (eggs + larvae)	345.1	62.6 (81.8)	99.1 (71.2)	139.2 (59.6)	152.1 (55.9)	(67.1)	358.3	60.5 (83.1)	103 (71.2)	127.6 (64.3)	148.6 (58.5)	(69.2)	(68.1)c
	Total predators	110.6	67.9 (38.6)	76 (31.2)	82.2 (25.6)	90.2 (18.4)	(28.4)	119.5	71.1 (40.5)	83.2 (30.3)	91.6 (23.3)	97.7 (18.2)	(28.0)	(28.2)f

L.S.D at 0.05 = 1.00

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التقييم الحقلى لبعض المبيدات الحشرية على ذبابة البنجر والمفترسات المصاحبة لها فى حقول بنجر السكر

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تم تقييم ثلاث مبيدات حشرية؛ بروفينوفوس، ديازينون، ثياميثوكسام ضد ذبابة البنجر التى تصيب نباتات بنجر السكر فى محافظة كفر الشيخ خلال موسمين ١٩٩٩/٢٠٠٠ و ٢٠٠٠/٢٠٠١، وكذلك الأثر الجانبى لهذه المركبات على المفترسات المصاحبة لهذه الافة وهى أبوالعيد ذو الإحدى عشر نقطة، أسد المنّ والحشرة الرواغة.

كان مبيد ديازينون الأكثر كفاءة فى خفض تعداد الأطوار غير الكاملة لذبابة البنجر حيث بلغت النسبة المئوية للخفض فى تعداد هذه الافة بعد ١٥ يوما من الرش ٨٠,٩ ٪ فى موسم ١٩٩٩/٢٠٠٠ و ٨١,٣ ٪ فى موسم ٢٠٠٠/٢٠٠١ . تلاه فى الفعالية مبيد بروفينوفوس حيث أعطى نسبة خفض ٨٠,٤، ٧٨,٥ ٪ فى التعداد خلال ١٩٩٩/٢٠٠٠ و ٢٠٠٠/٢٠٠١ على التوالى. أما مبيد ثياميثوكسام فكان أقل تأثيراً فقد أعطى نسبة خفض فى التعداد ٦٩,٢ و ٧٠,٥ ٪ خلال ١٩٩٩/٢٠٠٠ و ٢٠٠٠/٢٠٠١ على التوالى.

من ناحية أخرى كان كلا من ديازينون و بروفينوفوس عاليا السمية على المفترسات، فبعد تجارب الموسمين ١٩٩٩/٢٠٠٠ و ٢٠٠٠/٢٠٠١ بلغت نسب الخفض فى تعداد المفترسات ٥٦,٩، ٦٢,٥ ٪ – ٦٤,٩، ٦٣,٩ ٪ – ٣٥,٠، ٥٩,٥ ٪ لكل من أبوالعيد ذو إحدى عشر نقطة وأسد المن والحشرة الرواغة على التوالى.

أما التأثير الجانبى لمبيد ثياميثوكسام فقد كان قليل السمية على المفترسات فقد أدى إلى خفض تعدادها بنسب ٢٧,٧، ٣١,٠، ٢٥,٦ ٪ لكل من أبوالعيد ذو إحدى عشر نقطة وأسد المنّ والحشرة الرواغة على التوالى.

كان مبيد ديازينون هو الأكثر كفاءة فى خفض تعداد الأطوار غير الكاملة (بيض + يرقات) لذبابة البنجر بعد موسمين متتاليين من التجريب، تبعه بروفينوفوس ثم ثياميثوكسام. كان المتوسط العام للنسب المئوية للخفض ٨١,٢، ٧٨,٣، ٦٨,١ ٪ على التوالى. من ناحية أخرى أظهر مبيد بروفينوفوس أعلى تأثير سام على مجموع المفترسات المصاحبة للافة يليه ديازينون. أما مبيد ثياميثوكسام فقد أظهر أقل تأثير سام عليها وكانت نسب الخفض ٦١,٩، ٥٣,٥، ٢٨,٢ ٪ على التوالى.