EFFECT OF DIFFERENT COMPOUNDS IN THE MANAGEMENT OF POTATO TUBER MOTH INFESTING POTATO AND TOMATO PLANTS

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Abstract

Comparative effectiveness of the tested compounds against 1st instar larvae of PTM infesting potato plants under greenhouse conditions showed that the tested compounds could be arranged descendingly according to their toxicity as follows : xentari, abamectin, profenofos, pirimiphos – methyl, Agerin, MVP II, Dipel 2x, Ecotech and Verotecto. The residual effect of tested compounds against Potato Tuber moth (PTM) infesting potato plants indicated that all tested bio – compounds gave 100% mortality as initial effect . The tested insecticides could be arranged descendingly by relative toxicity, as follows:xentari, abamectin, profenofos, pirimiphos–methyl, Agerin, MVP II, Dipel 2x, Ecotech and Verotecto. While on tomato plants, the results indicated that all tested bio – compounds gave 100% mortality as initial effect. The data indicated that xentari, profenofos and abamectin were the most toxic to 1st instar larvae of PTM, pirimiphos – methyl, MVP II and Agerin had a moderate toxic effect, while Dipel 2x, Ecotech and Verotecto were the least toxic to PTM larvae. Under field conditions, abamectin gave the highest residual half – life (RL_{50}) value followed by profenofos and xentari . The lowest results were obtained with Agerin, Dipel 2x, Ecotech and Verotecto, on potato plants. While on tomato plants, abamectin, profenofos, pirimiphos – methyl, xentari and Agerin gave full initial kill of 100%. The tested insecticides could be arranged descendingly according to their effect as follows : abamectin, profenofos, pirimiphos – methyl, xentari, Agerin, MVP II, Verotecto.

INTRODUCTION

Potato could be an important crop to solve the international food problem. It can be cultivated in 2 – 3 seasons in the same year, and also be cultivated in various soil and weather conditions. It is also rich in the main nutritive components of the Human diet. PTM is a difficult pest to control because the timing of application is critical for ensuring that newly hatched larvae are killed before they penetrate leaf tissue or tunnel into tubers. The bio-insecticides, *Bacillus thuringienssis (Bt.)* and granulosis virus(GV) , have been used for the control of Lepidopterous pests for many years.

This study focused on the evaluation of the efficiency of bio – compounds under greenhouse and field conditions, against *P. operculella.*

MATERIALS AND METHODS

Greenhouse experiments:

Potato, variety Draga, and tomato, variety Super streen B, were planted on the 15th of November and 1st of February 1998, respectively, under greenhouse conditions at the Central Pesticides Laboratory ARC , Ministry of Agriculture , Egypt . Day time green house temperature ranged from 18 °C to 25 °C . Single plant , planted in forty- five pots 50 cm in diameter and 60 cm high (5 replicates x 9 times) , was treated after 35 days with the recommended concentrations of profenofos 72% EC (750 ml / fed.) , pirimiphos – methyl 50% EC (375 ml / fed.) , abamectin 1.8% EC (60 ml / fed.) , Verotecto 4% ai (300 g / fed.) , xentari 10.3% water dispersible granule (240 g / fed.) , Agerin 6.5% w/w (200 g / fed.) , Dipel 2x 6.4% (200 g / fed.) , Ecotech 10% (300 g / fed.) and MVP II 20% aqueous flowble (1000 ml / fed.) were applied using a knapsack low volume sprayer. Each potato or tomato plant was infested with 10 1st instar larvae at intervals 0,1,3,6,9,12,17,20 and 27 days after treatment and untreated plants were each infested with 10 1st instars . The plants were left for 5 days after infestation, until , the larvae had reached the second instar inside the leaves .The leaflets were examined using a binocular microscope, and the total number of larvae were recorded.

Field experiments:

Two experiments were carried out in El-Santa, Gharabeya Governorate during two successive summer seasons, 1999, and 2000. An area of two feddans was divided into 10 plots, each divided into 4 replicates and cultivated with Draga potato variety on the 15th of January 1999, and with super streen B (VF 145 B 7879) tomato variety on the 15th of February 2000. The experiments included 9 different treatments with the tested compounds (profenofos, pirimiphos – methyl, abamectin, Verotecto, xentari, Agerin, dipel 2X, Ecotech. and MVP II). A completely randomized design was applied for each treatment including the control. The levels of infestation by *P. operculella* in the treatments were measured after one week, from samples of 100 leaves picked at random from each replicate and intervals of 0,1,3,6,9,12,17,20, and 27 days after treatment and examined in the laboratory. The number of larvae within the 100 leaves was determined and recorded.

RESULTS AND DISCUSSION

Preliminary experiments were carried out in greenhouse to evaluate the candidate products before testing in the field. The potato and tomato plants were tested after 35 days with each tested compound. The mortalities were estimated five days following exposure of 1st instar larvae to treated plants.

1- The residual effect of tested compounds against PTM infesting potato and tomato plants- in greenhouse :

*** On potato plants:**

The initial and residual effects of tested compounds against the 1st instar larvae of *P.operculella* infesting potato plants are shown in table 1. All tested bio-compounds and insecticides gave 100% mortality as initial effect. xentari had the highest RL_{50} value of 36.99 days indicating long persistence and higher toxicity against PTM followed by abamectin, profenofos and pirimiphos-methyl which gave RL_{50}s of 32.20, 31.93 and 28.45 days, respectively. Lower persistence were achieved with Agerin, MVP II, Dipel 2x, Ecotech and Verotecto, where the RL_{50}s were 21.99, 20.30, 16.88, 12.85 and 9.95 days, respectively. Abdel-Megead *et al.* (1998) found that abamectin was the most effective compound against *P.operculella* followed by profenofos , *Bacillus tharingiensis* and Granulosis virus, respectively. Bekheit *et al.* (1997) indicated that *Bt.* and GV. applications reduced the percentage of infestation and number of PTM larvae.

*** On tomato plants:**

The corrected percentage of mortality for 1st instar larvae infested tomato plants treated with the tested bio-compounds in greenhouse are shown in table 2 . All tested compounds gave 100% mortality as initial effect . xentari gave the highest RL_{50} value of 39.11 days indicating long persistence and high toxicity against PTM followed by profenofos, abamectin, pirimiphos-methyl, MVP II and Agerin . The least effect was achieved with Dipel 2x, Ecotech and Verotacto, where the RL_{50}s were 15.85, 14.04 and 10.61 days, respectively.

2. Field evaluation of tested compounds against *P. operculella* on potato and tomato crops:

The following field experiments were carried out to study the effect of the application of the tested bio-insecticides against PTM larvae infesting potato and tomato plants under field conditions. The control effects of the compounds against PTM larvae infesting potato plants are shown in Table 3.

Abamectin gave the highest RL_{50} value of 24.28 days indicating long persistence and high toxicity against PTM followed by profenofos, xentari and pirimiphos-methyl, which gave RL_{50}s of 23.96, 22.53 and 19.45 days, respectively. The lowest results were obtained with Agerin, MVP II, Dipel 2x, Ecotech and Verotecto, where the RL_{50}s were 15.56, 13.53, 10.66, 9.53 and 7.45 days, respectively. The initial and residual effects of tested compounds against PTM infesting tomato plants in the field are shown in table 4. The percentage mortality of PTM after treatment with insecticides showed that abamectin, profenofos, pirimiphos-methyl, xentari and Agerin gave full initial kills of 100 % followed by Verotecto, Dipel 2x, MVP II and Ecotech characterized by strong initial kills of 98.00, 96.00, 93.75 and 93.75 respectively. The data also indicated that abamectin caused the most pronounced deleterious effect on PTM. It has a long residual effect and is more potent than other tested insecticide with an RL_{50} value of 25.94 days followed by profenofos, pirimiphos-methyl, xentari, Agerin and MVP II with RL_{50}s of 23.92, 21.65, 20.71, 16.82 and 14.39 days, respectively. Verotecto, Dipel 2x and Ecotech were the least effective in this respect, giving RL_{50} values of 9.16, 8.39 and 7.82 days, respectively . The Granulosis virus was found to be effective in the field in Western Australia (Reed, 1964, 1971a and 1971b) . Mathiessen *et al.* (1978) isolated the virus and tested its effectiveness in the field . A baculovirus collected in Peru was also effective in reducing PTM infestation (Raman, 1989). Raman and Alcazar (1988) also used a Granulosis virus for PTM control in Peru. The tomato looper might be effectively controlled with *Bacillus thuringiensis* preliminary bioassays have indicated that *Bacillus thuringiensis ssp.* Kurestaki controlled potato tuber worm larvae despite the fact that they hid in tunnels within the tomato leaves (Broza and Sneh, 1994). Baculoviruses are valuable natural control agents , but their utility in many agricultural applications has been limited by their slow speed of kill, narrow host specificity and instability in the field (Inceoglu *et al.* , 2001) .

It may be concluded that the use of biocides are highly specific for PTM . Field experiments showed that abamectin gave the highest RL_{50} value indicating long presistence and high toxicity against PTM infesting potato and tomato plants followed by xentari . The lowest results were obtained with Agerin, MVP II , Dipel 2x , Ecotech and Verotecto .

Table 1 . Initial and residual effect of tested compounds against *p. operculella* infesting potato plants in greenhouse.

Treatments	Concentration per fed.	Percentage mortality at indicated days after application									RL_{50} days
		0	1	3	6	9	12	17	20	27	
Profenofos 72% EC	750 ml	100	100	100	100	94.59	87.18	78.95	73.17	57.15	31.93
Pirimiphos – methyl 50% EC	375 ml	100	100	100	100	89.20	76.92	71.05	65.85	51.43	28.45
Abamectin 1.8% EC	60 ml	100	100	100	100	97.30	92.31	84.21	78.05	57.15	32.20
Verotecto 4% a.i.	300 g	100	100	80.00	69.23	54.05	48.72	47.37	39.02	05.71	9.95
Xentari 10.3% a.i.	240 g	100	100	100.00	100	94.59	93.59	86.84	78.05	60.00	36.99
Agerin 6.5% w/w	200 g	100	100	96.25	87.18	75.68	74.36	63.16	58.54	34.29	21.99
Dipel 2x 6.4% a.i.	200 g	100	100	93.75	74.36	64.86	64.10	55.26	51.22	20.00	16.88
Ecotech 10% a.i.	300 g	100	100	87.50	69.23	61.54	59.46	52.63	43.90	17.14	12.85
MVP II 20% a.i.	1000 ml	100	100	93.75	82.05	67.57	66.67	60.53	53.66	28.57	20.30

RL_{50} = Residual half – life

Table 2 . The effect of tested compounds against *p. operculella* infesting tomato plants in greenhouse .

Treatments	Concen-tration per fed.	Percentage mortality at indicated days after application									RL_{50} days
		0	1	3	6	9	12	17	20	27	
Profenofos 72% EC	750 ml	100	100	100	100	100	100	92.50	79.49	61.11	29.27
Pirimiphos – methyl 50% EC	375 ml	100	100	100	100	91.89	86.11	70.00	58.98	47.22	24.84
Abamectin 1.8% EC	60 ml	100	100	100	100	100	100	97.50	87.18	61.11	28.66
Verotecto 4% a.i.	300 g	100	100	92.31	77.50	62.16	52.78	40.00	25.64	2.78	10.61
Xentari 10.3% a.i.	240 g	100	100	100	100	91.89	87.50	78.21	70.00	65.28	39.11
Agerin 6.5% w/w	200 g	100	100	100	90.00	75.68	66.67	55.00	43.59	33.33	17.97
Dipel 2x 6.4% a.i.	200 g	100	100	97.44	87.50	75.68	61.11	50.00	35.90	27.78	15.85
Ecotech 10% a.i.	300 g	100	100	97.44	85.00	70.27	61.11	45.00	33.33	16.67	14.04
MVP II 20% a.i.	1000 ml	100	100	100	95.00	86.49	77.78	62.50	51.28	36.11	20.83

RL_{50} = Residual half - life

Table 3. Initial and residual effect of tested compounds against. *operculella* infesting potato plants in the field .

Treatments	Concen-tration per fed.	Percentage mortality at indicated days after application									RL_{50} days
		0	1	3	6	9	12	17	20	27	
Profenofos 72% EC	750 ml	100	100	100	100	92.43	84.38	70.25	60.20	43.12	23.96
Pirimiphos – methyl 50% EC	375 ml	100	100	100	90.69	88.63	62.51	55.70	45.81	38.31	19.45
Abamectin 1.8% EC	60 ml	100	100	100	100	92.21	90.11	76.05	55.15	45.15	24.28
Verotecto 4% a.i.	300 g	100	100	69.00	60.22	45.64	39.66	35.27	30.00	4.22	7.45
Xentari 10.3% a.i.	240 g	100	100	100	91.51	90.22	73.62	68.62	49.44	40.63	22.53
Agerin 6.5% w/w	200 g	100	100	87.19	80.22	70.15	60.39	55.00	35.45	30.30	15.56
Dipel 2x 6.4% a.i.	200 g	100	100	81.42	70.41	52.32	50.00	45.09	29.46	16.87	10.66
Ecotech 10% a.i.	300 g	100	100	75.68	61.21	50.93	48.81	45.63	32.22	13.20	9.53
MVP II 20% a.i.	1000 ml	100	100	86.83	80.81	60.94	55.65	51.40	31.33	24.39	13.53

RL_{50} = Residual half - life

Table 4 . Initial and residual effect of tested compounds against. *operculella* infesting tomato plants in the field .

Treatments	Concen-tration per fed.	Percentage mortality at indicated days after application									RL_{50} days
		0	1	3	6	9	12	17	20	27	
Profenofos 72% EC	750 ml	100	100	100	100	100	100	83.33	68.42	36.11	23.92
Pirimiphos – methyl 50% EC	375 ml	100	100	100	97.14	90.75	82.18	70.00	57.53	30.56	21.65
Abamectin 1.8% EC	60 ml	100	100	100	100	100	100	88.89	73.68	47.28	25.94
Verotecto 4% a.i.	300 g	98.00	96.87	86.47	60.00	50.00	40.86	30.22	28.37	13.89	9.16
Xentari 10.3% a.i.	240 g	100	100	96.77	91.43	90.62	83.78	69.44	57.89	19.44	20.71
Agerin 6.5% w/w	200 g	100	96.87	90.55	87.43	80.37	66.68	50.33	45.26	19.44	16.82
Dipel 2x 6.4% a.i.	200 g	96.00	93.75	80.10	60.00	48.62	40.86	28.26	26.74	11.11	8.39
Ecotech 10% a.i.	300 g	93.75	92.00	75.42	57.14	48.00	40.65	36.33	33.84	5.56	7.82
MVP II 20% a.i.	1000 ml	93.75	92.00	83.87	62.71	50.00	45.05	41.67	36.84	11.11	14.39

RL_{50} = Residual half - life

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تقييم فاعلية مركبات مختلفة للسيطرة على فراشة درنات البطاطس التى تصيب نباتات البطاطس والطماطم

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إختبارات الصوبة الزجاجية : –

* بدراسة طوال فترة تأثير المركبات المختبرة على نباتي البطاطس والطماطم داخل الصوبة بحساب فترة نصف عمر المتبقيات أمكن ترتيب المركبات تنازلياً كما يلى : الزنتارى – الفيرتيمك – بروفينوفوس – بريمفوس ميثايل – الأجرين – إم فى بي تو – دايبل ٢إكس – إيكوتيك – ثم الفيروتيكتو... عند معاملتها على نبات البطاطس.

بينما أمكن ترتيبها تنازليا عند معاملتها على نبات الطماطم كما يلى :– الفيرتيمك– السيليكرون – الزنتارى – الأكتيلك – إم فى بى تو – أجرين – دايبل ٢إكس – إيكوتيك – فيروتيكتو.

الاختبارات الحقلية : –

أوضحت النتائج الحقلية ما يلى :–

١– استخدام المركبات المختبرة لمكافحة فراشة درنات البطاطس على محصول البطاطس أمكن ترتيبها تنازليا كما يلى :– فيرتيمك – سيليكرون – زنتارى – أكتيلك – أجرين – إم في بي تو – دايبل ٢إكس – إيكوتيك – فيروتيكتو – بقيم فترة نصف عمر ٢٤,٢٨ ، ٢٣,٩٦ ، ٢٢,٥٣ ، ١٩,٤٥ ، ١٥,٥٦ ، ١٣,٥٣ ، ١٠,٦٦ ، ٩,٥٣ ، ٧,٤٥ يوم على الترتيب .

٢– عند معاملة نبات الطماطم حقليا بالمركبات المختبرة لمكافحة فراشة درنات البطاطس كان الترتيب تنازليا كما يلى :– فيرتيمك – سيليكرون – أكتيلك – زنتارى – أجرين – إم في بي تو – فيروتيكتو – دايبل ٢إكس – إيكوتيك – حيث كانت قيم فترة نصف عمر كما يلى :– ٢٥,٩٤ ، ٢٣,٩٢ ، ٢١,٦٥ ، ٢٠,٧١ ، ١٦,٨٢ ، ١٤,٣٩ ، ٩,١٦ ، ٨,٣٩ ، ٧,٨٢ يوماً على الترتيب .