Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo, 13(3), 989 - 996, 2005

DISSIPATION RATE OF CERTAIN INSECTICIDES ON TOMATO PLANTS AND THEIR BIORESIDUAL ACTIVITIES AGAINST *SPODOPTERA littoralis* (BOISD.)

[67]

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ABSTRACT

Field trials were conducted at El-Gharbia governorate to determine the insecticidal activities of chlorpyrifos-methyl, profenofos and methomyl on tomato plants against the cotton leaf-worm (*Spodotera littoralis*). Data showed the high initial mortality (100, 100 and 100%) against the second and the fourth instars larvae with reasonable persistence. The residues of these insecticides on fruits of the sprayed and contaminated tomato plants were determined by GLC and HPLC, with recoveries of 100, 100 and 94.58%, respectively. The initial deposits of chlorpyrifos-methyl, profenofos and methomyl were 2.10, 2.58 and 20.11ppm, while decreased to 0.19, 1.41 and 0.33ppm after 3,1 and 13 days from spraying, respectively, such residue levels are below the maximum residue level (MRL). The estimated half-life values ($t_{0.5}$) were 0.4898, 1.026 and 1.1867 days for the same insecticides, respectively.

Key words: Insecticides, Cotton leaf-worm, Chlorpyrifos-methyl, Profenofos, Methomyl, Residues, Tomota plants

INTRODUCTION

The cotton leaf-worm, *Spodoptera littoralis* (Boisd) is one of the most important insect pests in Egypt. It attacks cotton, vegetable and ornamentals. Many farmers are using the organophosphorus (chlorpyrifos-methyl & profenofos) and the carbamate methomyl to control this serious pest (**Tomlin, 2000**). Tomato (*Lycopersicon esculentum*) is considered to be an important among fresh eaten crops.

The present study was undertaken to determine the insecticidal effectiveness of two organophosphates and one carbamate insecticides against this pest. Also the residues behaviour of the sprayed compounds on tomato fruits by the lapse of time was studied to clarify the pre-harvest intervals (PHI's) to avoid health hazards. The residual behavior of pesticides was studied by several researchers i.e. **Abd el-Rahman (2005), Abd El-Allem *et al* (2004), Hegazy *et al* (2004), Nasr and Hegazy (2003), El - Hadidi (2000) and Hegazy *et al* (1997).**

1- Central Agricultural Pesticides Laboratory, Agricultural Research Center, Dokki, Giza, Egypt

(Received June 14, 2005)
(Accepted June 25, 2005)

Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo, 13(3), 989 - 996, 2005

MATERIAL AND METHODS

Field experiment

Tomato was planted on Feb 5th 2005 under the normal field conditions at Manshat Gansour, Tanta, El-Gharbia governorate. Three plots were sprayed on tomato fruit stage on 2nd april 2005 at the recommended rate of the studied insecticides, i.e. chlorpyrifos-metlyl (reldan 50% EC 250cm^3/100L H_2O), profenofos (selecron 72% EC 187.5cm^3/100L H_2O) and methomyl (lannate 90% SP 75gm/100L H_2O). The fourth plot was left untreated as control. Spraying of insecticide was done by using a knapsack sprayer equipped with one nozzle.

Bioresidual activity

Samples of tomato leaves were collected at 2hr (initial) and then after 1, 3, 6, 9, 13, 16 and 21 days from spraying. The bioresidual efficiency of the tested insecticides was evaluated on laboratory strain of *S. littoralis*. Ten larvae of each 2nd and 4th instars were allowed to feed on treated tomato leaves in a clean glass Jar. Three replicates were used at each interval. The same was done with the untreated control. The mortality of larvae was counted and recorded 24 hrs later after feeding and corrected for natural mortality by using **Abbot's formula (1925)**. (The average percent mortality of the two tested instars was used as the parameter indicating the bioresidual activity (persistence) of chlorpyrifos-methyl, profenofos and methomyl throughout the experimental period).

Fruit Sampling for residue analysis

Samples of tomato fruits of 1000 g/plot were taken in random. Three subsamples (replicates) of 100g each were prepared and kept in polyethylene bags at deep freezer at -20°C till insecticides residue analysis.

Extraction and clean up

The organophosphate insecticides chlorpyrifos-methyl and profenofos were extracted and cleaned-up according to the methods that adopted by **Hegazy *et al* (1997) and Nasr and Hegazy (2003).** On the other hand, the method of **El-Hadidi (2000)** was used for extraction and clean up of the carbamate methomyl from tomato fruits.

Determination

Chlorpyrifos-methyl and profenofos residues were determined by using Heweltt Packard 6890 gas chromatograph equipped with Flame Photometric detector (FPD) (p-mode), column PAS-1701 (30mx 0.32 mmx 0.25μm). Temperature programming was adjusted under the following conditions: injection 240^{0}C, column 230^{0}C and detector 250^{0}C. The carrier gas was nitrogen at a flow rate 4ml/min, hydrogen at 75ml/min and air at 100ml/min. Using these conditions, the retention times (Rt's)

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(Received June 14, 2005)
(Accepted June 25, 2005)

values were 3.66 and 2.01 min, respectively.

Methomyl residues were determined by using HPLC equipped with a UV detector, set at 254nm. C18 (Zorba SB 5µm) Column was used. The mobile phase was freshly prepared as a mixture of acetonitrile/water (70:30) with the flow rate of 1 ml/min. Under these operating conditions, the retention time of methomyl was 3.65min.

Kinetic study

In order to calculate the rate of degradation (k) of the three tested insecticides and determine the half-life periods ($t_{0.5}$'s) on tomato fruits, the equation of **Moye *et al* (1987)** was followed.

RESULTS AND DISCUSSION

a) Bioresidual activities of the tested insecticides

Data in Table (1) showed that the second and fourth instar larvae of *S. littoralis* were highly susceptible to chlorpyrifos-methyl and profenofos showing 100% mortality within the time intervals of 0, 1 and 3 days after spraying. The mortality of larvae started to decline after 6 days to reach 82.5 & 97.5%, respectively. By the prolongation of post application, the average of mortality percent for chlorpyrifos-methyl and profenofos had declined gradually to be 39 & 88.5%; 22.5 & 54.25% and 12.5 & 17.5% after 9, 13 and 16 days from spraying, respectively. No larval mortality was recorded after 21 days from spraying.

Data also indicated that profenofos was the highly toxic compound against both the 2nd and the 4th larval instars, achieving 100 and 95% mortality after six days from spraying, whereas chlorpyrifos - methyl caused 85 and 80% mortality at the same time interval.

The carbamate methomyl achieved 100% kill as initial against both instars of *S. littoralis* larvae. Such efficacy was continued against the two instars, showing 100 and 91.25% mortality after 1 and 3 days from application, respectively. By the progression of time, methomyl activity started to decline gradually and disappeared completely after 21 days (0-mortality).

Figure (1) showed that profenofos achieved the highest $t_{0.5}$ (time elapsed to achieve 50% mortality) among the tested insecticides (14.3 days) followed by methomyl (10.25 days) and chlorpyrifos-methyl (8.15).

Our results are in agreement with those obtained by **Abd-Allah (1998)** who reported that chlorpyrifos-methyl had the highest toxicity to *S. littoralis*. **El-Dahan (1991)** found that methomyl was less potent than organophosphorus compounds against *S. littoralis*. **Mourad *et al* (1991)** reportd that different organophosphorus were more toxic than carbamate insecticides based on residual activity. The same trend of results was found by **Bayoumi *et al* (2003)** who found that chlorpyrifos-methyl was the most effective pesticides towards *S. littoralis larvae* followed by methomyl. **Watson *et al* (1982) and Abdallah & Shams El-Dine (1991)** were obtained almost same performance of insecticides against the cotton leaf-worm larvae.

b) Residues of the tested insecticides

Data in Table (2) indicated the initial deposits and residues of chlorpyrifos-methyl, profenofos and methomyl insecticides on tomato fruits. The obtained results showed that chlorpyrifos-methyl was found in the lowest levels of residue (0.03 ppm) followed by profenofos (0.22 ppm) and methomyl (0.33ppm) after 13 days from spraying. The three insecticides were completely disappeared by the end of experiment (21 days).

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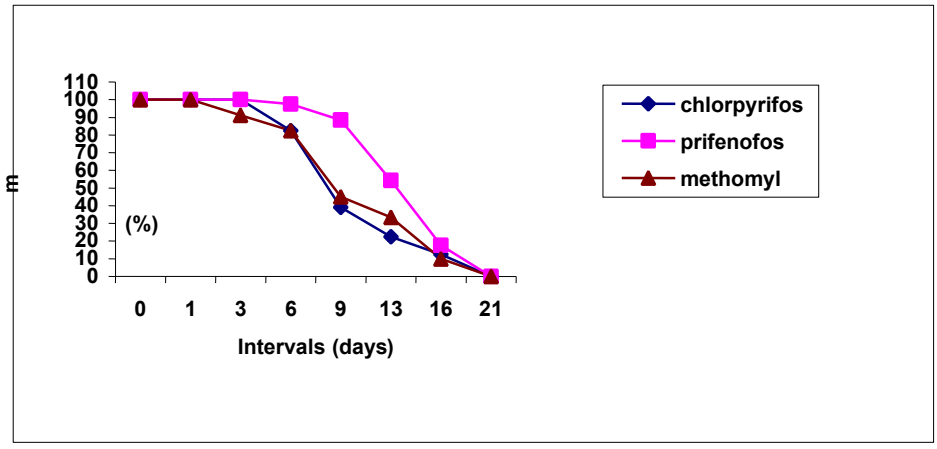
Table 1. Bioresidual activities of chlorpytifos-methyl, profenofos, and methomyl on tomato plants against 2nd and 4th instars of *S.littorallis* larvae

Intervals (days)	% Corrected mortality								
	Chlorpyrilos-methyl			Profenofos			Methomyl		
	2nd	4th	Average	2nd	4th	Average	2nd	4th	Average
Initial (2hr)	100	100	100	100	100	100	100	100	100
1	100	100	100	100	100	100	100	100	100
3	100	100	100	100	100	100	95	87.5	91.25
6	85	80	82.5	100	95	97.5	85	80	82.5
9	43	35	39	90	87	88.5	56	52	45
13	25	20	22.5	58.5	50	54.25	35	32	33.5
16	15	10	12.5	20	15	17.5	10	10	10
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$t_{0.5}$	8.15			14.30			10.25		



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(Received June 14, 2005)
(Accepted June 25, 2005)

Fig. 1. Bioesidual activities of Chlorpyrifos-methyl, profenofos and methomyl against *S. littoralis*

Table 2. Residues of chlorpyrifos-methyl, profenofos and methomyl on tomato fruits at different time intervals

Intervals (days)	Chlorpyrilos-methyl		Profenolos		Methomyl	
	Residues (ppm)	% loss	Residues (ppm)	% loss	Residues (ppm)	% loss
Initial (2hr)	2.10	00.0	2.58	0.00	20.11	0.00
1	0.74	64.77	1.41	45.35	14.98	25.21
3	0.19	90.96	0.91	64.73	10.01	50.23
6	0.10	95.24	0.61	76.36	5.91	70.62
9	0.06	97.15	0.54	79.07	1.85	90.80
13	0.03	98.58	0.22	91.48	0.33	98.36
16	UND	100.00	0.09	96.52	0.01	99.50
21	UND	100.00	UND	100.00	UND	100.00
MRL	0.5		2		1	
k	1.4151		0.6753		0.5841	
$t_{0.5}$	0.4898		1.026		1.1867	

Initial : (Two hours after application)
UND : Undetectable
MRL : Maximum residue level
k : Rate of degradation
$t_{0.5}$: Half-life period

The initial deposits (0-time) of chlorpyrifos-methyl, profenofos and methomyl were 2.10, 2.58 and 20.11 ppm, while decreased to 0.19, 0.91 and 10.01 ppm, respectively, after three days from application. This indicates that chlorpyrifos-methyl showed the most degradation behaviour (90.96%), followed by profenofos (64.73%) and methomyl (50.23%) within this period. The variation in the degradation may be attributed to the insecticide type, applied rate, time after treatment,…etc. **El-Sayed *et al* (1976)**, stated that the amounts of deposits depended on the rate of application, the nature of the treated

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surface and the relation between the treated surface and its weight. **Gennari *et al* (1985),** also reported that the degradation was very dependent on climate factors including sunlight and daily temperature fluctuations.

According to **CODEX (2003),** the maximum residue levels of chlorpyrifos-methyl and profenofos on tomato fruits were 0.5 and 2.0 ppm, respectively, this indicates that only 3 and 1 days, respectively were enough for reaching the safe level for harvesting tomato after spraying by these two organophosphorus insecticides. But methomyl should be collected 13 days after treatment due to its high residues and MRL (1ppm).

The rate of degradation (k) of chlorpyrifos-methyl, profenofos and methomyl were 1.4151, 0.6753 and 0.5841 days, respectively, and the calculated residue half-lives ($t_{0.5}$) were 0.4898, 1.026 and 1.1867 days, respectively.

Such results are in agreement with that reported by **Hegazy *et al* (1997)** who found that only three days was enough for the chlorpyrifos-methyl residues to reach a safe level less than the MRL of the **CODEX (1993)** (0.5 ppm).

Nasr and Hegazy (2003) indicated that profenofos residues on and in tomato fruits decreased from 2.45 ppm to reach 0.19 ppm after 15 days post-treatment revealing total loss of 92.24% of the initial deposits. The data further showed that the half-life $t_{0.5}$ of profenofos was 23 hours.

Sahoo *et al* (2004) reported that the use of profenofos at the minimum effective dosages does not seem to cause any hazards to the consumers if waiting periods of 3 days is followed. Moreover, the consumer can further reduce the risk by washing the treated tomato fruits thoroughly with plain water before consumption. **Gil Garcia *et al* (1997)**, stated that climatic conditions (growing season) and temperature are important in methomyl degradation. Similar findings were obtained by many investigators, **Abd El-Rahman (2005), Abd El-Allem *et al* (2004), and Hegazy *et al* (2004)**.

As conclusion, it's more efficient to spray chlorpyrifos-methyl and profenofos for their low residues and lower preharvest intervals.

From the present work we should be pointed out that it is necessary to use safely and highly effective insecticides in controlling S. littoralis larvae which feed on tomato plant leaves to insure good yield of tomato fruits and safety to human being.

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Arab Univ. J. Agric. Sci., Ain Shams Univ., Cairo, 13(3), 989 - 996, 2005

مجلة اتحاد الجامعات العربية للدراسات والبحوث الزراعية، جامعة عين شمس، القاهرة 13(3)، 989 - 996، 2005

معدل تدهور بعض المبيدات الحشرية على نباتات الطماطم ونشاطها الحيوى ضد دودة ورق القطن

[67]

نيفين الصيفي أحمد[1] - أمل أحمد حسنين

1- المعمل المركزي للمبيدات - مركز البحوث الزراعية - الدقي - الجيزة - مصر

أجريت تجربة حقلية في محافظة الغربية 100 , 94.58% على التوالي أظهر لتقدير الفعل الابادى لمبيدات التحليل المتبقي لها ولمبيدات الكلوربيريفوس ميثيل والبروفينوفوس الكلوربيريفوس ميثيل البروفينوفوس والميثوميل على دودة ورق القطن أظهرت والميثوميل للطماطم 2.1 , 2.58 , 20.11 هذه المبيدات سببت موت ابتدائي عالية جزء في المليون قد انخفض الى 0.19 , درجات ثبات مقبولة. كذلك تم تقدير 1.11 , 0.33 جزء في المليون عند 3 و 1 المتبقيات في ثمار الطماطم نتائج رش نباتات و 13 يوم من الرش على التوالي. هذه الطماطم باستخدام الكروماتوجرافي الغازى القيم تحت الحد الآمن للحد الأقصى السائل (GLC) والكروماتوجرافي السائل عالي الكفاءة للمتبقيات (MRL). أظهرت النتائج فائق الدقة (HPLC). كذلك فإن نصف فترة الحياة 0.4898 ،

أظهرت النتائج أن النسبة المئوية 1.026 ، 1.1867 يوم لمبيدات الاسترجاع لمبيدات الكلوربيريفوس ميثيل الكلوربيريفوس ميثيل البروفينوفوس والبروفينوفوس والميثوميل 100 , على التوالي الميثوميل

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(Received June 14, 2005)
(Accepted June 25, 2005)