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PERSISTENCE OF DIAZINON AND PIRIMIPHOS-METHYL RESIDUES IN SUGAR-BEET PLANTS AND SOIL

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Abstract

Research was carried out to investigate the residual persistence of the organophosphates,diazinon and pirimiphos-methyl on sugar-beet plants (vegetative parts and roots) and the contamination of soil with these chemicals under the treated plants. The residue half-life values (RL50) determined on vegetative parts and soil reached 14.86 and 47.53 hours for diazinon and 12.05 and 59.41 hours for pirimiphos-methyl, respectively.

In the vegetative parts, the initial amount detected for diazinon (4.93 ppm) was less than the initial amount detected for pirimiphos-methyl (10.54 ppm). The initial concentration was not detected in sugar-beet roots for diazinon and pirimiphos-methyl, respectively. The vegetative parts did not have any detectable residues of diazinon and pirimiphos-methyl after 12 & 16 days from application, respectively. No detectable residues of diazinon or pirimiphos-methyl residues were found in the roots during the days of the experiments. Diazinon and pirimiphos-methyl were found to be shorting persistent in the vegetative parts, but they were more stable in the soil.

The vegetative parts could be used safely in animal feeding after one day from treatment. Also, the roots of sugar beet could be used safely in sugar industry.

INTRODUCTION

Sugar-beet plant (*Beta vulgarism*) is an important crop for sugar production in Egypt. The high sucrose content of sugar beet makes it a good source for sugar and the high nutritive value of its leaves suggests their use as an extra source for forage for farm animals.

This crop is attacked with various insects. The cotton aphid (*Aphis gossypii* Glover), the beet-weevil (*Lixus junci* Boh.), the beet-fly (*Pegomyia mixta* Vill.), the beet moth (*Scrobipalpa ocellatella* Boyd.) and the cotton leaf worm (*Spodoptera littoralis*

Boisd.) are the most economically important insect pests infesting sugar beet plants. Diazinon (O,O-diethyl O-(2-iosopropyl-6-methyl-4-pyrimidinyl phosphorothioate) and pirimiphos-methyl (O-2-diethyl amino-6-methyl pyrimidin-4-yl O,O phosphorothioate) are recommended for the control of these insect pests in Egypt.

The present study was carried out to investigate the residual behavior of diazinon and pirimiphos-methyl in the vegetative parts and roots of sugar-beet and the contamination of soil under the treated plants.

MATERIALS AND METHODS

The experimental work was conducted in Kafr El-Sheikh region at Sakha Experimental Station and started in November 1997 until May 1998. Sugar-beet seeds of the Pleno variety were planted on November 23nd, 1997.

Diazinon (E.C. 60%) and pirimiphos-methyl (actellic E.C. 50%) were applied on April 13th 1998, at the rates of 500 and 750 ml/ from the commercial product, each per 100 L of water (recommended dose), respectively, using a knapsack sprayer equipped with one nozzle.

Plant samples of 5 plants each were taken at intervals of one hour after application (zero time, 1, 3, 6, 9, 13, 16, 20 & 37 days). Sub-samples of 50 and 100 g. from the vegetative parts and roots, were taken respectively for residue analysis.

Soil samples of 500 g. were taken from the soil under the plants were at 5-cm depths at intervals of one hour (zero time) then after 9, 20, 37 days after application.

Analytical procedures

A. Extraction

1. Vegetative and root samples : The extraction procedure used is the general method suitable for organophosphorus compounds (Ministry of Welfare, Netherlands, 1988). Fifty gram of homogenized sample was mixed with 50-g. anhydrous sodium sulphate and 100 ml ethylacetate. The mixture was blended for 3 min. and the extract was filtered.

2. Soil samples : Soil samples (clay) were ground. Then, 100 g. were placed in 500 ml conical flasks containing 50-g. anhydrous sodium sulphate and 200 ml methylene chloride. The flasks were shaken for one hour using an electrical shaker. Then the methylene chloride layers were filtered through anhydrous sodium sulphate, then evaporated just to dryness using a rotary evaporator at 40°C and the residues were ready for chromatographic determination without clean-up.

B. Clean-up of extracts

The clean-up procedure was done according to the method of Al-Samariee *et al.* (1988). The extract was mixed with 3 g. of activated charcoal, then shaken for 2 min. The mixture was filtered through filter paper and the supernatant rinsed with an additional 50 ml ethylacetate and collected just to dryness using a rotary evaporator at 40°C and the residues were ready for chromatographic determination.

C. Gas liquid chromatography determination

A Pye Unicom 4500 gas chromatograph equipped with a flame photometry detector operated in the phosphorus mode (526-nm filter) was used for diazinon and pirimiphos-methyl determination. The column (1.5 m x 4 mm i.d. Pyrex) was packed with 4% SE-30 + 6% OV-210 on gas chromosorb Q (80-100 mesh); temperature degrees were 230°C for column, 240°C for detector and 235°C for injector and gas flow was 30, 30, 30 ml/min. for nitrogen, hydrogen and air, respectively. Retention times for diazinon and pirimiphos-methyl under these conditions were 2.13 and 3.32 min., respectively.

Results were corrected according to the rates of recovery which were determined in fortified untreated samples. Following the techniques previously mentioned, the rates of recovery for diazinon were 100 ,100 and 100% and for pirimiphos-methyl were 100 ,100 and 100 % in vegetative parts, roots and soil, respectively.

RESULTS AND DISCUSSION

Results in Table 1 represent the residues of diazinon and pirimiphos-methyl on and in sugar- beet plants (vegetative parts and roots). The data showed that after one hour from treatments, the concentration of the initial deposits were 4.93 ppm and

10.54 ppm for diazinon and pirimiphos-methyl on and in vegetative parts, respectively.

Table 1. Residues of diazinon and pirimiphos-methyl on and in sugar-beet plant.

Time after application (day)	Residues (ppm)			
	Diazinon		pirimiphos-methyl	
	Vegetative part	Root	Vegetative part	Root
Zero time*	4.93	UND	10.5	UND
1	1.61	UND	2.64	UND
3	0.79	UND	0.74	UND
6	0.24	UND	0.15	UND
9	0.05	UND	0.04	UND
13	UND	UND	0.02	UND
16	UND	UND	UND	UND
20	UND	UND	UND	UND
37	UND	UND	UND	UND
RL_{50} in hours	14.86		12.05	

* One hour after application

The residues decreased sharply to 1.61 ppm and 2.64 ppm, respectively, within the first 24 hours after spraying. The residues of the two insecticides dropped to 00.79 , 0.24 and 0.05 ppm and 0.74, 0.15, 0.04 and 0.02 ppm after 3, 6, 9 and 13 days from treatment, respectively. The vegetative parts did not contain any detectable residues of diazinon and pirimiphos-methyl after 16 days from application.

The half-life values of diazinon and pirimiphos-methyl were 14.86 and 12.05 hours in the vegetative parts, respectively.

The solution could however reach sugar-beet roots through seeping on the aerial part of the plant, moving through the soil. No detectable amount of diazinon and pirimiphos-methyl residues were found in the roots during all days of treatments.

Hegazy *et al.* (1989) found no detectable amount of Malathion residues in the

roots of sugar beet plants during the whole experimental period, while very small amounts of methamidophos were detected. In different work, the initial concentration of fenitrothion in garlic heads was low (1.11 ppm) and decreased sharply during the first three days to reach 0.23 ppm (Abdel- Rahman, 1996).

Studies in initial deposits detected for diazinon (4.93 ppm) and pirimiphos-methyl (10.5 ppm) in the vegetative parts, could be attributed to difference in rate of application of diazinon (300 g a.i./100 L water) and pirimiphos-methyl (370 g a.i. / 100 L water).

The fast disappearance of diazinon and pirimiphos-methyl may be their due to its higher vapor pressure (1.4x10 at 20°C for diazinon) and (1x10 mm Hg 30 °C for pirimiphos-methyl). Other factors could also be involved such as weather, metabolic conversion and other degradation processes. However, the quick degradation of either chemicals was clearly shown in 67.34 % reduction in diazinon residues and 74.95 % reduction in pirimiphos-methyl after only one day from treatment.

The reduction of insecticide residues from the leaves is probably due to the dilution occurring by plant growth and the effect of volatilization from the surface of plant tissues due to meteorological conditions such as temperature, humidity, rainfall and UV-light.

The results clearly indicated that diazinon and pirimiphos-methyl had short persistence on the vegetative parts of sugar-beet plants. These results are in agreement with those of Shokr (2000), who studied the residues of fenitrothion and chlorpyrifos-methyl in sugar-beet crop and found that the half-life values of this insecticide were 16.8, and 14.4 hours, respectively. The vegetative parts could be used safely in animal feeding after one day from treatment. Also, the roots of sugar beet could be used safely in sugar industry.

The data obtained in Table 2. showed that the residue levels in soils under sugar-beet plants, one hour after application were 0.67 and 0.494 ppm for diazinon and pirimiphos-methyl, respectively.

Table 2. Residues of diazinon and pirimiphos-methyl in soil.

Time after application (day)	Residues (ppm)	
	Diazinon	Pirimiphos-methyl
Zero time*	0.67	0.494
9	0.028	0.038
20	0.014	0.026
37	0.012	0.0037
RL_{50} in hours	47.53	59.41

* One hour after application

The amount of Residues decreased to 0.028, 0.014 and 0.012 ppm and 0.038, 0.026 and 0.0037ppm after 9, 20 and 37 days from spraying diazinon and pirimiphos-methyl, respectively.

The residue half-life values in soil under sugar- beet plants were 47.53 and 59.41 hours for diazinon and pirimiphos-methyl, respectively.

Generally, the persistence of modern organophosphorus insecticides in soil does not exceed one month, therefore the danger of their residues contaminating fodder and food products through the roots is reduced to the minimum. Fenitrothion persists in the soil during 10-20 days (Gruzdyev *et al.*, 1983). Diazinon and pirimiphos-methyl were found to be short persistent in vegetative parts, but were more stable in soil.

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ثبات متبقيات مبيدى الديازينون والبريميفوس – ميثايل فى وعلى بنجر السكر والتربة

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يهدف هذا البحث لدراسة ثبات متبقيات مبيدى الديازينون و البريميفوس – ميثيل على وفى نباتات بنجر السكر ودراسة مدى تلوث التربة أسفل النباتات نتيجة عملية الرش. أوضحت الدراسة أن فترات نصف العمر بالنسبة لمبيد الديازينون كانت ١٤,٨٦، ٤٧,٥٣ ساعة؛ ولمبيد البريميفوس – ميثيل كانت ١٢,٠٥، ٥٩,٤١ ساعة على الأجزاء الخضرية والتربة على التوالى.

المتبقى الأولى على المجموع الخضرى لنبات البنجر كان أعلى فى حالة مبيد الديازينون (٤,٩٣ جزء فى المليون) عنه فى حالة مبيد البريميفوس – ميثيل (١٠,٥٤ جزء فى المليون). وأيضا لم تكن هناك أثرمن المتبقى الأولى على الجذور لنباتات البنجر بالنسبة لمبيدى الديازينون و البريميفوس – ميثيل على التوالى. وكذلك لم يحتوى المجموع الخضرى على أى متبقيات يمكن الكشف عنها بعد اليوم الثالث عشرو السادس عشر من المعاملة لمبيد الديازينون و البريميفوس – ميثيل على التوالى. أيضا لم يكن أى متبقيات لكلا المبيدين على الجذور حتى نهاية المعاملة.

أظهر مبيدى الديازينون والبريميفوس – ميثيل ثباتاً قليلاً نسبيا على المجموع الخضرى، وأيضا كان المبيدين أعلى ثباتا فى التربة عند المقارنة بالثبات على المجموع الخضرى لنباتات البنجر.