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Short Communication

Dissipation of fenpropathrin residues in squash fruits intercropped with garden rocket

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The dissipation and residue of fenpropathrin in squash fruits intercropped with garden rocket under field conditions were studied. Samples were collected periodically on the sampling days after applications. The residue data revealed the half-life values of fenpropathrin in Squash fruit and garden rocket were found to be 1.78 and 1.85 days, respectively. The residues of fenpropathrin were more greatly concentrated in the squash fruit shell than that squash fruit pulp. The initial concentration level of fenpropathrin in squash fruit was lower than in the garden rocket plants. Fenpropathrin levels in squash fruit or garden rocket below maximum residue level (1.0 mg/kg) were detected 3 days after application and no residues were detected on the 10th day.

Key words: Dissipation, fenpropathrin, squash fruits, garden rocket, intercropping.

INTRODUCTION

In Egypt, squash fruit and garden rocket are important vegetables for human consumption in mature stages. The need to maximize food production in a limited cultivated area encourages the use of intercropping system in agriculture (that is, squash fruit with garden rocket). The aim is to gain more production per unit area in a limited time. Both squash fruit and garden rocket are liable to be infested with different insect pests and diseases which usually cause serious injury and reduction to the final yield. Among the classes of pesticides commonly employed in controlling crop pests are the synthetic pyrethroids, whose use has increased over the past decade. They are being used extensively due to their effectiveness against a broad spectrum of insects, the low dosage required, and their advantageous environmental properties such as photostability and nontoxicity to mammals (Navickiene et al., 1999; Albadri et al., 2012). Fenpropathrin (a-cyano-3-phenoxybenzyl-2, 2, 3, tetramethylcyclopropanecarboxylate), a typical pyrethroid insecticide used as an acaricide insecticide, classified as class II "moderately hazardous by the World Health Organization (Anonymous, 1991). It is used to control many species of mites and insects like whiteflies, cotton field crops, glass house crops, vegetables. Appreciable levels of pyrethroid residues can occur in food commodities from crops, food of animal origin (eg. milk, eggs and meat), soils, sediments, and surface, ground and drinking water (Priya et al., 2007). This experiment was carried out to investigate the residues of Fenpropathrin in a squash fruits intercropped with garden rocket.

MATERIALS AND METHODS

Experimental

Field experiments were conducted in Aboutouala, Mania El-kamh

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Table 1. Residues of fenpropathrin in Squash fruit and garden rocket.

Days after application	Garden rocket		Squash fruits shell		Squash fruits pulp	Whole squash fruits	
	Residue level (mg/kg) Mean ± SD	Dissipation (%)	Residue level (mg/kg) Mean ± SD	Dissipation (%)	Residue level (mg/kg) Mean ± SD	Residue level (mg/kg) Mean ± SD	Dissipation (%)
Initial[a]	1.76±0.06	0.00	1.52±0.05	0.00	0.01±0.01	1.53±0.08	0.00
1	1.02±0.06	42.05	0.90±0.04	40.78	0.10±0.01	1.00±0.06	34.64
3	0.67±0.04	56.8	0.33±0.02	78.28	0.21±0.01	0.54±0.04	64.71
5	0.32±0.02	81.81	0.15±0.02	90.13	0.10±0.01	0.25±0.02	83.66
7	0.05±0.02	97.15	0.01±0.01	99.34	0.02±0.01	0.03±0.01	98.04
10	BDL	100	BDL	100	BDL	BDL	100
t½ h		1.85		1.79	-		1.78
ATL		1.0					1.0

ATL, Allowable tolerance level; BDL, below detectable level; Initial[a], 1 h post treatment.

province, Sharkia governorate, Egypt, on 2 Jun 2012.

Fenpropathrin 20% EC was applied at the recommended rate of application that is, 100 g ai per feddan (1 feddan = 4,200 m^2) on the squash fruits (Cucurbita pepo) intercropped with garden rocket (Eruca *sativa*) with Knap Sap sprayer in plots of 4 ×4 m size, along with a control plot. Garden rocket and Squash fruit were cultivated and intercropped interchangeably in the lines of each plots. Squash fruit or garden rocket in triplicate was collected randomly from each plot at 0 (1 h), 1, 3, 5, 7 and 10 days after applications for dissipation study. Samples were collected randomly and periodically from each plot in triplicate along with control.

Extraction, clean-up and analysis

The method of extraction used was that published by Luke et al. (1981). A sample of squash fruit or garden rocket, shell and pulp (50 g) was shaken mechanically with acetone (100 ml) for 1 h. The mixture was filtered through a filter paper into a 1 L separating funnel and the filter washed with acetone (2×10 ml). Saturated sodium chloride solution (10 ml), hexane (60 ml) and dichloromethane (60 ml) were added and the mixture was shaken vigorously for 2 min, then the organic layers were filtered through anhydrous sodium sulfate (10 g) into a round-bottomed flask. This partition step was repeated twice using hexane (60 ml). The extract was concentrated in a rotary evaporator at low pressure at 40.8°C. The extract was finally made up to 2 ml and added to the liquid – solid chromatography column. The concentrated extract was transferred to the top of a glass chromatographic column (30 × 1 cm i.d.) pre-packed with 2 g of florisil heated 24 h at 130.8°C and brought to 3% moisture before use and 1 g of anhydrous sodium sulfate. The elution was processed with 20 ml hexane: ethyl ether (7:3, v/v) at 2 ml min^{-1}(Navickiene et al., 1999). The elute was evaporated to dryness, rinsed with high performance liquid chromatography (HPLC) grade methanol and filtered (0.2 µm) for direct HPLC analysis.

The residues of fenpropathrin in different samples were directly determined according to Zhou et al. (2008) after extraction and clean-up using HPLC (with a UV-detector set at the wavelength 210 nm. A reversed-phase VP-ODS C18 column (250 × 4.6 mm i.d., particle size 5 mm) was used and the mobile phase was acetonitrile/water (74/26, v/v, 10% methanol was included in water) at 1.0 ml min^{-1}. The injection volume and detection wavelength were 10 µl and 210 nm, respectively. The percent recovery of fenpropathrin in squash fruit shells, squash fruit pulp and garden rocket were 91.63, 90.12, and 89.13, respectively.

RESULTS AND DISCUSSION

The persistence behavior of fenpropathrin in squash fruit or garden rocket samples at different day's interval has been summarized in Table 1. The initial deposits (1 h after spraying) of fenpropathrin in squash fruit and garden rocket were found to be 1.53 and 1.76 µg g^{-1}, respectively. However, no residue was detected in the untreated control samples. The residues of fenpropathrin in Squash fruit and garden rocket samples declined progressively with time. About 66.4364.71 and 56.8% of the initial residue was dissipated after 3 days of application which further increased to 83.66 and 81.81% after 5 days irrespective of the application doses. In the Squash fruit and garden rocket fenpropathrin were not detected on the day 10 after application. The calculated half-life values of fenpropathrin in squash fruit and garden rocket were found to be 1.78 and 1.85 days, respectively (Table 1). In the field, the dissipation of pesticide residues in/on crops depends on physical and chemical factors, including climatic conditions, type of application, plant species, dosage, interval between application, growth dilution factor and time of harvest (Khay et al., 2008). It was reported that the half-life value of fenpropathrin was 3.4 to 4.2 days in the tomatoes and 4.0 to 4.5 days in the green beans (Galera et al., 1997).

Experimental data (Table 1) on the fate of fenpropathrin residues between shell and pulp in squash fruit show that fenpropathrin residues were more greatly distributed in the squash fruit shell than that squash fruit pulp. These results indicated that fenpropathrin residue was concentrated in squash fruit shell; this may be due to

physicochemical properties of fenpropathrin such as, water solubility, 0.33 mg/L at 25°C (Tomlin, 2004). Pesticides with 100% of the residues distribute in peel. This kind of pesticides included pyrethroid pesticides, pp-DDE, chlorfenapyr, pyridaben, chlorpyrifos with weak solubility in water (or strong lipid solubility). They only stay in peel and are hard to migrate to pulp during the whole planting and storing processes (Xu et al., 2012). The same author found that the pesticides with average distribution ratios more than 90% in peels of grape were those with the solubility less than 2 mg L^{-1}. The factors affecting the pesticide distribution and migration between peel and pulp may include: (1) the pesticide preventing property of the grape peel; (2) physico-chemical properties of the pesticides (such as the polarity, solubility and special groups helping for pass though the peel); (3) contacting time after pesticide sprayed; (4) concentration in the peel; (5) degeneration by sunlight; (6) rinsing by rain, and so on (Xu et al., 2012).

Table 1 shows that the initial concentration level of fenpropathrin in squash fruit was obviously lower than in the garden rocket plants. These results suggest that, the amount of fenpropathrin may be affected by the kinds of crop. Garden rocket exposed to liquid spray directly while in the squash, the fruit be protected by the broadleaf. The dissipation rate of pesticides following application depends mainly on many parameters, including chemical and photochemical degradation, volatilization, climatic conditions, plant species, formulation type and pesticide application method (Sur et al., 2000).

As shown in Table 1, the allowable tolerance level of fenpropathrin in squash fruit and garden rocket was 1.0 mg/kg, respectively as adopted by the FAO/WHO Codex Aliment Arius Commission (CAC, 2008). It can thus be concluded that fenpropathrin levels in squash fruit or garden rocket below maximum residue level (1.0 mg/kg) were detected 3 days after application and no residues were detected on the 10th day. Based on this value, it might be stated that fenpropathrin may not pose any residual toxicity problem in Squash fruit or garden rocket samples during 3-day of application. Rafiei et al. (2010) showed that fenpropathrin levels below maximum residue level (0.5 mg/kg) were detected 3 days after application in a cucumber cultivar in greenhouse.

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