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Residues of Synthetic Pyrethroid Insecticides on Tomato under Sub-tropical Conditions of Punjab, India

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Tomato (Lycopersicon esculentum Miller), an important vegetable crop of tropical and subtropical regions of the world, is attacked by many insect pests like jassids, whitefly, tobacco caterpillar and fruitborer. Among these, the fruitborer, Heliothis armigera Hübner is most serious and quite difficult to control. Recently, it has been found that the applications of synthetic pyrethroids give effective control of this insect pest (Anonymous 1985). Pesticides applied to food crops leave residues which may be hazardous to the consumers. The dissipation of an insecticide deposited on a crop varies with the crop variety, dosage applied, agroclimatic conditions, etc. Since limited information is available on the dissipation of synthetic pyrethroid insecticides on tomato crop in subtropical regions of the world, the present studies were undertaken to determine the residues of cypermethrin, fenvalerate and deltamethrin on tomato fruits following their application at recommended and double the recommended dosages.

MATERIALS AND METHODS

Tomato (variety Punjab Tropic) was raised at the University Farm (Ludhiana, Punjab, India) from seedlings transplanted in December, 1986 according to the locally recommended agronomic practices (Anonymous 1985). The treatments evaluated for residues included control, fenvalerate (Fenval 20EC) @ 50 and 100 g a.i.ha^{-1}, cypermethrin (Basathrin 25 EC) @ 50 and 100 g a.i. ha^{-1}, and deltamethrin (Decis 2.8 EC) @ 12 and 24 g a.i. ha^{-1}. There were three replications for each treatment and the size of each plot was 60 m^2. Spraying of the crop was started at 50% flowering stage and continued at intervals of ten days with a total of four sprays.

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Three samples (0.5 kg each) of marketable size tomato fruits were taken at random from the treated and control plants at 0, 1, 2, 4, 6, 8 and 10 days after the last spray.

A 100 g representative sample was blended thrice with 200, 50 and 50 ml of acetonitrile and filtered through vacuum. The combined acetonitrile fractions after dilution with 3 volumes of 10% aqueous sodium chloride solution were partitioned into 100, 50 and 50 ml portions of n-hexane. The combined n-hexane fraction was concentrated to about 5 ml and cleanedup on a column of silica gel (60-120 mesh) activated for 2 hours at 110°C. The column after prewashing with n-hexane was eluted with 150 ml benzene. The pigments in the sample extract migrated as a colored band and were removed by discarding first 25 ml of eluate. This fraction did not contain any residues of insecticides being studied. The rest of the eluate was concentrated to about 5 ml in rotary vacuum evaporator and analysed by GLC (Packard Model Becker-417) using ^{63}Ni source electron-capture detector and a column (1 m x 2 mm i.d.) packed with 1.5% SP-2250 + 1.95% SP-2401 on 100-120 mesh Suppelcoport. The carrier gas (N_2) flow rate was 60 ml per minute while operational temperatures (°C) were: column oven 240, injection port 220 and detector 250. The cleanedup extract of 100 g tomato fruit could be concentrated to 5 ml, out of which 5 ul (100 mg plant equivalent) when injected did not give any interfering peak in the region of the compounds detected. Under the operating conditions, 10 ng of each synthetic pyrethroid gave about half scale deflection. Based on twice the noise level, the limit of determination of pyrethroids was worked out to be 0.02 mg kg^{-1}. The average recovery values obtained following the above method from samples of tomato fruits fortified at 0.2 and 0.5 mg kg^{-1} before extraction ranged from 78.3 to 80.0, 87.7 to 89.3 and 87.0 to 90.7% for cypermethrin, fenvalerate and deltamethrin, respectively.

RESULTS AND DISCUSSION

The quantitative estimate of residues of cypermethrin, fenvalerate and deltamethrin on tomato fruits at various time intervals after the last spray is presented in Table 1. Immediately after the fourth spray, the mean level of initial deposit of cypermethrin was 0.25 and 0.48 mg kg^{-1} on the fruits of tomato at recommended and double the recommended dosage. These levels were reduced to 0.13 and 0.22 mg kg^{-1} and 0.07 and 0.08 mg kg^{-1} in one and four days respectively. The residues of cypermethrin were not detected in the samples of tomato fruits collected

Table 1. Residues (mg kg^{-1}) of cypermethrin, fenvalerate and deltamethrin on tomato

Days after spray	Cypermethrin		Fenvalerate		Deltamethrin	
	Range	Mean	Range	Mean	Range	Mean
Recommended Dosage						
0 (Before spray)	ND	ND	ND	ND	ND	ND
0 (1 hour after spray)	0.21-0.30	0.25	0.22-0.29	0.26	0.07-0.09	0.08
1	0.11-0.14	0.13	0.09-0.15	0.13	0.07-0.09	0.08
2	0.08-0.10	0.09	0.08-0.11	0.10	0.05-0.09	0.07
4	0.05-0.08	0.07	0.07-0.09	0.08	0.05-0.07	0.06
6	ND		ND		ND	
8	ND		ND		ND	
Double the Recommended Dosage						
0 (Before spray)	ND	ND	ND	ND	ND	ND
0 (1 hour after spray)	0.44-0.57	0.48	0.42-0.49	0.45	0.08-0.23	0.14
1	0.14-0.32	0.22	0.16-0.43	0.28	0.06-0.12	0.09
2	0.08-0.11	0.09	0.10-0.16	0.12	0.04-0.05	0.04
4	0.06-0.10	0.08	0.07-0.12	0.10	0.05-0.08	0.07
6	0.05-0.08	0.06	0.05-0.10	0.08	0.04-0.06	0.05
8	ND		ND		ND	
10	ND		ND		ND	

ND = Not detectable (less than 0.02 mg kg^{-1})

Weather Data

Date of spraying	Temperature (°C)				Relative humidity (%)				Total rainfall (mm)
	Maximum		Minimum		Maximum		Minimum		
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	
28-4-1987	24.4-37.3	31.5	14.4-23.0	18.5	42.0-100	69.0	11-80	41.0	47.3

at 6 days after application at 50 g a.i.ha^{-1}. The maximum initial deposit of cypermethrin on tomato fruits following its applciation at the recommended dosage was found to be below its maximum residue limit of 0.5 mg kg^{-1} recommended by FAO/WHO (1985). For both the fenvalerate treatments, the maximum initial deposits of 0.29 and 0.49 mg kg^{-1} were also less than the maximum residue limit of 1 mg kg^{-1}. Similarly the maximum initial deposits of 0.09 and 0.23 mg kg^{-1} of deltamethrin obtained following its application at recommended and double the recommended dosages respectively were also found to be quite low. The residues of deltamethrin declined to not detectable level ($<$0.02 mg kg^{-1}) after 8 days (Table 1).

The low initial deposit of synthetic pyrethroids on tomato fruits is ascribed to their application at low dosages. These results corroborate those reported by other workers (Mesters 1978; Jain 1979; Awasthi 1986), who also found similarly low initial deposits of these synthetic pyrethroids on tomato. Thus the use of synthetic pyrethroids on tomato crop under sub-tropical conditions does not seem to constitute residue hazards to consumers.

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