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Monitoring of Pesticides from Farm Gate Samples of Vegetables in Haryana

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Forty six farm gate samples of seasonal vegetables namely cauliflower (6), cabbage (6), pea (10), brinjal (1), okra (4), tomato (1), bitter-gourd (4), smooth-gourd (4) and chilly (green and red) (10) were monitored for residues of different insecticides applied during their growth period. Residues of monocrotophos, quinalphos, BHC isomers, DDT analogues and endosulfan were found in cauliflower, cabbage and pea peel samples whereas pea grain samples were found to contain monocrotophos and quinalphos. Only one sample of cabbage out of the six analysed contained 0.230 mg kg^{-1} of monocrotophos which was above the MRL value (0.2 mg kg^{-1}). Residues of monocrotophos and endosulfan were found in one sample of brinjal. Samples of green and red chillies were contaminated with aldrin and dimethoate. Phosphamidon and malathion residues were found in green chillies only. Residues of dimethoate were found in tomato, and monocrotophos residues below detectable level were found in the 12 samples of summer vegetables i.e. okra, bitter-gourd and smooth-gourd. The incidence as well as level of contamination of pesticides has decreased significantly as compared to previous years.

KEY WORDS : monitoring, pesticides, residues, vegetables, organochlorine, organophosphorus

Cauliflower, cabbage, pea, brinjal, tomato, okra, bitter-gourd, smooth-gourd and chilly are the important vegetable crops in India. They are attacked by various insect-pests like hairy caterpillar (*Amsacta moori*), cabbage semi-looper (*Plusia orichalcea*), diamond back moth (*Plutella xylostella* L.), leaf miner (*Phytomyza atricornis*), whitefly (*Bemisia tabaci* G.) tobacco caterpiller (*Spodoptera litura* F.), gram caterpiller (*Heliothis armigera* Hübner), aphid (*Aphis gosypii* Glov.), Jassid (*Amrasca biguttula,* Ishida) and fruit borer (*Earias fobia* Stoll) etc. which reduce the yield of the crops considerably. Due to severe attack of various insect-pests, repeated sprays of insecticides are required to protect the crops. Although reports[1,2] on the monitoring of pesticide residues in fruits and vegetables in temperate countries are available, no systematic study on monitoring of farm gate vegetable samples (ready for sale from farmer's field) has been done in India so far. Therefore, the present study was undertaken during 1993-94 to monitor the level of contamination of different pesticides in the farm gate samples of vegetables. The study was a part of the programme of the All India Co-ordinated Research Project (AICRP) on Pesticide Residues.

EXPERIMENTAL

Farm gate samples of cauliflower, cabbage, pea, brinjal, tomato, okra, bitter-gourd, smooth-gourd and chilly (green and red) were collected during 1993-94 from different fields located in the vicinity of Hisar town and Haryana

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Agricultural University Research Farm. About half to one kg sample of each vegetable was collected periodically. Samples were processed for residues of BHC, DDT, endosulfan, aldrin, monocrotophos, quinalphos, dimethoate, malathion and phosphamidon based on the information provided by the growers on the use pattern of pesticides. The samples were generally processed immediately after collection.

Extraction and clean-up

The samples were chopped into small pieces and representative samples (50 g each) obtained after quartering were macerated in a Waring Blender for 30 sec. with anhydrous sodium sulphate (5-10 g). For organochlorine insecticides, the macerated samples were extracted with hexane+acetone (4+1 by volume) by shaking for 1 h on mechanical shaker and the extract was cleaned with charcoal using hexane + acetone (4+1 by volume) as eluent[3]. For organophosphorus insecticides, the macerated samples were extracted with chloroform by shaking for one h on mechanical shaker and cleaned by passing through chromatographic column containing adsorbent mixture (activated charcoal : hyflosupercel : magnesis :: 2:2:1) in between two layers of anhydrous sodium sulphate (2.5 cm each). Elution was done with freshly redistilled chloroform (150 ml)[4]. Cleaned chloroform extract was concentrated to near dryness on flash evaporator followed by manifold evaporator and the residue was redissolved in n-hexane (2 ml) for GLC analysis. Per cent recovery of different insecticides from vegetable samples fortified at 0.5 and 1.0 mg kg^{-1} level was found to be from 80 to 95%.

The cleaned extracts were analysed by GLC (Hewlett Packard 5890 A) using ECD or NPD detectors as per following details:

GLC : Hewlett Packard 5890 A

For organochlorine insecticides: Detector : ECD (Ni^{63}), column SPB-5 fused silica capillary column (30 m x 0.32 mm ID x 0.25 µm film thickness), temperatures : column, 180°C (3 min) → 5°C min^{-1} → 190°C → 30°C min^{-1} → 250°C (8 min); inlet 260°C, detector 275°C), carrier gas, N_2, flow rate, 60-70 ml min^{-1}

For organophosphorus insecticides: Detector : NPD, column, glass column containing

Table 1. Residues of aldrin, dimethoate, malathion and phosphamidon in chilly

Sample	Variety	Residues (mg kg^{-1})			
		Aldrin	Dimethoate	Phosphamidon	Malathion
Green chilly	HC 17	0.002	0.035	0.002	ND
	HC 28	0.001	0.015	0.007	ND
	HC 44	0.001	0.037	0.009	ND
	HC 46	0.002	0.094	ND	ND
	HC 47	0.001	0.072	ND	0.009
Red chilly	HC 17	0.002	0.017	ND	ND
	HC 28	0.002	0.011	ND	ND
	HC 44	0.002	0.010	ND	ND
	HC 46	0.001	0.013	ND	ND
	HC 47	0.002	0.024	ND	ND

ND - Non detected

MRL Aldrin + dieldrin = 0.01 mg kg^{-1}, dimethoate = 2 mg kg^{-1} (veg.), phosphamidon = 0.2 mg kg^{-1} (veg.), malathion = 3 mg kg^{-1} (veg.), (Prevention of Food Adulteration, Act, India, 1954)

stationary phase 3% OV-17 coated on chromosorb WHP (80-100 mesh), temperatures: column, 210°C; inlet, 230°C; detector 250°C), carrier gas, N_2, flow rate N_2 20 ml min^{-1}, H_2 3.5 ml min^{-1}, zero Air 100 ml min^{-1}.

Results and Discussion

Green and red chillies : As evident from the data given in Table 1, residues of aldrin and dimethoate were detected in both red and green chillies, while residues of phosphamidon and malathion were detected in green chilly only. In all chilly samples, the level of contamination was below Maximum Residue Limit (MRL) for the detected pesticides.

Cauliflower : All the six samples were found to be contaminated with monocrotophos, quinalphos (Table 2) and BHC (α-, β and γ - isomers) (Table 3). DDT (p, p'-DDT) was found in measurable amount (0.071 mg kg^{-1}) in one sample and endosulfan in three samples (Table 3).

Cabbage : Pattern of contamination of cabbage was almost identical with that of cauliflower. All the six samples were found to be contaminated with monocrotophos, quinalphos (Table 2) and BHC (Table 3). Residues of o, p'-DDT, p, p'-DDT and endosulfan A were detected in one sample and endosulfan B in two samples (Table 3). Only one sample contained 0.230 mg kg^{-1} monocrotophos which was above the MRL value (0.2 mg kg^{-1}).

Pea grain : All the five samples were found to be contaminated with monocrotophos and quinalphos (Table 2). None was found to contain residues above MRL (0.1 mg kg^{-1}, monocrotophos and quinalphos). None of pea grain samples showed presence of either BHC isomers, DDT analogues or endosulfan residues (Table 3).

Pea peel : Like pea grain, all the five samples

Table 2. Residues of monocrotophos and quinalphos in cauliflower, cabbage, pea grain, pea peel, brinjal and summer vegetables

Vegetable	Date of sampling	Residues (mg kg^{-1})	
		Monocro-tophos	Quinalphos
Cauliflower			
CF - 1	18.2.93	0.009	0.002
CF - 2	25.2.93	0.022	0.007
CF - 3	2.3.93	0.020	0.003
CF - 4	18.3.93	0.032	0.003
CF - 5 (C)*	18.3.93	0.049	0.054
CF - 6	30.3.93	0.098	0.051
Cabbage			
CA - 1	18.2.93	0.046	0.014
CA - 2	25.2.93	0.230	0.001
CA - 3	2.3.93	0.092	0.003
CA - 4	18.3.93	0.093	0.007
CA - 5 (C)*	18.3.93	0.069	0.003
CA - 6	30.3.93	0.118	0.004
Pea grain			
PG - 1	18.2.93	0.020	0.004
PG - 2	25.2.93	0.021	0.004
PG - 3	18.3.93	0.030	0.008
PG - 4 (C)*	18.3.93	0.013	0.002
PG - 5	30.3.93	0.044	0.002
Pea peel			
PP - 1	18.2.93	0.005	0.002
PP - 2	25.2.93	0.009	ND
PP - 3	18.3.93	0.013	0.002
PP - 4 (C)*	18.3.93	0.008	ND
PP - 5	30.3.93	0.015	0.006
Brinjal	22.6.93	0.022	ND
Summer vegetables (12 samples)	4.6.93 to 1.7.93	BDL	ND

* Sample from city, BDL — Below detectable limit, ND — Not detected

MRL : Monocrotophos; peas = 0.1 mg kg^{-1}, cabbage and cauliflower = 0.2 mg kg^{-1}
Quinalphos, cabbage and cauliflower = 0.1 mg kg^{-1}

Table 3. Residues of BHC isomers, DDT analogues and endosulfan A and B in cauliflower, cabbage, pea grain, pea peel and brinjal

Vegetable	Date of sampling	Residues (mg kg^{-1})								
		BHC					DDT		Endosulfan A	Endosulfan B
		Alpha-	Beta-	Gamma-	Delta-	ΣBHC	o,p'-	p, p'-		
Cauliflower										
CF - 1	18.2 93	0.031	0.123	0.175	ND	0.329	ND	ND	0.009	0.008
CF - 2	25.2.93	0.063	0 091	0 070	ND	0.224	ND	ND	ND	ND
CF - 3	2.3.93	0.016	0.046	0.049	ND	0.111	ND	ND	ND	ND
CF - 4	18.3.93	0.007	0.067	0.142	ND	0.216	ND	ND	ND	ND
CF - 5 (C)*	18.3 93	0 055	0.122	0.082	ND	0 259	ND	0.071	0.079	0.046
CF - 6	30.3.93	0 018	0.181	0.078	ND	0.277	ND	ND	ND	0.009
Cabbage										
CA - 1	18.2.93	0.066	0 185	0.149	ND	0 400	0.012	0 089	ND	ND
CA - 2	25.2 93	0 024	0.123	0.131	ND	0.278	ND	ND	ND	ND
CA - 3	2.3.93	0.026	0 169	0.217	ND	0 412	ND	ND	ND	ND
CA - 4	18.3 93	ND	0.105	0.150	ND	0 255	ND	ND	ND	0.009
CA - 5 (C)*	18.3.93	0.009	0 132	0.108	ND	0 249	ND	ND	ND	ND
CA - 6	30.3.93	0.007	0.173	0.157	ND	0.337	ND	ND	0.439	0.021
*Pea grain (5)***	18.2.93 to 30.3.93	ND	ND	ND	ND	ND	ND	ND	ND	ND
*Pea peel (5)***	18.2.93 to 30.3.93	ND	ND-0 146	ND	ND	ND-0.146	ND	ND-0 041	ND-0.015	ND-0 011
Brinjal	22.6.93	ND	ND	ND	ND	ND	ND	ND	0.014	0.021

* Sample from city, ND - Not detected
** No. of samples

of pea peel were found to be contaminated with monocrotophos and quinalphos (Table 2). BHC beta isomer, p, p'-DDT, endosulfan A and endosulfan B were detected in only one sample of pea peel (Table 3).

Brinjal : The only one sample of brinjal tested for contamination, contained residues of monocrotophos, endosulfan A and endosulfan B (Tables 2-3).

Tomato : Like brinjal the only one sample of tomato tested, contained residues of dimethoate upto 0.005 mg kg^{-1}. No other insecticide was present in detectable amounts.

Summer vegetables : Summer vegetables (12) i.e. okra, bitter-gourd and smooth-gourd analysed for monocrotophos and quinalphos did not contain detectable amounts of toxic residues of any of these insecticides (Table 2).

A comparison of the data obtained in present studies with the earlier data[5] revealed that the incidence as well as level of pesticidal contamination of seasonal vegetables has significantly declined in India which can probably be attributed to change in usage pattern of pesticides. During last one decade the use of organochlorine pesticides, which used to be main contaminants, has considerably decreased. These are being replaced with organophosphate and other group of pesticides which are easily degradable and do not persist for longer periods in the

environment.

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