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Original Research Article

Pesticide Residues from Farm Gate Vegetable Samples of Vegetables in Bihar

S. B. Sah[1*], R. N. Gupta[2], M. Kumar[2], S. K. Mandal[3], T. Saha[1] and S. P. Singh[3]

[1]Department of Entomology, Bihar Agricultural University, Sabour, Bhagalpur-813 210 (Bihar), India
[2]Department of Plant Pathology, Bihar Agricultural University, Sabour, Bhagalpur-813 210 (Bihar), India
[3]Rajendra Agricultural University, Pusa, Samastipur (Bihar), India
**Corresponding author*

A B S T R A C T

The present study was undertaken to evaluate pesticide contamination that is applied during growth period of vegetables in farm gate vegetables samples of Muzaffarpur district of Bihar. 40 farm gate samples of seasonal vegetables namely okra (10), brinjal (10), cauliflower (10) and cabbage (10) were monitored during 2012. Out of which, 30 samples (75 %) were found to be contaminated with different pesticides, of which 6 samples (15 %) contained residues above maximum residue limit (MRL).The residue of cypermethrin and chlorpyriphos were above MRL in 2 samples each and endosulphan and quinalphos in one sample each of farm gate vegetables. The result reveals that farmer should use eco-friendly method to manage the pests of vegetable and aware of time interval between application of insecticide to harvesting of vegetables.

Keywords

Farm gate, vegetables, monitoring, pesticide, residue

Introduction

The pesticides are a group of chemical basically used in agriculture for control of pests, diseases and weeds and as vector control agents in public health programme. It is estimated that more than one third of the potential food production is lost due to pest infestation and other damages. The crop losses in India vary from 10 to 30 per cent depending on the crop, region and severity of pest infestation. In monetary terms, these losses amount to Rs. 2,90,000 million per year. Even if half of these losses can be avoided, a substantial quantity of food can be made available for human consumption (Agnihotri, 1999). Besides the yield loss, the pest infested produce is not acceptable in the world market. These losses can be prevented by the use of newer technologies and improved scientific methods of farming in which pesticides are still considered as indispensable inputs. Pesticides are a sort of assurance to the farmers that damage to the crops is minimum and after harvest, produce is stored safely. Therefore, use of pesticides is inevitable to sustain current level of food production.

The vegetables occupy and important status in Indian diet because a sizable population in India is vegetarian. Vegetables are rich source of proteins, carbohydrates minerals, vitamins and dietary fibers. India is a largest producer I the world next only to China. In Bihar, the total area under vegetables crops is 4.90 lakh ha with total annual production of 7.5 lakh MT. The major vegetables grown on commercial scale are okra, brinjal, cauliflower, cabbage, tomato, onion, chilli, gourds, pea and cowpea. Vegetables crops are grown intensively, sometimes even two or more crops are taken in a season. The plants are spaced closely for high yields. Such Cropping pattern create microclimatic conditions which are highly suitable to pest and diseases. Besides, vegetable plants being green, succulent and juicy, are often and idial host for insect pest and diseases. Vegetables crops on a conservative basis face about 25- 30 per cent losses due to insect pest and diseases (Agnihotri, 1999). Most of the vegetables are grown around cities and town where crop can fetch remunerative prices and hence any loss by insect or diseases is simply not tolerated by the farmers. In the event of pest attack, they resort to chemical control because it is effective, economical and reliable. Pesticide, being toxic in nature, leave behind hazardous residues on edible part of vegetables which can cause health hazards to the consumers. The extent of hazards depends upon the amount of residues and their toxicity. The problem of pesticide residues in vegetables is particularly more serious because these are harvested at short intervals and some of them are consumed in raw state. Post-harvest injudicious use of pesticides at retailers levels though dipping of vegetables in pesticide solution for fresh appearance has further compounded the problem. The consumption of such produce afresh and without much processing result in the exposure of consumers health to possible toxic effect.

The change in pesticide use pattern in vegetables with newer pesticides following increased requirement op plant protection under hi-tech and off-season vegetables cultivation has simultaneously increased pesticide residues load and vegetables produce. Accordingly, the monitoring of farmgate smples of various vegetables carried out at different location in India showed the contamination level to the extent of 73 per cent with varying levels of pesticide residues especially with insecticides like endosulfan, lindane, monocrotphos, quinalphos, chlorpyriphos, dimethoate, triazophos, phosphamidon, malthion, cypermethrin, deltamehrin, fenvalerate and fungicides like carbendazim and mancozeb (Madan *et al.,* 1996; Awasthi and Ahuja, 1997; Chahal *et al.*, 1997; Shah *et al.,* 2000; Kole *et al.,* 2002; Deka *et al.*, 2005). Many a times, the extent of residues is above the prescribed MRL. The periodic monitoring of market basket samples of various vegetables carried out across the country showed 40 to 60 per cent samples contaminated with pesticide residues (Handa, 1992). Further, it is alarming to find out the most of the contaminated samples were found to be loaded with hard to degrade and highly toxic pesticides like DDT and HCH (Srivastav and Patel, 1990). However, there has been wide variation in level of contamination in different vegetables. The contamination of vegetables with DDT and HCH appears to be from lateral unauthorized use of the pesticides after harvest (Awashti and Ahuja, 1997).

Materials and Methods

The sample of farm gate vegetables were collected from Muraul and Bandara Blocks of muzaffarpur district. Ten farm gate samples each of okra, brinjal, cabbage and cauliflower were collected from farmers field located in Muraul and Bandara Blocks of muzaffarpur district during crop season in 2012.From each block, five samples of vegetables were collected. The samples were collected when the produce was ready for transportation to the market. The detailed history of pesticidal treatment and other relevant information were obtained from the farmers at the time of sample collection. For okra and brinjal 0.5-1.0 kg of fruits and for cauliflower and cabbage, 4-6 marketable heads were collected randomly to represent the whole crop area. A total of forty samples of above vegetable were collected and brought to the laboratory for residue analysis in respect of the pesticide last applied to the crop. Samples were chopped in to small pieces and mixed well. A representative sample (50 g) obtained by quartering was subjected to multi residue analysis.

Extraction and clean up and estimation of endosulfan residue

A 50g representative sample of chopped vegetables was extracted with a mixture of hexane: isopropyl alcohol (2:1, v/v, 100 ml) in a Warring blender and filtered. The process was repeated twice. The filtered extract was transferred into a separatory funnel, diluted with aqueous solution of sodium chloride (10%, 150 ml) and the pesticide was partitioned into hexane (3 x 50 ml). The hexane extract was concentrated to 45 ml under reduced pressure and 5 ml acetone was added to it 0.5 g Darco G 60 was added and the contents swirled and allowed to stand for 15 min. and then filtered. The extract was concentrated and dissolved in a known volume of hexane for GLC analysis.

Orgonophosphates

A representative sample of chopped vegetables was extracted with 100 ml acetone and filtered. The extract was transferred into a separatory funnel, diluted with aqueous solution of sodium chloride and the insecticide was partition into ethyl acetate (50, 25, 25 ml). The ethyl acetate extract was concentrated and cleaned up by passing through a pre-washed column packed with 5 g adsorbent mixture of silica gel and activated charcoal (5:1, w/w). The column was eluted with 125 ml mixture of acetone: hexane (3:7, v/v). Eluate was concentrated and final volume was made in acetone: hexane for analysis (3:7, v/v).

Synthetic pyrethroids

A representative 50 g sample of chopped vegetables was extracted with 100 ml acetone and filtered. The extract was transferred into a separatory funnel, diluted with aqueous solution of sodium chloride and the insecticide was partitioned into hexane (50, 25, 25 ml). The hexane extract was concentrated and cleaned up by passing through a pre- washed column of activated neutral alumina (grade-1, 10 g) sandwiched between layers of anhydrous sodium sulphate (2 g). The column was eluted with 100 ml mixture of hexane:acetone (9:1, v/v). Eluate was concentrated to dryness and the residue was dissolved in hexane for Gas Chromatograph-Mass Spectrometer (GC MS), Chemito GC 1000 analysis.

Detector

ECD-$Ni^{63}$for organochlorines and synthetic pyrethroids. TID for organophosphate.

Column

Glass column (2m) packed with 3% OV-101 on 80-100 mesh CHW (HP).

Glass column (2m) packed with 1.5% OV-17+1.95% QF-1 on 80-100 mesh CHW (HP) (For organochlorines only).

Results and Discussion

The data on the residues analysis of pesticides in farm gate samples collected from farmer`s field of Muzaffarpur (Bihar) during 2012 presented in Tables 1 that revealed-

Okra

Out of ten samples, two contained cyermethrin residues in the range of 0.112-0.347 mg kg-1and one exceeded the mrl of 0.2 mg kg-1.quinalphos residues (0.462 mg kg-1) were detected in one sample and were above MRL (0.25 mg kg-1). Two samples were found contaminated with endosulfan, one each with dimethoate, malathion and fenvalerate and the residues of these insecticides were below MRL. Thus out of 10 samples, 8 were found contaminated with different pesticides, of which two samples had residues above MRL.

Brinjal

3 samples of brinjal were found contaminated with endosulphan (0.276-0.840 mg kg-1), two with quinalphos (0.076-0.156 mg kg-1), and one with fenvalerate (0.385 mg kg-1) which were below MRL. However, one sample of brinjal contained cypermethrin residues (0.407 mg kg-1) above MRL. Therefore, out of ten samples of brinjal analysed, 7 contained pesticide residues and one sample had cypermethrin residue above MRL.

Cauliflower

2 samples of cauliflower were found contaminated with endosulphan residues in range of 0.943-2.870 mg kg-1and one above the prescribed MRL (2.0mg kg-1), Cholorpyriphos (0.057mg kg-1) in 1sample were above MRL. Fenvalerate and cyermethrin residues were detected in 2 sample each and quinalphos and methyl parathion in 1 sample each and were within prescribed limits. Out of 10 samples analysed, 8 were found contaminated with different pesticides, of which two samples had residues above MRL.

Cabbage

2 samples of cabbage were found contaminated with cyermethrin (ND-0.072 0mg kg-1) and one each with endosulfan, dimethoate, quinalphos andmalathion and the residues were below respective MRL value. Cholrphriphos residues (0.021 mg kg-1) detected in one sample were above MRL (0.01 mg kg-1). Thus out of 10 samples analysed, 7 were found contaminated with different pesticides, of which one samples had residues above MRL.

So, we can conclude that out of 40 samples of different farm gate vegetables analysed, 30 samples (75 %) were found to be contaminated with different pesticides, of which 6 samples (15 %) contained residues above maximum residue limit (MRL).

Singh and Gupta (2002) analyzed some 162 samples of tomato, auberiginde, cauliflower, cabbage, cucumber, chilli, bottle gourd, bitter gourd, okra and onion, collected from farmer field and fresh vegetable markets near Jaipur, Rajasthan, India, for organochlorine and organophosphate insecticide residues during 1999-2000.Out of the 162 samples collected,91were found contaminated with different insecticides, with 4 samples, 2 each of aubergine and cucumber, recording insecticide residues above the maximum residue limits.

Kole *et al.,* (2002) monitored pesticide residue in 149 farm gate vegetable samples viz. brinjal (46), cabbage (17), cauliflower (29), chilli (5), okra (15), pointed gourd (23), potato (9) and tomato collected from two district of West Bengal, in respective of the pesticide last applied.

Table.1 Residues (mg kg-1) of pesticides in farm gate vegetable (Sample analysed: 40)

Sample No.	Pesticide last applied	Interval between last application and harvest(days)	Residues (mg kg-1)	MRL (mg kg-1)	>MRL
OKRA					
1.	Dimethoate	10	0.058	2.0	Nil
2.	Cypermehrin	5	0.112	0.2	Nil
3.	Endosulphan	7	0.864	2.0	Nil
4.	quinalphos	10	ND	0.25	Nil
5.	Fenvalerate	5	0.588	2.0	Nil
6.	Cypermehrin	3	0.347	0.2	1
7.	Endosulphan	6	1.128	2.0	Nil
8.	Chlorpyriphos	10	ND	0.2	Nil
9.	Malathion	7	0.713	3.0	Nil
10.	Quinalphos	6	0.462	0.25	1
BRINJAL					
1.	Quinalphos	10	0.076	0.25	Nil
2.	Endosulphan	5	0.840	2.0	Nil
3.	Chlorpyriphos	12	ND	0.2	Nil
4.	Dimethoate	10	ND	2.0	Nil
5.	Endosulphan	10	0.276	2.0	Nil
6.	Deltamethrin	11	ND	0.2	Nil
7.	Endosulphan	7	0.385	2.0	Nil
8.	Cypermehrin	4	0.407	0.2	1
9.	Endosulphan	7	0.312	2.0	Nil
10.	Quinalphos	7	0.156	0.25	Nil
CAULIFLOWER					
1.	Cypermehrin	12	ND	2.0	Nil
2.	Chlorpyriphos	6	0.057	0.01	1
3.	Endosulphan	12	0.943	2.0	Nil
4.	Methyl parathion	5	0.462	1.0	Nil
5.	Deltamethrin	10	ND	0.2	Nil
6.	Fenvalerate	7	0.081	2.0	Nil
7.	Quinalphos	7	0.024	0.25	Nil
8.	Cypermehrin	7	0.378	2.0	Nil
9.	Endosulphan	6	2.870	2.0	1
10.	Fenvalerate	8	0.164	2.0	Nil
CABBAGE					
1.	Endosulphan	7	0.312	2.0	Nil
2.	Chlorpyriphos	7	0.121	0.01	1
3.	Cypermehrin	10	0.045	2.0	Nil
4.	Malathion	10	0.279	3.0	Nil
5.	Cypermehrin	12	ND	2.0	Nil
6.	Quinalphos	7	0.028	0.25	Nil
7.	Fenvalerate	12	ND0.560	2.0	Nil
8.	Dimethoate	10	0.560	2.0	Nil
9.	Cypermehrin	7	0.072	2.0	Nil
10.	Deltamethrin	10	ND	0.2	Nil
Total sample=40			Contaminated=30		>MRL=6
ND: Not detected					

About 50 per cent of the samples were found to be contaminated with various pesticides (0.01-2.23 mg Kg^{-1}) of which 16 per cent, were above MRL. Out of 24 samples above MRL, deltamethrin was present in 9 cases followed by cypermethrin (4), quinalphos (4), monocrotophos (3), mancozeb (2) and chlorpyriphos and fenvelerate each in one case. Among the vegetables, frequency of contamination was maximum in chilli and okra (80%). No sample contained residues of dicofol and endosulfan above MRL.

Banerji and Dixit (2003) determined the residues of carbamate, organophosphorous and some organochlorine pesticide in summer fruits and vegetables collected from different places near Ganga River at Kanpur, Uttar Pradesh. The residues of organophosphorous insecticides were below detectable limit in the vegetable and fruits. However few samples showed residues in very low quantities, which were below the tolerance limits of these insecticides.

Kumari *et al.,* (2003) conducted monitoring of 80 winter vegetable samples during 1997-98 for pesticidal contamination. The samples were found 100 per cent contaminated with low but measurable amoof unts of pesticide residues. The residue level organophosphorous insecticide were highest followed by carbamates, synthetic pyrethroids and organochlorines. About 32 per cent of samples had organophosphorous and carbamate residues above their respective MRL.

Parveen *et al.,* (2005) analyzed about 206 samples from 27 vegetables produced from different markets of Karanchi, Pakistan, during 2003-03 for residues of 24 pesticides. On average, 63 per cent of the samples were contaminated and 46 per cent of the contaminated samples exceeded the maximum residue levels. Approximately 49, 68, 72 and 62 per cent of the samples were contaminated in 2000, 2001, 2002 and 2003, respectively, showing an annual increasing trends. On the other hand, MRL violation was 62, 56, 37 and 31 per cent, respectively, showing an annual decreasing trends.

Singh (2006) determined pesticide residues in 64 farm gate vegetable samples namely brinjal (18), okra (15), cauliflower (11), cabbage (8) and green chili (12) collected from farmer fields in three district of Bihar. About 69 per cent of the samples were found contaminated with organochlorine, organophosphate and synthetic pyrethroids group of pesticides and 11 per cent of these contained residues above respective MRL values. Cypermethrin was found to be the most common contaminant in vegetables and its residues exceeded MRL in one sample each of cabbage and cauliflower. However, in green chili, ethion was detected as a major contaminant.

The highest contaminated sample is brinjal followed by cauliflower, cabbage and tomato. Similar results are also reported by Charan *et al.,* (2010) in farm gate vegetables.

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