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Decontamination of Profenophos, Acephate, Triazophos and Ethion in Okra at Field Level

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Abstract: ***The aim of the study was to find the most effective method which can reduce the residues of pesticides in okra at the maximum level. The magnitude of reduction of profenophos, acephate, triazophos and ethion was observed in the range of 22.99-67.09, 30.14-74.72, 27.00-70.41 and 15.02-73.75 percent respectively. The treatment T_1 (washing under running tap water for 10 min resulted in the maximum removal than rest of the treatments in decontamination of profenophos, triazophos and ethion showing 67.09, 70.41 and 73.75 % respectively. Acephate was reduced in maximum amount i.e. 74.72% by T_4 treatment (dipping in 0.5% acetic acid) which was at par with T_1. Moreover, T_8 (microwave treatment for 2 min) resulted in increase in ethion residues upto 10.81%.***

1. Introduction

India is the largest producer of Okra and it is widely grown in Bihar, Gujarat, Odisha, Jharkhand, Andhra Pradesh, Chhattisgarh, Madhya Pradesh, Haryana, and Assam. Okra (*Abelmoschus esculentus*), is one of the important vegetable crops grown during spring-summer and rainy season in India. It occupies 5.28 thousand ha area and its production is 61.46 thousand metric ton in India (Anon. 2017). It has high nutrition as well as medicinal and industrial value, also it is very common in all sections of people.

Okra suffers heavily at fruiting stage due to attack of shoot and fruit borer causing 70 % damage to the crop making it totally unfit for human consumption (Misra and Singh, 1996; Duara *et al.*, 2003) Leafhopper, *Amrasca biguttula biguttula* (Ishida) and shoot and fruit borer (*Earias spp.*) are the major pests of okra. . In spite of constant efforts made by the Government and SAU´s in advocating IPM and cultured practices of pest control, most farmers rely on use of chemical pesticides. Among different vegetable crops, the maximum pesticide usage is found in chilli (5.13 kg a.i /ha) followed by brinjal (4.60 kg a.i /ha), cole crops (3.73 kg a.i /ha) and okra (2-3 kg a.i /ha) (Kodandaram *et al.*, 2013). Indiscriminate use of pesticides particularly at fruiting stage and non adoption of safe waiting period lead to accumulation of pesticide residues in consumable vegetables. Organophosphate group of pesticides contributes more than 50 % of these toxic residues. Among these, profenophos, acephate, triazophos and ethion are most commonly used. Hence, a study entitled " **Decontamination of profenophos, acephate, triazophos and ethion in okra at field level** " was conducted at AINP on pesticide residue laboratory, AAU, Anand to find out the most effective treatment in decontamination.

2. Materials and Methods

The particulars of materials used during the course of investigation and methods adopted in conducting the present study entitled **''Decontamination of profenophos, acephate, triazophos and ethion and in okra at field level.**

2.1 Decontamination study of organophosphate pesticides by different household processing methods (washing, dipping, cooking and ozone treatment) in okra

2.1.1 Experimental details

An experiment was conducted during 2016-17 at AINP on Pesticide Residue laboratory, AAU, Anand (Gujarat) to study the decontamination of profenophos, acephate, triazophos, and ethion in vegetable samples. Vegetable samples were collected from the plot treated with pesticides, followed by various decontamination treatments. The samples were then analyzed at Pesticide Residue Laboratory for the possible losses of pesticides. The experiment was carried with three replications along with an absolute control treatment.

2.1.2. Line of work

Design	: Completely Randomized Design
Location	AINP on pesticide residues, AAU, Anand
Year	2016-2017
Pesticides sprayed	1) Profenophos 50 EC (0.2 % a.i based) 2) Acephate 75 SP (0.25 % a.i based) 3) Triazophos 40 EC (0.1 % a.i based) 4) Ethion 50 EC (0.3 % a.i based)
Commodity under study	Okra
Number of repetitions	: 3
No. of treatments	: 9

Treatment details:

No. of treatments**:** 9

T_0 treatment: Treated control

T_1 treatment: Washing under running tap water for two minutes.

T_2 treatment: Dipping in tap water for 10 min +T_1

T_3 treatment: Dipping in 2% brine solution for 10 min+T_1

T_4 treatment: Dipping in 0.5 % acetic acid solution for 10 min + T_1

T_5 treatment: Dipping in 0.1 % $KMnO_4$ solution for 10 min + T_1

T_6 treatment: Ozonation for 15 min

T_7 treatment: Dipping in 0.1 % $KMnO_4$ and ozonation for 15 min + T_1.

T_8 treatment: Microwave treatment for 2 min

2.1.3 Experimental setup

Suitable vegetable plants were sprayed with double the recommended dose of the following pesticide profenophos 50 EC (0.2 % a.i based), acephate 75 SP (0.25 % a.i. based), triazophos 40 EC (0.1 % a.i. based) and ethion 50 EC (0.3 % a.i. based) in the field at Main Vegetable Research Station A.AU, Anand. The fruit samples were collected from field after 24 hrs of the spray. The samples were kept at room temperature for further 24 hrs. Experiment was carried out at AINP on pesticide residue laboratory, AAU, Anand.

Insecticide application

Required spray solution of four organophosphate pesticides *viz.*, profenophos (50 EC), acephate (75 SP), triazophos (40 EC) and ethion (50 EC) were prepared. The required quantity of organophosphate pesticides application was calculated using the following formula

$N_1V_I = N_2V_2$

Where, N_1 = Pesticide available trade formulation, V_1 = Volume of pesticide to be required (mL or g), N_2 = Double recommended solution, V_2 = volume of water (10 L.)

Accordingly, the required quantity of organophosphate formulation was determined by the formula for organophosphate treatments. The calculation of different doses is as under.

Table A: Technical name, trade name and quantity of insecticide required

S. No	Techical name of insecticide	Trade name & formulation of insecticide (N_1)	Application rate		Quantity of insecticide required in g or Ml (V_2)
			Double the recommended dose (N_2)	Quantity of water (V_1)	
1	Profenophos	Curacron (50 % EC)	0.2 % a.i.	10L	40
2	Acephate	Orkum (75 % SP)	0.25 % a.i.	10L	30
3	Ethion	Fosmite (50 % EC)	0.3 % a.i.	10L	60
4	Triazophos	Trizocel (40 %) EC	0.1 % a.i.	10L	25

Collection of vegetable samples

For residue analysis okra samples (2 kg) were collected from field after 24 hrs of the spray. Samples were kept at room temperature for further 24 hrs, after that it was taken for treatments.

2.1.4 Decontamination treatments

Decontamination treatment was carried out in laboratory by different treatments followed by drying at room temperature. Procedures were accomplished either by different washing solution, ozonation and microwave exposure to evaluate their effectiveness on removing such residues.

Methodology

Required solution of all the four organophosphate pesticides at double the recommended dose (a.i. based) was prepared, and sprayed over the vegetable crops. The vegetables samples were collected from field after 24 hrs of spray and kept at room temperature for further 24 hrs. For treated control i.e. T_0, 250 g of each commodity was taken immediately for the determination of residue level of pesticides before the treatments. The remaining commodity was divided into eight parts, each containing 250 g of the vegetable.

Washing treatment

The vegetable samples were dipped in a jar for 10 minutes filled with aqueous solutions, 0.1 % $KMnO_4$, 0.5 % acetic acid, 2% brine and tap water individually as separate treatment. This was followed by running tap water treatment for 10 min with gentle rotation by hands. The samples were allowed to dry on the blotting paper at room temperature under fan.

Ozonation

Commercial available ozonator was used for ozonation of pesticides treated vegetable samples for the period of 15 minutes as suggested by manufacturer. This ozone treatment was given at concentration of 400 mg h^{-1} in 2 liters water.

$KMnO_4$ cum Ozonation treatment

Vegetable samples were dipped in 2 L of 0.1 % $KMnO_4$ solution for 15 min alongwith, ozonation treatment.

Microwave treatment

The selected vegetable samples were subjected to microwave oven treatment for 2min to study the pesticide losses.

2.1.5 Method of Analysis

Tests	Instruments	Reference
Pesticides	GLC-FPD	QuEChERS AOAC (2007)

3. Result & Discussion

The magnitude of reduction of different OP's are given below in table B and graphically represented by Fig 1. Acephate residues reduction in okra fruits due to different treatments ranged from 30.14 to 74.72 percent. The maximum reduction (74.72 %) of acephate residues was found in treatment T_4 (dipping in 0.5 % acetic acid solution followed by T_1). Treatment T_1 (washing under running tap water) resulted in 72.37 % loss and was found at par with T_4. T_5 treatment (dipping in 0.1 % $KMnO_4$ followed by T_1) was found at par with T_6 treatment (ozontaion for 15 min) and T_2 treatment (dipping in tap water). T_3 (dipping in 2 % brine solution followed by T_1) and T_8 (microwave treatment) resulted in moderate reduction of acephate (39.14- 46.03 %) Minimal reduction 30.31 % was found in T_7 treatment (dipping in 0.1 % $KMnO_4$ and ozonation for 15 min followed by T_1). Methamidophos was not detected in any of the treatments.

The magnitude of reduction of profenophos residues ranged from 22.99 to 67.09 percent. The maximum reduction (67.09 %) of profenophos residues was found in T_1 treatment (washing under running tap water) followed by T_4 treatment (dipping in 0.5 % acetic acid solution followed by T_1) showing 64.96 % reduction of residues and were found at par with each other. T_2 treatment (dipping in tap water) was found at par with T_6 treatment (ozonation for 15 min) and showed reduction to the tune of 52.73 – 54.44 percent.

Dipping in 2 % brine solution followed by T_1 resulted in 38.72 percent reduction whereas dipping in 0.1 % $KMnO_4$ along with ozonation followed by T_1 revealed 34.36 reduction. Microwave treatment showed only 24.36 percent reduction and T_5 (dipping in 0.1 % $KMnO_4$ solution followed by T_1) treatment resulted in minimal removal (22.99 %) of residues.

The magnitude of reduction of ethion residues ranged from 15.02 to 73.75 percent. The data revealed that the treatment T_1 (washing under running tap water) resulted in maximum reduction (73.75 %) of ethion followed by T_4 treatment (dipping in 0.5 % acetic acid for 10 min followed by T_1) revealing 59.30 % reduction. T_2 (dipping in tap water treatment) was found to be the next best treatment reducing upto 52.08 % of residues. Dipping in 2 % brine solution and 0.1 % $KMnO_4$ alongwith ozonation showed moderate reduction ranging (34.85 – 37.05 %).T_5 treatment revealed the minimum reduction of 15.02 percent. Due to T_8 treatment (microwave treatment) there was an increase of 10.80 % in residues which could be due to loss of moisture from the commodity.

The residues of triazophos was considerably reduced by the treatments which ranged from 27.00 to 70.42 percent. The maximum reduction (70.41 %) was found in T_1 treatment (washing under running tap water) followed by T_4 treatment (dipping in 0.5 % acetic acid solution followed by T_1) which showed reduction of 52.17 % of residues. The next best treatment was T_2 (dipping in tap water) treatment and found as effective as T_4 treatment (dipping in 0.5 % acetic acid followed by T_1) treatment showing 46.87 – 52.17 percent dislodging. Dipping in 2 % brine solution, 0.1 % $KMnO_4$ and microwave treatment showed moderate removal of triazophos (30.76 – 39.59 %). Minimal reduction of 27 percent was found in T_7 treatment (dipping in 0.1 % $KMnO_4$ and ozonation followed by T_1).

Data presented from above findings showed that treatment T_1 (washing under running tap water) recorded maximum reduction of ethion, profenophos and triazophos in okra fruit. Kumari (2008) and Singh *et al.* (2004) also found similar trend.
Washing under running tap water for 2 min was found the best treatment in reducing the level of profenophos, ethion and triazophos could be due to the fact as okra fruit has hairy structure which might have helped in dislodging the residues due to the pressure under running tap water the residues, also observed by Kumari B. (2008).

The reason for dislodging of acephate by 0.5 % acetic acid treatment from okra depends upon many factors such as solubility of acephate in different solvents, adherence and adsorption activity in okra, abiotic conditions etc.

Solubility of acephate in different organic solvents ranges from (292.90 to 327.60 mg/mL) K (Wang *et al*. 2007) which could be the reason for maximum removal by 0.5 % acetic acid solution as it is the only organic solvent among all the given treatments. Moreover, morphological attributes of okra fruit also supports this phenomenon. Due to presence of hairy structure & waxy layer, the entry of insecticide inside its deeper tissues is restricted as acephate is slightly systemic.

Furthermore, active entrapping of acephate by waxy layer of okra fruit to most of residues were present over the fruit and as like dissolves like, maximum dislodging of acephate was observed by dipping in 0.5 % acetic acid followed by washing under running tap water for 2 min.

Table B: Data of residue reduction in different commodities

S.No	Residue (µg g^{-1}) → / Treatments ↓	Acephate			Profenophos			Ethion			Triazophos		
		X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
1.	T_0: Control	1.234	-	-	1.170	-	-	1.73	-	-	1.359	-	-
2.	T_1: Washing under running tap water for two min	0.341	0.893	72.37	0.385	0.785	67.09	0.454	1.276	73.75	0.402	0.957	70.41
3	T_2: Dipping in tap water for 10 min followed by T_1	0.533	0.701	56.81	0.533	0.637	54.44	0.829	0.901	52.08	0.722	0.637	46.87
4	T_3: Dipping in 2% brine solution for 10 min followed by T_1	0.751	0.483	39.14	0.717	0.453	38.72	1.089	0.641	37.05	0.821	0.538	39.59
5	T_4: Dipping in 0.5% acetic acid solution for 10 min followed by T_1	0.312	0.922	74.72	0.410	0.76	64.96	0.704	1.026	59.30	0.650	0.709	52.17
6	T_5: Dipping in 0.1% $KMnO_4$ solution for 10 min followed by T_1	0.496	0.738	59.80	0.901	0.269	22.99	1.470	0.26	15.02	0.941	0.418	30.76
7	T_6 : Ozonation for 15 min	0.519	0.715	57.94	0.553	0.617	52.73	0.978	0.752	43.47	0.978	0.381	28.04
8	T_7: Dipping in 0.1% $KMnO_4$ solution for 10 min followed by T_1	0.862	0.372	30.14	0.768	0.402	34.36	1.127	0.603	34.85	0.992	0.367	27.00
9	T_8: Microwave treatment for 2 min	0.666	0.568	46.03	0.885	0.285	24.36	1.917	-.187	-10.81	0.850	0.509	37.45
10	S.Em.±	0.01			0.01			0.02			0.02		
11	CD	0.03			0.03			0.07			0.07		
12	CV(%)	3.78			3.47			3.94			5.62		

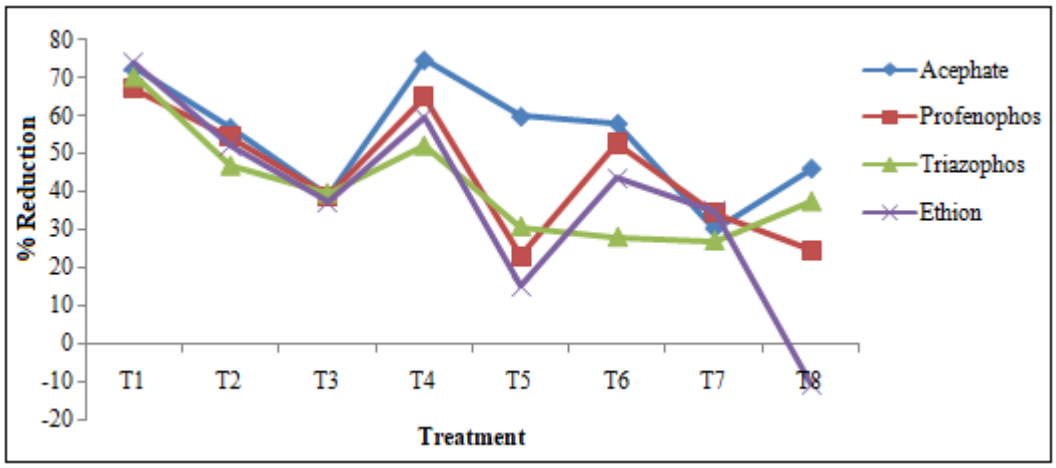

Figure 1: Overall view of reduction in residues

4. Conclusion

Decontamination of acephate, profenophos, ethion and triazophos was observed in the range of 30.14- 74.72, 22.99-67.09, 15.02-73.75 and 27.00-70.42 percent, respectively. Treatment T_1 (washing under running tap water for 10 min) was resulted in maximum removal than rest of the treatments in decontamination of profenophos, ethion and triazophos showing 67.09, 73.75 and 70.42 %, respectively. Acephate was reduced in maximum amount i.e. 74.72 % by T_4 treatment (dipping in 0.5 % acetic acid) which was at par with T_1. The next best treatment was found T_4 (dipping in 0.5 % acetic acid) which resulted in 64.96, 59.30 and 52.17 % reduction of profenophos, ethion and triazophos, respectively. T_1 treatment (washing under running tap water for 10 min) was the second best treatment for removal of acephate upto 72.37 percent. Among all the treatments, T_5 (dipping in 0.1% $KMnO_4$ followed by T_1) treatment was found to show a minimal effect in reduction of profenophos and ethion. Similarly T_6 (ozonation for 15 min) was least effective in reducing acephate and triazophos residues. Moreover, T_8 (microwave treatment for 2 min) treatment resulted in increase in ethion residues upto 10.81 percent.

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