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Anugu Anil Reddy
Assistant Professor, Department of Entomology, Agricultural Polytechnic, Malthummeda, PJTSAU, Kamareddy, Telangana, India

Narendra Reddy C
Associate Dean, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad, Telangana, India

Anitha Kumari D
Senior Scientist (Ento.), Vegetable Research Station, ARI, SKLTSHU, Hyderabad, Telangana, India

Manohar Rao A
Professor and Univ. Head (Rtd.), Department of Horticulture, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad, Telangana, India

Narendar Reddy S
Associate Dean, Agriculture College, PJTSAU, Jagtial, Telangana, India

Srinivasa Reddy S
Assistant Professor, Department of Entomology, Agricultural College, Palem, PJTSAU, Telangana, India

Corresponding Author:
Anugu Anil Reddy
Assistant Professor, Department of Entomology, Agricultural Polytechnic, Malthummeda, PJTSAU, Kamareddy, Telangana, India

Decontamination methods for different insecticides in chilli (*Capsicum annum* L.)

Anugu Anil Reddy, Narendra Reddy C, Anitha Kumari D, Manohar RaoA, Narendar Reddy S and Srinivasa Reddy S

Abstract
The present decontamination method study was carried out at All India Network Project on Pesticide Residues, Rajendranagar, Hyderabad during kharif 2015-16 for test insecticides *viz.*, fipronil at 500 g a.i. ha^{-1}, spinosad at 125 g a.i. ha^{-1}, chlorantraniliprole at 30 g a.i. ha^{-1}, profenophos at 400 g a.i. ha^{-1}, lambda cyhalothrin 15.63 g a.i. ha^{-1}, imidacloprid (betacyfluthrin + imidacloprid at 30 g a.i. ha^{-1}), betacyfluthrin (betacyfluthrin + imidacloprid at 30 g a.i. ha^{-1}) and dimethoate at 300 g a.i. ha^{-1} with different decontamination methods. Among various decontamination methods tested, Formula 1 was found to be most effective in removing pesticide residues to an extent of 62.72-75.71 percent varying with type of pesticides, followed by 2% salt solution in chlorantraniliprole, profenophos, lambda cyhalothrin and dimethoate, while 0.1% baking soda solution was found more effective than 2% salt solution in fipronil, spinosad, imidacloprid and beta cyfluthrin and least removal of all insecticides from green chillies was recorded from tap water wash which ranged from 10.57 to 30.19 percent.

Keywords: Chilli, insecticides, residues, decontamination methods

1. Introduction
Chilli (*Capsicum annum* L.), is an important vegetable and condiment crop grown throughout the world and it has immense commercial, dietary and therapeutiuc values. It is a rich source of A, C, E and P and an alkaloid capsacin, which has high medicinal value and is used in many pharmaceutical preparations. India is the world leader in chilli production followed by China and Pakistan. A number of pesticides are being frequently used, to combat the major pests in chilli. However, some of these insecticides leave residues on pods and these residues may persist up to harvest.The extensive and irrational use of pesticides resulted in the presence of residues of insecticides on chilli is likely to be associated with severe effects on human health. Hence, great significance has to be given to estimate pesticide residues in chilli and to standardize simple cost-effective methods which can be practiced by home makers to eliminate pesticide residues. In the light of the above facts a study was carried out to measure the residues in chilli and to assess the effect of different decontamination techniques on the removal of pesticide residues.

2. Materials and Methods
The zero-day samples after third spray from the bioefficacy trail from different treatments *viz.*, fipronil 5% SC, spinosad 45% SC, chlorantraniliprole 20% SC, profenophos 50% EC,lambda cyhalothrin 5% SC, imidacloprid + beta cyfluthrin 300% OD and dimethoate 30% EC in large quantities and made into six sets, each with four replications. One set of samples from each treatment (in 4 replications) was analyzed for deposits of the pesticide. The remaining sets of samples of zero day from each treatment samples were subjected to various decontamination methods separately and these samples were analysed for residues through validated method. Finally, the residues were calculated for each treatment to know the efficiency of the various decontamination methods for the removal of pesticide residues from the chilli samples. The following decontamination / risk mitigation methods *i.e* Tap water wash, Soaking in 2% salt solution for 10 min followed by tap water wash, Cooking in pressure cooker for 10 min, Dipping in 0.1% Sodium Bicarbonate solution keep it for 10 min followed by tap water wash and dipping in Formula 1 (4% Acetic Acid + 0.1% $NAHCO_3$ + 1 Lemon).

$$\text{Per cent removal} = \frac{\text{Initial deposit - Residues after treatment}}{\text{Initial deposit}} \text{ X } 100$$

3. Results and Discussion

The chilli samples were collected from various plots treated with recommended doses of fipronil at 500 g a.i. ha^{-1}, spinosad at 125 g a.i. ha^{-1}, chlorantraniliprole at 30 g a.i. ha^{-1}, profenophos at 400 g a.i. ha^{-1}, lambda cyhalothrin15.63 g a.i. ha^{-1}, imidacloprid (betacyfluthrin + imidacloprid at 30 g a.i. ha^{-1}), betacyfluthrin (betacyfluthrin + imidacloprid at 30 g a.i. ha^{-1}) and dimethoate at 300 g a.i. ha^{-1} were used to estimate the initial deposits and efficiency of different decontamination methods through quantification of their residues after subjecting to risk mitigation methods and the results were presented in table 1.

Table 1: Effectiveness of various decontamination methods for the removal of insecticides in chilli

Insecticides	Initial deposits (mg kg^{-1})	Mean percent removal of Insecticides					CD (5%)
		Tap water	2% salt solution	Cooking	0.1% $NaHCO_3$	Formula 1	
Fipronil	1.47	14.91	44.84	33.04	50.19	69.27	2.43
Spinosad	0.78	16.37	40.39	36.59	44.29	66.43	4.36
Chlorantraniliprole	0.56	19.33	50.97	36.84	43.99	73.37	3.37
Profenophos	2.60	12.61	44.27	29.93	38.47	71.06	4.20
Lambda –cyhalothrin	1.20	30.19	49.32	38.15	42.59	62.72	5.52
Imidacloprid	1.10	21.86	50.37	43.41	56.16	64.17	6.38
Betacyfluthrin	0.28	27.60	42.02	36.87	48.54	66.31	4.44
Dimethoate	3.86	10.57	49.55	31.97	40.78	75.71	3.39

3.1 Fipronil 5% SC @ 500 g a.i ha^{-1}

The treatment dipping in formula 1 solution for 10 min followed by tap water wash for 30 sec was found to be most effective (69.27%) in removal of insecticides than other decontamination methods and further this decontamination method was significantly efficient in the removal of fipronil when compared to other methods. The percent removal of fipronil residues due to various decontamination methods in descending order were tap water wash for 30 sec, formula 1(69.27) > dipping in 0.1% Baking soda solution (50.19) > soaking in 2% salt solution (44.84) > cooking in pressure cooker (33.04) > Tap water (14.91).

3.2 Spinosad 45% SC @ 125 g a.i ha^{-1}

Various decontamination methods were evaluated in order to know their efficiency in removing spinosad residues from green chilli. Results revealed that all the treatment solutions significantly differed among each other in their efficiency in removing spinosad residues. Dipping in formula 1 solution for 10 min followed by tap water wash for 30 sec was found to be most effective (66.43%) than other treatments. The next promising treatment was dipping in 0.1% baking soda solution for 10 min followed by tap water wash for 30 sec (44.29%). The next best treatment followed was soaking in 2% salt solution followed by tap water wash for 30 sec (40.39%) and cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (36.59%) while tap water wash for 10 min (16.37%) found to be least effective in removal of spinosad residues from green chilli fruits.

3.3 Chlorantraniliprole 20% SC @ 30 g a.i ha^{-1}

The green chilli samples obtained from the plots sprayed with chlorantraniliprole @ 30 g a.i ha-1 were subjected to various decontamination methods. The results indicated that among the different treatments employed, dipping fruits in formula 1 solution for 10 min followed by tap water wash for 30 sec was found to be more effective (73.37%) than other treatments. Soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec (50.97%) was found to be next promising treatment, followed by dipping in 0.1% baking soda solution for 10 min followed by tap water wash for 30 sec (43.99%), cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (36.84%) and tap water wash for 10 min (19.33%).

3.4 Profenophos 50% EC @ 400 g a.i ha^{-1}

The green chilli samples were collected from the plots sprayed with profenophos @ 400 g a.i ha-1 were subjected to different decontamination methods at 2 hours after spraying. Results revealed that dipping in formula 1 solution for 10 min followed by tap water wash for 30 sec was found to be most effective among all treatments. In this treatment residues were reduced up to 71.06 percent. The next promising treatment was soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec (44.27%), followed by dipping in 0.1% baking soda solution for 10 min followed by tap water wash for 30 sec (38.47%), cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (29.93%) and tap water wash for 10 min (12.61%).

3.5 Lambda cyhalothrin 5% SC (15.63 g a.i. ha-1)

Various decontamination methods were evaluated in order to know their efficiency in removing lambda cyhalothrin residues from green chilli. Results revealed that all the treatment solutions significantly differed among each other in their efficiency in removing lambda cyhalothrin residues. Dipping in formula 1 solution for 10 min followed by tap water wash for 30 sec was found to be most effective (62.72%) than other treatments. Next promising treatment was soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec (49.32%), followed by dipping 0.1% baking soda solution for 10 min followed by tap water wash for 30 sec (42.59%), cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (38.15%) and tap water wash for 10 min (30.19%).

3.6 Imidacloprid + Beta cyfluthrin 300% OD @ 30 g a.i. ha^{-1}

To study the efficacy of various decontamination methods, the chilli samples collected from the plots treated with imidacloprid + beta cyfluthrin 300 OD @ 30 g a.i. ha-1 were subjected to different decontamination methods.

3.6.1 Imidacloprid

The collected green chilli samples were subjected to different decontamination solutions at 2 hours after spraying. The results depicted that dipping in formula 1 solution for 10 min followed by tap water wash for 30 sec was found to be significantly effective in removing 64.17 percent residues,

than other treatments. The next promising treatment was dipping in 0.1% Baking soda solution for 10 min followed by tap water wash for 30 sec (56.16%), followed by soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec (50.37%), cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (43.41%) and tap water for 10 min (21.86%).

3.6.2 Beta cyfluthrin

The green chilli samples collected from the plots treated with imidacloprid + beta cyfluthrin @ 30 g a.i. ha-1 were subjected to various decontamination methods. The results revealed that all the treatments were significantly differed among each other in their efficiency in removing beta cyfluthrin residues. Dipping in formula 1 solution for 10 min followed by tap water wash for 30 sec was found to be most effective (66.31%) than other treatments. The next promising treatment was dipping in 0.1% baking soda for 10 min followed by tap water wash for 30 sec (48.54%) followed by soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec (42.02%), cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (36.87%) and tap water wash for 10 min (27.60%).

3.7. Dimethoate 30% EC (300 g a.i. ha^{-1})

The removal of dimethoate residues from green chilli samples were significantly differed in different decontamination methods at 2 hours after spraying of dimethoate @ 300 g a.i ha^{-1}. The results revealed that dipping in formula 1 solution for 10 min followed by tap water wash for 30 sec was found to be significantly effective when compared to other treatments. In this treatment residues were reduced up to 75.71 percent. The next promising treatment was soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec (49.55%) followed by dipping in 0.1% baking soda solution for 10 min followed by tap water wash for 30 sec (40.78%), cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (31.97%) and tap water wash for 10 min (10.57%).

In the present study, dipping in formula 1 (4% Acetic Acid + 0.1% NAHCO3 + 1 Lemon), a formulation prepared by AINP on Pesticide Residues proved to be the most efficient in removing various pesticides and these findings were in agreement with the results of Dikshit *et al*. (1984) [2] who reported that washing of cowpea with 1% acetic acid solution was capable of removing 85.70 and 88.60 percent of metasystox and carbaryl residues, respectively. Similar results were also reported by Radwan *et al*. (2004) [4] who reported that washing of hot pepper, sweet pepper and brinjal with 2% acetic acid removed pirimophos-methyl residues by 76.61, 95.74 and 94.58 percent, respectively.

Reddy and Rao (2004) [5] found that dipping of grapes in 1% acetic acid solution for 10 min, followed by water wash removed 51.80, 46.60, and 70.00 percent of chlorpyriphos, quinalphos and bifenthrin residues, respectively. Similarly, Zhang *et al*. (2006) [6] found that 79.8, 65.8, 74.0 and 75.00 percent residues of chlorpyrifos, p,p-DDT, cypermethrin and chlorothalonil were removed by washing cabbage with 10% acetic acid solution for 20 min, respectively. The treatment with soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec was found to be next best decontamination method in case of chlorantraniliprole, profenophos, lambda- cyhalothrin and dimethoate. The results were in agreement with the findings of Geetha (2015) [3] who reported that loss of 31.47, 32.13, 46.87 and 43.78 percent of chlorpyriphos, profenophos, cypermethrin and triazophos residues in spinach by salt water treatment for 10 min. Washing of brinjal with 2 percent salt solution removed the 45.3, 43.0, 52.1, 49.8, 54.0, 47.9 and 76.5 percent of dimethoate, chlorpyriphos, quinalphos, profenophos, phosalone, lambda cyhalothrin and malathion residues, respectively (Cherukuri *et al*., 2014) [1].

4. Conclusion

Among various decontamination methods tested, Formula 1 was found to be most effective in removing pesticide residues to an extent of 62.72-75.71 percent varying with type of pesticides.

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