Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(6): 2010-2017

Received: 19-09-2020
Accepted: 26-10-2020

Dr. S Srinivasa Reddy
Assistant Professor, Department of Entomology, Agricultural College, Palem, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

Dr. C Narendra Reddy
Professor (Ento.) and Associate Dean, Agril.College, Jagtial, PJTSAU, Hyderabad, Telangana, India

Dr. A Anil Reddy
Assistant Professor (Ento.), APT, Malthumeda, PJTSAU, Hyderabad, Telangana, India

Dr. A Manohar Rao
Professor and University Head (Horticulture), College of Agriculture, Rajendranagar, PJTSAU, Hyderabad, Telangana, India

Dr. S Narender Reddy
Professor, Crop Physiology, College of Agriculture, Rajendranagar, PJTSAU, Hyderabad, Telangana, India

Corresponding Author:
Dr. S Srinivasa Reddy
Assistant Professor, Department of Entomology, Agricultural College, Palem, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Telangana, India

Risk mitigation methods for different pesticides on Indian bean for food safety

Dr. S Srinivasa Reddy, Dr. C Narendra Reddy, Dr. A Anil Reddy, Dr. A Manohar Rao and Dr. S Narender Reddy

Abstract
Objective: To evaluate the decontamination methods for the removal of pesticide residues on Indian bean for food safety.
Material and Methods: Evaluation of effectiveness of decontamination methods were carried out by collecting zero-day samples from each treatment wise after spray and made into many sets at four replications. One set of sample from each treatment was analyzed for initial deposits of the pesticide and remaining sets of samples of zero day from each treatment were subjected to various decontamination methods separately and these samples were analyzed for residues through validated method.
Results: The highest removal of all insecticides from green pods of field bean were obtained from the treatment Formula 1 (4% Acetic Acid + 0.1% $NAHCO_3$ + 1 Lemon) ranging from 67.60 to 74.90 per cent followed by 2% salt solution in chlorantraniliprole 20% SC @ 30 g a.i ha^{-1}**,** bifenthrin 10% EC @ 812 g a.i ha^{-1} profenophos 50% EC @ 400 g a.i ha^{-1}**,** lambda cyhalothrin 5% SC @ 15.63 g a.i ha^{-1}, beta cyfluthrin (Solomon 300 OD) @ 30 g a.i ha^{-1} while, 0.1% baking soda solution was found more effective than 2% salt solution for fipronil 5% SC @ 500 g a.i ha^{-1}, flubendiamide 480% SC @ 60 g a.i ha^{-1} imidacloprid (Solomon 300 OD) @ 30 g a.i ha^{-1} and least removal of all insecticides from green pods of field bean was recorded from tap water wash which ranged from 11.39 to 29.64 per cent.
Conclusion: Formula 1 (4% Acetic Acid + 0.1% $NAHCO_3$ + 1 Lemon) decontamination process can be practiced as a house hold process which proves best practice in removal of pesticide residues on Indian bean surface towards food safety and better human health.

Keywords: Green pods, decontamination, chromatography, QuEChERS

Introduction
Pulse crops are narrated as the jewels of Indian agriculture, in view of their unique capacity to fill the dietary requirements of protein besides their sustainable character through replenishing soil fertility. Field bean is an important pulse cum vegetable crop in India and is cultivated extensively for its fresh tender pods, leaves and seeds and as cattle feed. Pod borers were the key impediments for the low productivity in India to a loss up to nearly 54 per cent in field beans [1]. The major yield loss was inflicted by the pod feeders which include both the pod borers and pod bugs. Pesticide use has increased rapidly over the last two decades at the rate of 12 per cent per year. The extensive and irrational use of pesticides resulted in the presence of residues of insecticides on different edible plant parts used for human consumption resulting in various public health problems beside environmental ill effects. Presence of pesticide residues in the harvested beans is posing problem at the time of export and in recent times importing countries have rejected few consignments. Hence, great significance has to be given to for safe consumption. Elimination of these pesticide residues are significant before consumption of vegetables, hence it is important for the removal of these residues before consumption of vegetables. Various studies demonstrates that processing leads to large reduction in residue levels in the prepared food, particularly through washing, peeling and cooking operation [2, 3]. The aim of the study was to determine the best effective decontamination method to remove the various treatmental insecticides from the fresh pods of Indian bean for maintenance of food safety to consumer level as the above MRL values will cause the serious health issues to human beings. In order to avoid these circumstances the present investigation was carried out to remove the residues from the substance by various decontamination methods and to judge the best decontamination method among various methods of decontamination. Therefore, it is compulsory to look for cheap and finest methods which can be implemented easily at home,

thus keeping these requirement in mind, the present studies were taken up to evaluate the effect of different household processing and lab practices to reduce pesticide residues to a safe level for human consumption.

Materials and Methods

Evaluation of decontamination methods for removal of pesticide residues

The evaluation of decontamination methods for the removal of pesticide residues was carried out by collecting zero day samples after spray from the field trial during *kharif* 2015-16 from different treatments in large quantities and made into many sets at four replications. One set of sample from each treatment was analyzed for initial deposits of the pesticide and remaining sets of samples of zero day from each treatment were subjected to various decontamination methods separately and these samples were analyzed for residues through validated method (QuEChERS). Finally the residues were calculated to know the efficiency of the various decontamination methods in the removal of pesticide residues from the field bean samples. The following decontamination / risk mitigation methods were selected for evaluation of efficiency in removal of pesticide residues from field bean.

T_1 (Tap water wash)

Four litres of tap water was taken into the plastic tub of 7 litres capacity and 2 kg of field bean pods were dipped in the tub for 10 min, followed by the tap water wash for 30 sec, further the pods were kept for air drying on tissue paper for 5 min.

T_2 (Soaking in 2% salt solution for 10 min followed by tap water wash)

Four litres of 2% salt solution was prepared by mixing 80 g of table salt in 4 litres of water in plastic tub of 7 litres capacity and 2 kg field bean pods were dipped in the tub for 10 min, followed by the tap water wash for 30 sec, further the pods were kept for air drying on tissue paper for 5 min, followed by analysis.

T_3 (Cooking in pressure cooker for 10 min)

Cooking of the 2 kg field bean pods in pressure cooker for 10 min, followed by the tap water wash for 30 sec, further the pods were kept for air drying on tissue paper for 5 min, followed by analysis.

T_4 (Dipping in 0.1% Sodium Bicarbonate solution keep it for 10 min followed by tap water wash)

Four litres of 0.1% of $NaHCO_3$ solution was prepared by mixing of 4 g of $NaHCO_3$ in 4 litres of water in plastic tub of 7 litres capacity, mixture was kept for 1 min and 2 kg of field bean pods were dipped in the tub for 10 min, followed by the tap water wash for 30 sec, further the pods were kept for air drying on tissue paper for 5 min, followed by analysis.

T_5 (Dipping in Formula 1 (4% Acetic Acid + 0.1% $NAHCO_3$ + 1 Lemon)

Four litres of Formula 1 was prepared by mixing 160 ml of acetic acid, 4 grams of sodium bicarbonate and 4 lemons added to 4 litres of water in plastic tub of 7 litres capacity, mixture was kept for 1 min and 2 kg field bean pods were dipped in the tub for 10 min, followed by the tap water wash for 30 sec, further the pods were kept for air drying on tissue paper for 5 min, followed by analysis.

Per cent removal of pesticide

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

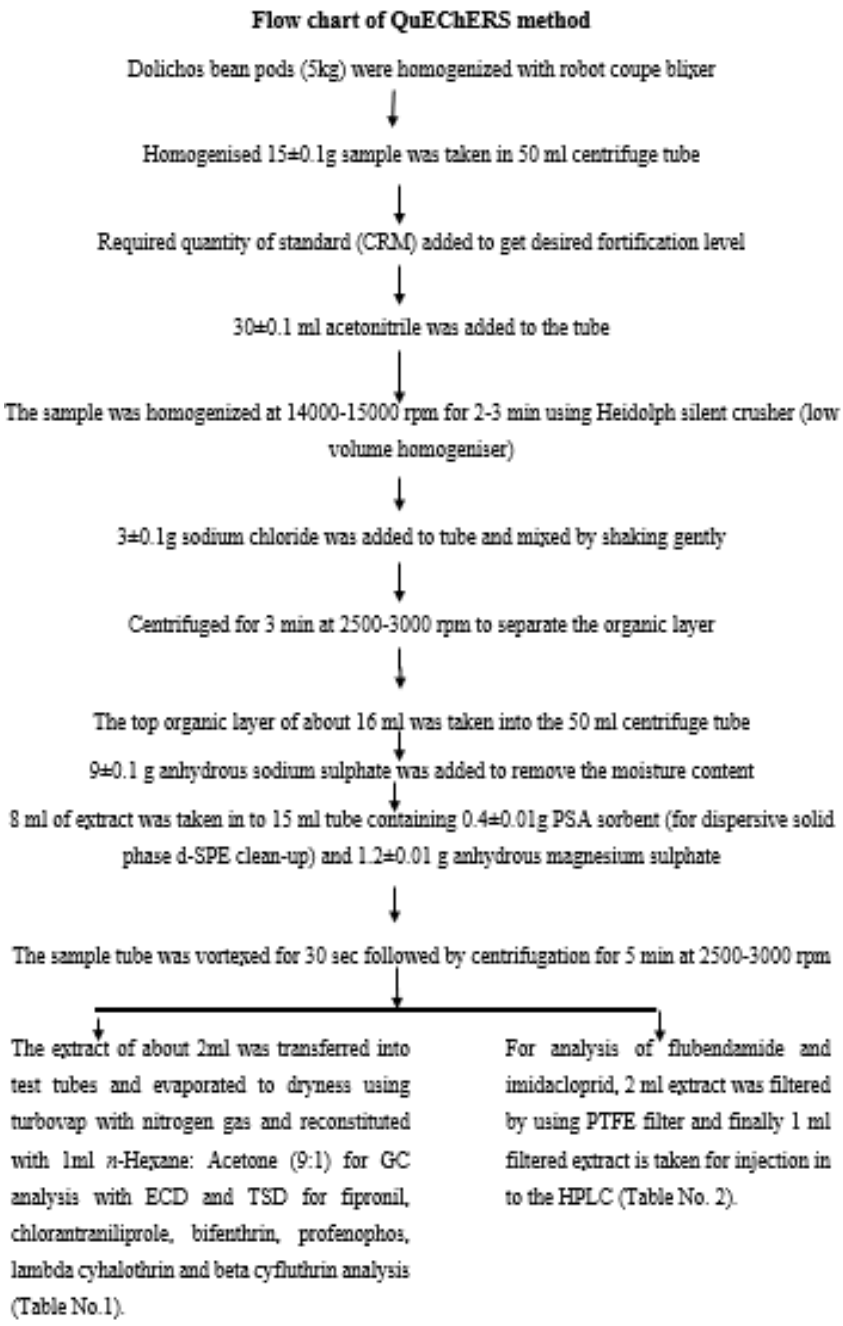

Table 1: Details of GC parameters

Gas Chromatograph	Gas Chromatography- AGILENT- 7890B
Column	VF-5ms Capillary Column 30 m length, 0.25 mm Internal Diameter, 0.25 mm film thickness; 1% methyl siloxane
Column Oven (^{0}C)	Fipronil- Initial 180^{0}C - 2 min hold - increase @ 10^{0}C/min upto 260^{0}C - hold time 5 mins – increase @2^{0}C/min upto 280^{0}C – hold for 10 min. Chlorantraniliprole - Initial 180^{0}C for 2 min - increase @ 10^{0}C/min upto 260^{0}C – hold for 15 min. Bifenthrin - Initial 200^{0}C for 6 min – increase @ 20^{0}C/min upto 280^{0}C – hold for 10 min. Profenophos - Initial 150^{0}C for 1 min - increase @ 20^{0}C/min upto 250^{0}C – hold for 9 min. Lambda cyhalothrin - Initial 200^{0}C for 6 min - increase @ 20^{0}C/min upto 280^{0}C – hold for 10 min. Beta cyfluthrin - Initial 180^{0}C - 2 min hold – increase @ 10^{0}C/min upto 260^{0}C - hold time 5 min – increase @2^{0}C/min upto 280^{0}C – hold for 10 min.
Detectors	Electron Capture Detector (ECD)
Detector Temperature (^{0}C)	300
Injector Temperature (^{0}C)	280
Injector Status	Split Ratio: 1:2
Carrier Gas	Nitrogen, Iolar II, Purity 99.999%
Carrier Gas Flow (ml min^{-1})	2
Make-up Flow (ml min^{-1})	25
Retention time (min)	Fipronil 8.96
	Chlorantraniliprole 4.18

	Bifenthrin 11.94
	Profenophos 11.87
	Lambda cyhalothrin 9.11
	Beta cyfluthrin 19.74
Total run time (min)	Fipronil 35.00
	Chlorantraniliprole 25.00
	Bifenthrin 20.00
	Profenophos 15.00
	Lamda cyhalothrin 20.00
	Beta cyfluthrin 35.00

Table 2: Details of HPLC operating parameters

HPLC	**Shimadzu LC-30**		
Detector	Mass Spectrometer (MS)		
Column	HPLC Column Kinetex C18 column, 2.6 micron particle size 100 length, 3 mm ID		
Solvents in Pump A	Water		
Solvents in Pump B	Metanol		
Solvents Gradient Program	Water: Methanol (5:95) mixture run for 2 min		
Solvents Gradient rate	0.4 ml min^{-1}		
Quantity of sample injected	1 µl		
Run time	10 min		
Retention time	Flubendamide-7.92 min Imidacloprid- 2.29 min		
LC Program For flubendamide	Time	Methanol	Water
	0.01	35	65
	2.00	60	40
	4.00	80	20
	6.00	60	40
	8.00	35	65
	10.01	Stop	-
LC Program for imidacloprid	Time	Methanol	Water
	0.01	35	65
	4.00	Stop	-

Results

The field bean pod samples collected at zero day (2 hours after application) after spray from the plots treated with fipronil 5% SC @ 500 g a.i. ha^{-1},flubendamide 480% SC @ 60 g a.i ha^{-1}, chlorantraniliprole 20% SC @ 30 g a.i. ha^{-1}, bifenthrin 10 EC @ 812 g a.i ha^{-1}, profenophos 50% EC @ 400 g a.i. ha^{-1}, lambda cyhalothrin 5% SC @ 15.63 g a.i ha^{-1}, imidacloprid 17.8% SL @ 25 g a.i. ha^{-1} and imidacloprid + beta cyfluthrin 300 OD @ 30 g a.i.ha^{-1} 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 are presented in table 3 and figs 1 to 9.

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

Fipronil is a broad-use insecticide that belongs to the phenylpyrazole chemical family. Dipping of field bean pods in formula 1 solution for 10 min followed by tap water wash for 30 sec was found to be significantly effective (71.18%) in removal of insecticides than other decontamination methods. The percentage removal of fipronil residues due to various decontamination methods in descending order were, formula 1 (71.18%) > dipping in 0.1% baking soda solution (52.51%) > soaking in 2% salt solution (48.25%) > cooking in pressure cooker (39.88%) > washing with tap water (18.96%). Per cent removal of fipronil residues on field bean pods from various decontamination methods is shown in fig.1

Flubendamide 480% SC @ 60 g a.i ha^{-1}

Flubendiamide is a novel class of insecticide belonging to thalic acid diamides family. Various decontamination methods were evaluated in order to know their efficiency in removing of flubendamide residues from field bean pods. Dipping in formula 1 solution for 10 min followed by tap water wash for 30 sec was found to be significantly effective (66.90%) 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 (46.37%). The next best treatments were soaking in 2% salt solution followed by tap water wash for 30 sec (38.81%) and cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (37.49%) while tap water wash for 10 min (15.61%) was found to be least effective in removal of flubendiamide residues from field bean pods. Per cent removal of flubendamide residues due to various decontamination methods is presented in fig.2.

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

Chlorantraniliprole is a new class of selective insecticides belonging to anthranilic diamides family. The field bean pod samples obtained from the plots sprayed thrice with chlorantraniliprole 20% SC @ 30 g a.i ha^{-1} were subjected to various decontamination methods. The results indicated that among the different treatments employed, dipping of field bean pods in formula 1 solution for 10 min followed by tap water wash for 30 sec was found to be significantly effective (68.28%) than other treatments. Soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec (52.93%) 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 (51.65%), cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (41.50%) and tap water wash for 10 min (20.28%). Per cent removal of chlorantraniliprole residues from various decontamination methods are presented in fig3.

Bifenthrin 10% EC @ 812 g a.i ha^{-1}

The removal of bifenthrin residues from field bean samples were significantly differed in different decontamination methods at 2 hours after spraying of bifenthrin 10% EC @ 812 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 67.60 per cent. The next promising treatment was soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec (52.29%) followed by dipping in 0.1% baking soda solution for 10 min followed by tap water wash for 30 sec (43.11%), cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (37.74%) and tap water wash for 10 min (29.64%).(Fig.4).

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

The field bean pod samples were collected from the plots sprayed with profenophos 50% EC @ 400 g a.i ha^{-1} were subjected to different decontamination methods at 2 hours after third spray. 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 among all treatments. In this treatment residues were reduced up to 72.43 per cent. The next promising treatment was soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec (45.12%), followed by dipping in 0.1% baking soda solution for 10 min followed by tap water wash for 30 sec (39.88%), cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (29.43%) and tap water wash for 10 min (11.39%) (Fig.5).

Lambda cyhalothrin 5% SC @ 15.63 g a.i ha^{-1}

The various decontamination methods were evaluated in order to know their efficiency in removing lambda cyhalothrin residues from field bean pods. The treatment with dipping in formula 1 solution for 10 min followed by tap water wash for 30 sec was found to be significantly effective (68.90%) than other treatments. The next promising treatment was soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec (51.96%), followed by dipping 0.1% baking soda solution for 10 min followed by tap water wash for 30 sec (43.63%), cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (36.88%) and tap water wash for 10 min (28.77%) (Fig.6).

Imidacloprid 17.8% SL @ 25 g a.i. ha^{-1}

The collected field bean green pod 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 74.90 per cent residues, than other treatments. The next promising treatment was soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec (61.89%), followed by dipping in 0.1% baking soda solution for 10 min followed by tap water wash for 30 sec (56.11%), cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (47.67%) and tap water for 10 min (22.74%) (Fig7).

Imidacloprid + Beta cyfluthrin 300 OD @ 30 g a.i. ha^{-1}
Imidacloprid (Solomon 300 OD)

The collected field bean green pod samples were subjected to different decontamination solutions at 2 hours after third spray. 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 74.29 per cent 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 (62.47%), followed by soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec (61.05%), cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (46.87%) and the least effective decontamination method was tap water for 10 min (22.38%) (Table.3 and fig. 8).

Beta cyfluthrin (Solomon 300 OD)

The field bean pod samples collected from the plots treated with imidacloprid + beta cyfluthrin @ 30 g a.i. ha^{-1} were subjected to various decontamination methods. The treatment with dipping in formula 1 solution for 10 min followed by tap water wash for 30 sec was found to be significantly effective (69.42%) than other treatments. Then next promising treatment was soaking in 2% salt solution for 10 min followed by tap water wash for 30 sec (47.06%) and the treatments followed were dipping in 0.1% baking soda for 10 min followed by tap water wash for 30 sec (38.07%), cooking in pressure cooker for 10 min followed by tap water wash for 30 sec (45.78%) and tap water wash for 10 min (28.59%).(Fig-9).

Discussions

To minimize dietary exposure to pesticides, it is pertinent to explore strategies that effectively help in reducing the residue content at individual level. Five simple, labour less and cost effective unit operations were imparted to field bean samples for reducing dietary consumption of pesticide residues which can be even followed in poor populace. Out of all treatments imparted each pesticide has its own treatment of reduction. In the present study, dipping in formula 1 (4% Acetic Acid + 0.1% $NAHCO_3$ + 1 Lemon), a formulation prepared by AINP on Pesticide Residues proved to be the most efficient in removing various pesticides from field bean samples and these findings were in agreement with the results of 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 per cent, respectively. Similarly, Zhang *et al.* (2006) [5] found that 79.8, 65.8, 74.0 and 75.0 per cent residues of chlorpyriphos, *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, bifenthrin, profenophos, lambda- cyhalothrin, imidacloprid and beta cyfluthrin (Solomon 300% OD formulation). The results were in agreement with the findings of Geetha (2015) [6] who reported that loss of 31.47, 32.13, 46.87 and 43.78 per cent of chlorpyriphos, profenophos, cypermethrin and triazophos residues in spinach by salt water treatment for 10 min. Washing of brinjal with 2 per cent salt solution removed the 45.3, 43.0, 52.1, 49.8, 54.0, 47.9 and 76.5 per cent of dimethoate, chlorpyriphos, quinalphos, profenophos, phosalone, lambda-cyhalothrin and malathion residues, respectively [7].

Washing of cucumbers in 2% salt solution for 10 min removed residues of trichlorfon, dimethoate, dichlorovos, fenitrothian and chlorpyriphos residues by 46.30, 47.80, 70.20, 28.90 and 60.50 per cent, respectively [8].

The treatment with dipping in 0.1% baking soda ($NaHCo_3$) solution for 10 min followed by tap water wash for 30 sec was the next best treatment in removing residues of fipronil, flubendamide and imidacloprid (Solomon 300% OD

formulation) from field beans. Dipping with 0.1 per cent sodium bicarbonate solution in brinjal removed the 25.4, 21.5, 34.0, 29.8, 33.6, 30.4 and 61.3 per cent of dimethoate, chlorpyriphos, quinalphos, profenophos, phosalone, lambda-cyhalothrin and malathion residues, respectively [7].

The washing of cucumber with 2% $NaHCO_3$ was efficient to remove the trichlorfon, dimethoate, dichlorovos, fenitrothian and chlorpyriphos residues by 73.20, 58.70, 96.40, 51.10 and 77.80 per cent, respectively [8].

The next best decontamination method was cooking in pressure cooker for 10 min followed by tap water wash for 30 sec. The cooking of brinjal removed the monocrotophos, quinalphos, permethrin and cypermethrin residues by 29.68, 22.84, 25.00 and 40.00 per cent, respectively [9].

Tap water wash for 10 min was the least effective treatment and the findings of the present investigations were in agreement with the findings Jayakrishnan *et al.* (2005)[10] reported that washing of tomato fruits with water removed lambda cyhalothrin residues by 29-30 per cent. The tap water wash for 10 min removed trichlorfon, dimethoate, dichlorovos, fenitrothian and chlorpyriphos residues by 36.60, 21.70, 22.60, 22.20 and 59.20 per cent in cucumber, respectively [8].

Cherukuri *et al.* (2014) [7] reported that the loss of 30.7, 35.3, 45.6, 42, 44.1, 40.9 and 70.3 per cent of dimethoate, chlorpyriphos, quinalphos, profenophos, phosalone, lambda-cyhalothrin and malathion residues in brinjal by tap water wash. The loss of malathion, chlorpyriphos, quinalphos, profenophos and cypermethrin in curry leaf to an extent of 25.9, 10.8, 18.6, 21.7 and 8.2 per cent by washing with tap water for 15 min [11]. Similarly, tap water wash for 10 min removed chlorpyriphos, profenophos, cypermethrin and triazophos residues by 15.37, 13.30, 19.21 and 19.88 per cent, respectively in spinach [6]. The highest removal of all insecticides from green pods of field bean were obtained from the treatment Formula 1 (4% Acetic Acid + 0.1% $NAHCO_3$ + 1 Lemon) ranging from 67.60 to 74.90 per cent followed by 2% salt solution in chlorantraniliprole 20% SC @ 30 g a.i ha^{-1}, bifenthrin 10% EC @ 812 g a.i ha^{-1} profenophos 50% EC @ 400 g a.i ha^{-1}, lambda cyhalothrin 5% SC @ 15.63 g a.i ha^{-1}, beta cyfluthrin (Solomon 300 OD) @ 30 g a.i ha^{-1} while, 0.1% baking soda solution was found more effective than 2% salt solution in fipronil 5% SC @ 500 g a.i ha^{-1}, flubendiamide 480% SC @ 60 g a.i ha^{-1} imidacloprid (Solomon 300 OD) @ 30 g a.i ha^{-1} and least removal of all insecticides from green pods of field bean was recorded from tap water wash which ranged from 11.39 to 29.64 per cent.

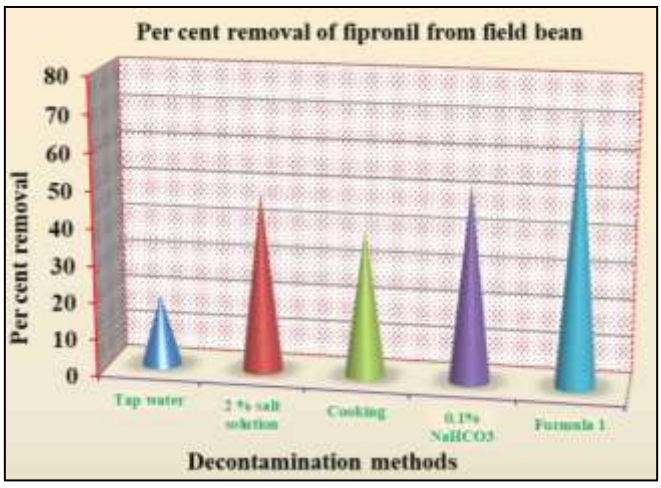

Fig 1: Per cent removal of fipronil residues

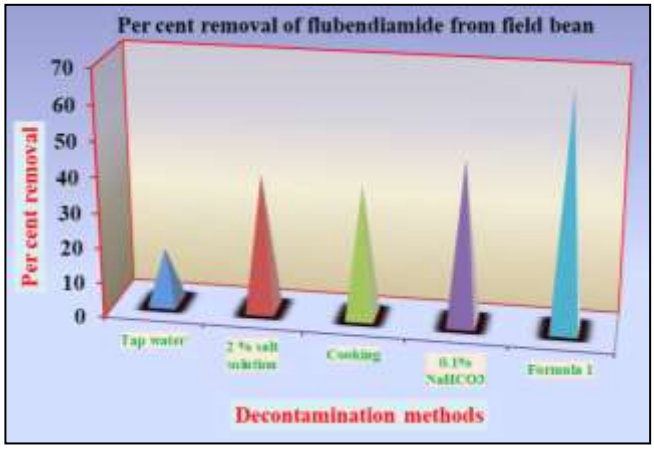

Fig 2: Per cent removal of flubendiamide residues

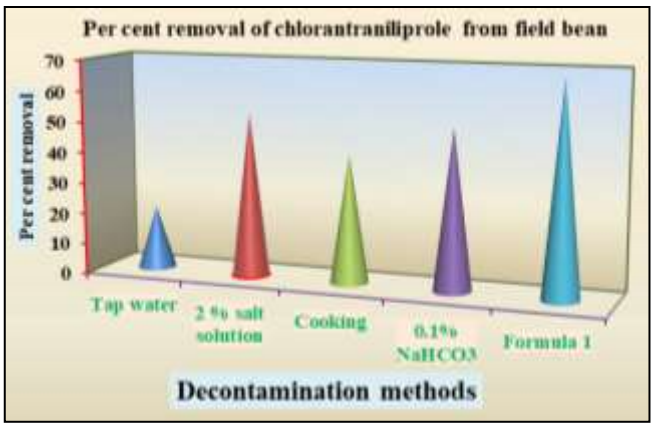

Fig 3: Per cent removal of chlorantraniliprole residues

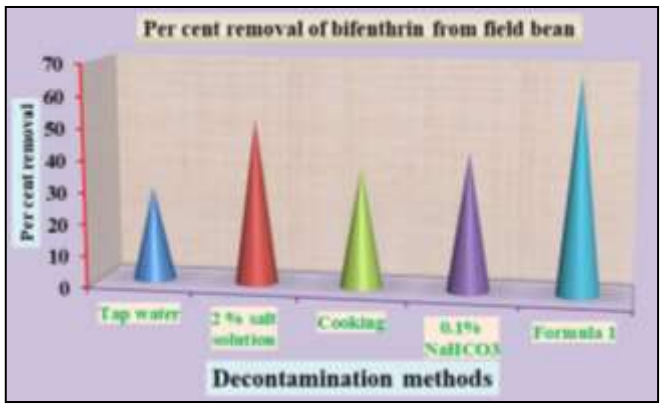

Fig 4: Per cent removal of bifenthrin residues

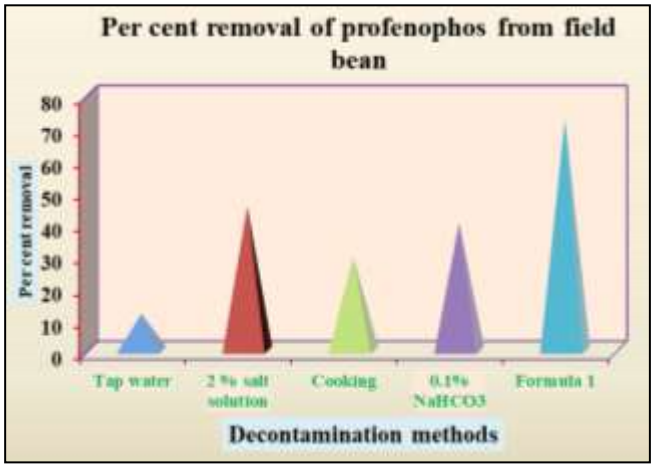

Fig 5: Per cent removal of profenophos residues

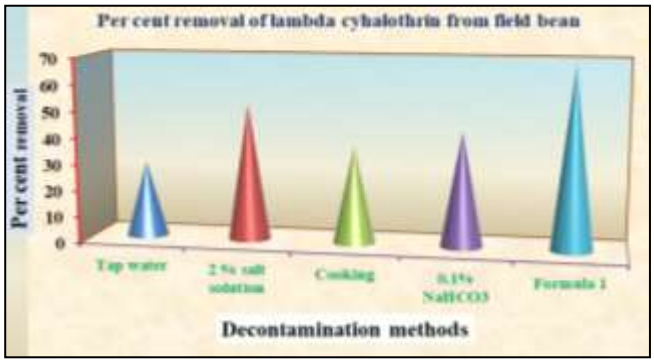

Fig 6: Per cent removal of lambda cyhalothrin residues

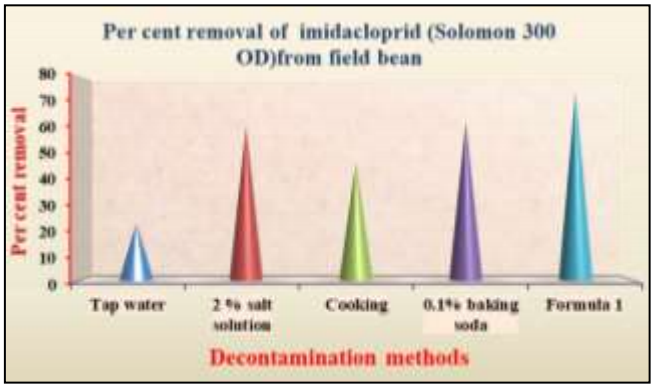

Fig 8: Per cent removal of imidacloprid residues

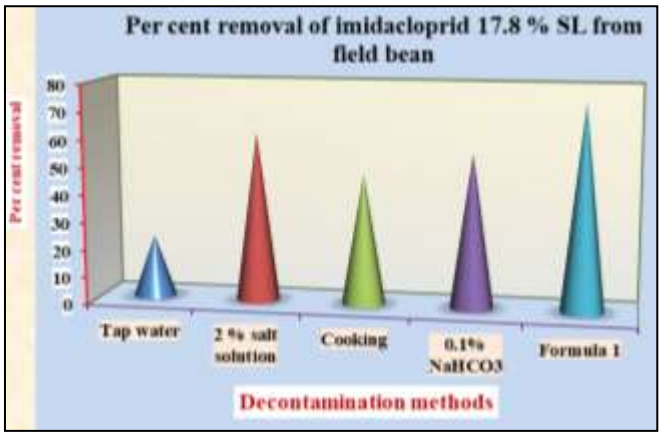

Fig 7: Per cent removal of imidacloprid 17.8% SL residues

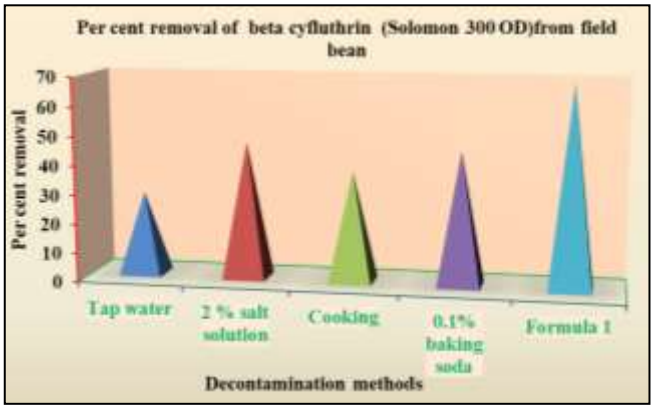

Fig 9: Per cent removal of betacyfluthrin (Solomon 300OD) residues from field bean by various decontamination methods

Table 3: Decontamination of insecticides using different methods

Treatments	Mean per cent removal of Insecticides (%)					
	Tap water	2% salt solution	Cooking in pressure cooker	0.1% baking soda	Formula 1	CD (5%)
Fipronil5% SC	18.96	48.25	39.88	52.51	71.18	5.38
Flubendiamide480% SC	15.61	38.81	37.49	46.37	66.9	4.22
Chlorantraniliprole 20% SC	20.28	52.93	41.5	51.65	68.28	2.82
Bifenthrin 10% EC	29.64	52.29	37.74	43.11	67.6	3.96
Profenophos 50% EC	11.39	45.12	29.43	39.88	72.43	3.26
Lambda cyhalothrin 5% SC	28.77	51.96	36.88	43.63	68.9	4.03
Imidacloprid 17.8% SL	22.74	61.89	47.67	56.11	74.9	7.11
Imidacloprid (Solomon 300%OD)	22.38	61.05	46.87	62.47	74.29	3.12
Betacyfluthrin (Solomon 300%OD)	28.59	47.06	38.07	45.78	69.42	3.19

Conclusion

Thus, based on the results obtained in this study it can be concluded that by processing the Indian with the traditional decontamination processing methods if it helps in the removal of pesticide residues below MRL levels, then it is safe for human consumption and among the all Formula 1 decontamination method was performed superiority and it can be recommended for removal of pesticide residues below MRL levels.

Acknowledgement

The authors would like to acknowledge the support given by Hon'ble Vice- Chancellor Dr.V. Praveen Rao, Professor Jayashankar Telangana State Agriculture University and Dr. V. Anitha, Dean of Post Graduate studies for provision of lab and field for the experiment.

References

1. Naik MI, Tejaswi L, Sridhara S, Manjunath M, Pradeep S. Yield loss and economic injury level for pod borers of field bean (*Lablab purpureus* L.). Environment and Ecology 2009;27(3):1044-1047.
2. Soliman KM. Changes in concentration of pesticide residues in potatoes during washing and home preparation. Food and Chemical Toxicology 2001;39:887-891.
3. Zohair A. Behavior of some organophosphorus and organochlorine pesticides in potatoes during soaking in different solutions. Food Additives and Contaminants 2001;39:751-755.
4. Radwan M, Shiboob M, Abu-Elamayem M, Abdel-Aal A. Pirimiphos-methyl residues on/in some field-grown vegetables and its removal using various washing solutions and kitchen processing. International Journal of Agriculture and Biology 2004;6(6):1026-1029.
5. Zhang YS, Li XP, Liu HM, Zhang YK, Zhao FF, Yu QJ, *et al*. Study on universal cleaning solution in removing blended pesticide residues in chinese cabbage. Journal of Environmental Chemistry and Ecotoxicology 2013;5(8):202-207.

6. Geetha P. Survey on pesticide usage, monitoring of pesticide residues and decontamination methods in spinach (*Spinacia oleracea* L.). M. Sc. Thesis. PJTSAU, Rajendranagar, India 2015.
7. Cherukuri SR, Shashi Bhushan V, Harinatha Reddy A, Ravindranath D, Aruna M, Ramesh B. Risk mitigation methods for removal of pesticide residues in brinjal for food safety. University Journal of Agricultural Research 2014;2(8):279-283.
8. Liang Y, Wang W, Shen Y, Liu Y, Lui XJ. Effects of home preparation on organophosphorus pesticide residues in raw cucumber. Food Chemistry 2012;133:636-640.
9. Neha T, Joshi P, Joshi H. Effect of household processing on reduction of pesticide residues in brinjal (egg plant, *Solanum melongena*). Advances in Applied Science Research 2012;3(5):2860-2865.
10. Jayakrishnan S, Dikshit AK, Singh JP, Pachauri DC. Dissipation of lambda-cyhalothrin on tomato (*Lycopersicon esculentum* Mill.) and removal of its residues by different washing processes and steaming. Bulletin of Environmental Contamination and Toxicology 2005;75:324-328.
11. Pallavi NK, Thomas BM, Naseema Beevi S, Thomas G. Monitoring and decontamination of pesticide residues in okra (*Abelmoschus esculentus* Moench). International Journal of Interdisciplinary and Multidisciplinary Studies 2014;1(5):242-248.