Dissipation and Effect of Processing of λ-Cyhalothrin Residues in Brinjal

C. Narendra Reddy[1*], D. Jagdishwar Reddy[2] and S. M. A. S. Rahman[3]

[1,3]Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad, Andhra Pradesh (500 030), India
[2]Department of Bioresource Management, College of Agriculture, Rajendranagar, Hyderabad, Andhra Pradesh (500 030), India

Article History

Manuscript No. 296
Received in 16th March, 2012
Received in revised form 18th May, 2012
Accepted in final 29th May, 2012

Correspondence to

E-mail: narendrareddyento@yahoo.co.in

Keywords

λ-Cyhalothrin, residues, dissipation, brinjal fruits

Abstract

The experiment was conducted during *kharif*, 2009 at College of Agriculture, ANGRAU, Rajendranagar, Hyderabad, India in a randomized block design with four replications. The dissipation pattern of λ-Cyhalothrin revealed that initial deposit of λ-Cyhalothrin (1.36 mg kg^{-1}) was dissipated to below detectable residues at 10 days after third spray when λ-Cyhalothrin was sprayed @ 15 g a.i. ha^{-1}. While, in case of double dose, the initial deposit (1.84 mg kg^{-1}) was dissipated to below detectable level at 15 days after third spray. The waiting period for safe harvest of brinjal fruits after three sprays of λ-Cyhalothrin @ 15 and 30 g a.i. ha were 5.05 and 7.67 days, respectively. The washing of brinjal fruits collected on 5th day after third spray with tap water for 2 minutes removed residues of λ-Cyhalothrin to the extent of 33.34 to 36.11% in both the treatments. The washing of brinjal fruits with 2% salt water for 2 minutes removed residues of λ-Cyhalothrin to the extent of 62.96 to 63.89% in both the treatments on 5th day after third spray.

1. Introduction

Brinjal or egg plant (*Solanum melongena* L.) is considered as one of the important vegetable crop due to its nutritive value consisting of minerals like iron, phosphorous, calcium and vitamins like A, B, and C. The crop is attacked by a number of insect pests from seedling to fruiting stage affecting its growth and productivity. Out of several insect pests, brinjal shoot and fruit borer, *Leucinodes orbonalis* Guen. is one of the most injurious to brinjal crop. The extent of damage by this pest was recorded to be 4.33-6.54% shoot and 52.3% fruit damage irrespective of planting time (Kumar et al., 2010). The loss caused by this pest was estimated to range from 70-92% (Tripathy et al., 2010). λ-Cyhalothrin is a broad spectrum fourth generation synthetic pyrethroid insecticide. It is contact and stomach poison used as foliar spray; found effective for the control of insect pests in vegetable crops in India (Naitam et al., 2003; Mathirajan et al., 2006; Meena and Lal, 2008). The reports about the residues of λ-Cyhalothrin on vegetable crops in India are limited (Mukherjee and Gopal, 2005 and Dikshit et al., 2007) and no information is available about its residues on brinjal fruits under agro-climatic conditions of Andhra Pradesh, India. Therefore, in the present investigation, persistence of λ-Cyhalothrin residues in/on brinjal fruits was evaluated and dislodging of surface residues by washing with water and salt water was explored.

2. Materials and Methods

Field experiment was conducted during *kharif*, 2009 at Students farm, College of Agriculture, ANGRAU, Rajendranagar, Hyderabad, India in a randomized block design with four replications. Brinjal variety *Pusa purple long* was grown according to the recommended package of practices for the region except the use of insecticide. The commercial formulation of λ-Cyhalothrin (Karate 5 EC) was sprayed @ 15 and 30 g a.i. ha^{-1} using a Knapsack sprayer. The first application of insecticide was done 50 days after transplanting and subsequent sprays were given at 15 days interval with spray fluid of 700 l ha^{-1}. Brinjal fruits samples (500 g) of marketable size were collected from each plot at 0 (1 hour), 1, 3, 5, 7, 10 and 15 days after third spray only. 0 and 5 days set of samples were also subjected to decontamination process (washing of fruits with tap water for 2 minutes and washing with 2% salt water for 2 minutes)

A representative sample (50g) of chopped brinjal fruits was extracted with 100 ml acetone in a wiring blender for 2 minutes and filtered. The process of blending was repeated twice with

75 ml of acetone and filtrates were combined. The acetone extract was concentrated under reduced pressure and transferred into separatory funnel. It was diluted with an aqueous solution of sodium chloride (150 ml) and the residues were partitioned into hexane (50, 25, 25 ml). The combined hexane extract was passed through anhydrous sodium sulphate and concentrated to a known volume.

The hexane extract representing 50 g of plant material was cleaned up by passing through a glass column packed with florisil and neutral alumina (5 g each) sand witched between layers of anhydrous sodium sulphate (2 g). The hexane extract was transferred on the column and the insecticide was eluted with 100 ml mixture of hexane acetone (9:1) at the rate of 2-3 ml min^{-1}. The cleaned up extract was evaporated to dryness and the residues were dissolved in hexane for GC analysis.

The residues of λ-Cyhalothrin was determined using SHIMADZU 2010 A Gas chromatograph equipped with electron capture detector and capillary column DB 1 capillary column, 30 mts, 0.25 mm ID, 0.25 µm film thickness. The operating temperatures were detector 300°C, injector 260°C, column oven programmed at 180°C-5 min-3°C-210°C-5min-20°C-240°C-10min (total time 31.5 m). The carrier gas (nitrogen flow) was 1.0 ml m^{-1} and make up flow was 25 ml m^{-1}. The retention times for λ-Cyhalothrin was 22.12 minutes. The residue data was subjected to regression analysis and waiting periods (T_{tol}) and half life (RL_{50}) were calculated as suggested by Gunther and Blinn (1955), and Hoskins (1961).

3. Results and Discussion

Prior to sample analysis, a recovery test was conducted. For the recovery test, 50 g of the brinjal sample and soil collected from control plots were fortified at two levels separately i.e. 0.01 ppm and 0.1 ppm of λ-Cyhalothrin from the standards prepared. The contents were mixed thoroughly and the samples extracted and cleaned up as per the procedure described above and recoveries of λ-Cyhalothrin in brinjal fruits and soil were presented in Table 1.

The mean percent recovery of λ-Cyhalothrin in brinjal fruit and soil samples were 86.38 and 87.29 at 0.01 ppm, respectively and 88.48 and 89.33 at 0.1 ppm level of fortification respectively. Reddy and Reddy (2011) reported that percent recovery of chlorpyriphos and deltamethrin in cabbage was above 80%, hence the present investigation is in concurrence with the earlier workers.

Table 1: % recovery of λ-Cyhalothrin in brinjal fruits and soil

Fortification level	λ-Cyhalothrin residues	
	Brinjal	Soil
0.01 ppm	86.38	87.29
0.10 ppm	88.48	89.33

The λ-Cyhalothrin residues in brinjal and soil were presented in the Table 2. The initial deposit of λ-Cyhalothrin (1.36 mg kg^{-1}) was dissipated to below detectable level at 10 days after third spray with corresponding dissipation of 25.53, 51.47, 80.15 and 97.79 % at 1, 3, 5 and 7th day after third spray of λ-Cyhalothrin @ 15 g a.i. ha^{-1}. The initial deposit of λ-Cyhalothrin (1.84 mg kg^{-1}) was dissipated to below detectable level at 15 days after third spray with corresponding dissipation of 16.84, 40.76, 60.87, 84.78 and 97.28% at 1, 3, 5, 7 and 10th day after third spray of λ-Cyhalothrin @ 30 g a.i. ha^{-1}. The calculated half life values for normal and double dose were 3.69 and 3.83 days, respectively and exhibiting similar rate of dissipation in both the treatments. The present findings were in agreement with Mukherjee and Gopal (2005) in tomato and Dikshit et al., 2007 and Singh et al., 2009 in okra against λ-Cyhalothrin. Singh and Singh (2009) also reported that half life of λ-Cyhalothrin as 4 days in pea pods. So far, no MRL for λ-Cyhalothrin has been worked out on brinjal in India. The waiting periods were calculated by considering MRL value of 0.2 mg kg^{-1} specified for other synthetic pyrethroids on vegetables (Codex alimentarius, 2004). The initial deposits of λ-Cyhalothrin was more than 0.2 mg kg^{-1} (MRL) as suggested by Codex alimentarius (2004). Hence, safe waiting periods were worked out as suggested by Hoskins (1961). The waiting period for safe harvest of brinjal fruits were 3.69 and 3.83 days, respectively for normal and double dose of λ-Cyhalothrin when sprayed thrice at the rate of 15 and 30 g a.i. ha^{-1} (Table 2).

Table 2: Dissipation of λ-Cyhalothrin residues in brinjal

Day after third spray	λ-Cyhalothrin @ 15 g a.i. ha^{-1}		λ-Cyhalothrin @ 30 g a.i. ha^{-1}	
	Residues (mg kg^{-1})	Dissipated (%)	Residues (mg kg^{-1})	Dissipated (%)
0	1.36	-	1.84	-
1	1.04	23.53	1.53	16.84
3	0.66	51.47	1.09	40.76
5	0.27	80.15	0.72	60.87
7	0.03	97.79	0.28	84.78
10	BDL	--	0.05	97.28
15	BDL	--	BDL	--
Soil	BDL	--	BDL	--
MRL (mg kg^{-1})	0.20		0.20	
T_{tol} (days)	5.05		7.67	
$T_{1/2}$ (days)	3.69		3.83	
Regression equation	Y=0.836 + (-0.183) X		Y=0.926 + (-0.529) X	

BDL=Below detectable level (0.01 mg kg^{-1}); MRL= Maximum residue limits

The data pertaining to the effect of processing on the removal of λ-Cyhalothrin residues from contaminated brinjal fruits is presented in Table 3. The washing of brinjal fruits collected on '0' day (1 hr) with tap water for 2 minutes removed residues of λ-Cyhalothrin to the extent of 38.24 to 41.30% in both the treatments. On 5th day, the extent of decontamination of residues decreased to 33.34 to 36.11%. The washing of brinjal fruits with 2% salt water for 2 minutes removed residues of λ-Cyhalothrin to the extent of 69.11 to 70.65% in both the treatments. On 5th day, the extent of decontamination of residues decreased to 62.96 to 63.89%. The present findings on the decontimation of λ-Cyhalothrin in brinjal fruits are in agreement with the results of Singh et al., (2009). They reported that washing of okra fruits with tap water removed λ-Cyhalothrin residues to the extent of 40.0-42.7% in 0 day samples and 30.8-33.9% at 5th day samples.

Table 3: Effect of decontamination methods for the removal of λ-Cyhalothrin in brinjal

Treatments	λ-Cyhalothrin 15 g a.i. ha^{-1}				λ-Cyhalothrin 30 g a.i. ha^{-1}			
	'0' Day after Third Spray		5th Day after third spray		'0' Day after Third Spray		5th Day after third spray	
	Residues (mg kg^{-1})	Dissipated (%)	Residues (mg kg^{-1})	Dissipated (%)	Residues (mg kg^{-1})	Dissipated (%)	Residues (mg kg^{-1})	Dissipated (%)
Unwashed	1.36	--	0.27	--	1.84	--	0.72	--
WTW	0.84	38.24	0.18	33.34	1.08	41.30	0.46	36.11
WSW	0.42	69.11	0.10	62.96	0.54	70.65	0.26	63.89

WTW: Washed with tap water for 2 minutes; WST: Washed with 2% salt water for 2 minutes

4. Conclusion

Initial deposit of λ-Cyhalothrin (1.36 mg kg^{-1}) was dissipated to below detectable residues at 10 days after third spray of λ-Cyhalothrin @ 15 g a.i. ha^{-1}, while, in case of double, the recommended dose of λ-Cyhalothrin, the initial deposit (1.84 mg kg^{-1}) was dissipated below detectable level at 15 days after third spray of λ-Cyhalothrin @ 50 g a.i. ha^{-1}. The waiting period for safe harvest of brinjal fruits, after three sprays of λ-Cyhalothrin @ 15 and 30 g a.i. ha^{-1} respectively was 5.05 and 7.67 days, respectively. The washing of brinjal fruits with 2%t salt water for 2 minutes removed residues of λ-Cyhalothrin to the extent of 69.11 to 70.65% in both the treatments.

5. References

Codex alimentarious. 2004. Maximum residue limits (MRL) valiums-Codex alimentarius 2B, 533

Dikshit, A., Lal, O.P., Srivastava, Y.N., 2007. Persistance of pyrethroid and nicotinyl insecticides on okra fruits. Pesticide Research Journal 19(2), 227-231.

Hoskins, W.M., 1961. Mathematical treatment of loss of pesticide residues. FAO Plant Protection Bulletin (FAO) 9(9), 163-168

Gunther, F.A., Blinn, R.C., 1955. Analysis of insecticides and acaricides. Inter Science Publishers, New York, 696

Kumar, N.C., Singh, B.K., Srivastava, P.C., 2010. Crop loss assessment due to brinjal fruit and shoot borer. Pest Management Horticultural Ecosystem 16, 151-153.

Mathirajan,V.G., Natarajan, K., Kuttalam, S., Chandrashekaran, S., Regupathy, A., 2006. Efficacy of λ-Cyhalothrin 5 EC against brinjal shoot and fruit borer (*Leucinodes orbonalis* Guen). Pesticide Research Journal 14(1), 117-119

Meena, R.K., Lal, O.P., 2008. Bioefficacy of certain synthetic insecticides against mustard aphid *Lipaphis erysemi* Kalt on cabbage. Journal of Entomological Research 32(1), 87-91

Mukherjee, I., Gopal, M., 2005. Residue behavior of fenvalerate, fluvalinate, lambda cyhalothrin and monocrotophos in egg plant (*Solanum melongena* L.) fruits. Pesticide Research Journal 25(2), 175-179

Naitam, N.R., Dorak, S.V., Wase, V.S., 2003. Bioefficacy of λ-cyhalothrin for the control of pests of tomato. Pest Management Horticultural Ecosystem 9, 151-153

Reddy, C.N., Reddy D.J., 2011. Persistance of chlorpyriphos and deltamethrin residues in cabbage. International Journal of Bioresource and Stress Management 2(3), 338-339

Singh, S.P., Mitali Lal, K., Kiran., 2009. Residues of λ-cyhalothrin in/on okra and effect of processing. Pesticide Research Journal 21(1), 98-100.

Singh, S.P., Singh, S., 2009. Dissipation and decontamination of cypermethrin and fluvalinate residues in okra. Pesticide Research Journal 21(2), 265-267

Tripathy, N.C., Gopal, R.S., Singh S.P., 2010. Assesment of crop loss due to *Leucinodes orbonalis* in brinjal. Journal of Entomological Research 34(1), 72-79.