Dissipation of Two Pyrethroids on Pigeonpea Crop (*Cajanus Cajan L.*)

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ABSTRACT

Field trials were undertaken to determine efficacy and residues of fenpropathrin and flunalinate in/on Pigeonpea. The objective of investigation was estimation of residues of these synthetic pyrethroids, in order to judge whether the pesticides residues found at harvest on pigeonpea were acceptable for human consumption. Fenpropathrin and flunalinate were sprayed separately @ 80 and 160 g.a.i.ha^{-1} and 40 and 80 g.a.ha^{-1}, respectively at flowering stage and repeated a pod formation stage. Residues were determined in/on the pigeonpea foliage, pods, straw and grains. Effect of decontamination process on the dissipation of residues was also studied with growth and yield of pegeonpea.

Keywords: Cajanus Cajan L., Decontamination, Fenpropathrin, Fluvalinate, Yield.

Pigeonpea (Cajanus Cajan L.) is the second most important pulse crop next to chickpea in India. Covering an area of about 3.82 million ha, a total production of 2.88 million tones. It account for about 13% of the area and contributes 19% of the total pulse production of the country. The production of pigeonpea (Cajanus Cajan L.) is low as compared to other pulse crops. The low productivity is mainly due to several pest infestations during the crop growth stages. The damage is especially by pod borer (Helicoverpa armigera Hubner). All India Co ordinate Pulses Improvement Project recommended the use of fenpropathrin [(R,S)-α-cyano-3-phenoxy benzyl-2,2,3,3-tetramethyl cyclopropane carboxylate] and fluvalinate [(R,S)-α-cyano-3-phenoxybenzyl (R)-2(2-chloro-trifluromethyl aniline)- 3-methyl butanoate] for the control of pod borer complex of pigeonpea. A detailed study on dissipation of fenpropathrin and fluvalinate on pigeonpea is not available pertaining to Indian agro climatic conditions expect by Kaushik and Handa (1993) and Mukherjee and Gopal (1996). Since these insecticides will be applied at the pod formation stage, it was therefore, considered desirable to study, dissipation of these insecticides on pigeonpea plant and their residues in grain, straw and pod cover. Effect of various decontamination processes on the dissipation of residues has also been studied.

Materials and Methods

The dissipation and effect of fenpropathrin and fluvalinate was carried out in/on pigeonpea at the experimental field at Magadh University during Rainy season of 1998-1999 using pigeonpea . P 606 in sandy loam soil. Rate of application of insecticides, fenpropathrin were 80 g.a.ha^{-1} @ 700 L ha^{-1} and 160 g.a.i.ha^{-1} @ 700 L. ha^{-1} and that of fluvalinate were 40 g.a.i.ha^{-1}. @ 700 L ha^{-1} and 80 g.a.i.ha^{-1} @ 700 L. ha^{-1} .The step involved in the residues analysis of insecticides was extraction, cleanup and estimation.
A representative sample (25g) was taken for analysis. Pigeonpea leaves and pods were separately churned with 50 ml. solvent mixture (1:1, n-hexane: acetone, v/v) is a waring blender for 2 min. at high speed, the homogenized material was filtered through Buchner funnel. Both the extract were combined and transferred in to 500 ml separatory funnel, diluted with 200 ml of 2% sodium chloride solution and shaken for two min. The phases were allowed to separate and the aqueous layer was discarded. The hexane layer was drained through 2 cm layer of anhydrous sodium sulphate and was concentrated to about 25 ml in a rotary vacuum evaporator. For extraction from pigeonpea grain, dry pod cover and straw, a representative sample (25g) was powdered in a grinder and then, placed in Soxhlet extraction thimble. Enough quantity of n-hexane was added to permit syphoning.

For clean up of pigeonpea foliage and pod samples, 45 ml of n-hexane extract, 5 ml of acetone and 1.5 g of activated charcoal were added. The colourless extract obtained was filtered and the residues were washed with (3x15 ml) of n-hexane: acetone (9:1) mixture. The extract was concentrated and dissolved in n-hexane for GLC analysis. By n-hexane extracts of pigeonpea grain were concentrated and cleaned by acetonitrile partitioning technique followed by clean up with activated charcoal.

Fenpropathrin and fluvalinate residues were determined by using a GLC equipped with ECD ^{63}Ni with following operational parameters for both the insecticide, oven temperature 270^{0}C, injector tamp 290^{0}C, detector temp 300^{0}C, carrier gas N_2 60 ml min^{-1}, chart speed 0.5 cm min^{-1}, injection volume 3 ml. The efficiency of extraction, partitioning and clean up was done by fortifying the substrates viz., folialge, pods, grains and analysing the samples in triplicate. Interpretation of residues data and working out regression equation was done following Hoskin (1961). RL_{50} was the time in days required to reduce the insecticidal residues to half of its initial deposit.

Decontamination of pigeonpea pod sample of 0 day and 5 days after second spray were subjected to following decontamination process (a) washing: pigeonpea pod samples (50 g) were washed by rubbing with hands under tap water for one min. (b) cooking: pigeonpea pod (50 g) were boiled for 15 min. using enough quantities of water to cover the samples (about 60 ml for 50 g pods).

Result and Discussion

The initial deposit of fenpropathrin on pigeonpea foliage when sprayed @ 80 g.a.i.ha^{-1} at flowering stage as 4.35 ppm which dissipated to 4.18 ppm after one day representing 3.90% loss of residues. The residues on pigeonpea foliage recorded in 5, 10 and 15 days were 1.19, 0.60 and 0.22 ppm respectively and loss of percentage residues were 72.64, 86.20 and 94.95 %. When treated @ 160 g.a.i.ha^{-1} on pigeonpea. The initial deposit 5.06 ppm fenpropethrin degraded to 4.75, 1.93, 0.90 and 0.34 ppm after 1, 5, 10 and 15 days respectively which corresponded to 6.07, 65.90, 84.09 and 93.99 % reduction in the residues. The residues of fenpropethrin (80 g.a.i.ha^{-1}) on pigeonpea pods at second spray at different time intervals were presented in table-1. The initial deposit of fenpropethrin on pigeonpea pods were 1.73 ppm. The residues at the end after 1, 5, 10 and 15 days were 1.19, 0.56, 0.22 and 0.08 ppm respectively indicated that corresponded to dissipation of residues by 31.21, 67.63, 87.28 and 95.37 %. The initial deposit of fenpropethrin (160 g.a.i.ha^{-1}) on pigeonpea pods collected after 1 hr. of second spray was 4.03 ppm. It declined to 3.32, 2.06, 0.47 and 0.15 ppm after 1, 5, 10 and 15 days respectively. The rate of dissipation of fluvalinate at all the labels of treatment were statistically similar (Table-1). Similar trend of dissipation was observed by Tanwar and Handa (1998).

The decontamination processes presented in Table-2 shown that initial deposit of 1.34 and 3.12 ppm from the treatment of fenpropathrin @ 80 and 160 g.a.i.ha^{-1} on pigeonpea pods, were reduced by 35.82 and 37.50 % by washing and residues left after washing were 0.86 and 1.95 ppm respectively. By cooking residues deposits 0.34 and 0.49 ppm and percentage reduction 74.62 and 84.29 % respectively. The residues of fenpropathrin (80 and 160 g.a.i.ha^{-1}) on 5^{th} day pods samples washing led to a reduction of 39.34 and 20.16% respectively. The corresponding reduction in value of residues after cooking on 0 and 5 day were 74.62, 84.29 and 91.80 and 87.33% respectively. From treatment of fluvalinate @ 40 and 80 g.a.i.ha-1 washing of 0 (1 hr.) day pigeonpea pods having initial deposit to 0.93 and 1.66 ppm could be removed by 41.93 and 50.60% respectively, while in case of day 5 sample 23.07 and 16.39% residues could be reduced. The corresponding reduction in fluvalinate residues after cooking pigeonpea pods on 0 and 5^{th} day were 87.09, 85.54% and 94.87, 63.93%. The terminal residues data obtained collectively for straw and pod cover and for grain of pigeonpea after harvest, i.e. 20 days after second spray of fenpropathrin following application of two dosage were 0.57 and 1.41 ppm respectively, Table-2. The corresponding residue of fenpropathrin in pigeonpea grain were below detectable label (<0.1 ppm). The terminal residues of fluvalinate following application of 40 and 80 g.a.i.ha^{-1} on straw and pod covers were found to be 0.68 and 1.41 ppm respectively and the corresponding values in pigeonpea grain were 0.02 and 0.06 ppm.

Relative efficacy of fenpropathrin and fluvalinate for the control of pod borer complex of pigeonpea was reflected in the yield of pigeonpea grain. The grain yield of pigeonpea in control was 10.58 q ha^{-1}, when treated with fenpropathrin (80 and 160 g.a.i.ha^{-1}) and fluvalinate (40 and 80 g.a.i.ha^{-1}) these were 17.85, 18.35 and 13.80, 15.19 q ha^{-1} respectively. All the treatments gave significantly higher yield than control and residues is also below detectable limit. Application of fenpropathrin (160 g.a.i.ha^{-1}) recorded maximum yield of chickpea as also observed by Bhagwat and Wightman (2001).

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Table No. 1 Dissipation of Fenpropathrin and Fluvalinate in/on Pigeonpea

Normal Dose

Days	Folige *Residues (ppm) Av.	Folige ± SD	Folige RL_{50}	Y	Pods *Residues (ppm) Av.	Pods ± SD	Pods RL_{50}	Y
Fenpropathrin								
0	4.35	0.35	3.17 days	1.4603-0.2016X	1.73	0.90	3.20 days	0.4450-0.1955X
1	4.18 (3.90)	0.41			1.19 (31.21)	0.06		
5	1.19 (72.64)	0.06			0.56 (67.63)	0.04		
10	0.60 (86.20)	0.04			0.22 (87.28)	0.02		
15	0.22 (94.95)	0.02			0.08 (95.37)	0.01		
Fluvalinate								
0	4.74	0.13	3.41 days	1.4978-0.2199X	0.88	0.03	4.15 days	8.3137-0.2063X
1	3.98 (16.03)	0.10			0.78 (11.36)	0.03		
5	1.20 (74.68)	0.05			0.40 (54.54)	0.03		
10	0.48 (89.87)	0.02			0.08 (90.90)	0.01		
15	0.18 (96.20)	0.03			0.05 (94.31)	0.05		

* Average three replication
Y Regression equation
RL_{50} Residues limit
Value in parentheses are % decrease

Table 1 contd…

Double Dose

Days	*Residues (ppm) Foliage Av.	± SD	RL_{50}	Y	*Residues (ppm) Pods Av.	± SD	RL_{50}	Y
Fenpropathrin								
0	5.06	0.03	3.23 days	1.6564-0.1815X	4.03	0.10	5.2 days	1.5115-0.2223X
1	4.75 (6.07)	0.52			3.32 (17.61)	0.07		
5	1.93 (65.90)	0.16			2.06 (48.88)	0.06		
10	0.90 (84.09)	0.05			0.47 (88.33)	0.02		
15	0.34 (93.99)	0.03			0.15 (96.27)	0.01		
Fluvalinate								
0	8.30	0.05	2.91 days	2.0352-0.2477X	1.61	0.03	3.17 days	0.4604-0.1994X
1	5.43 (34.57)	0.22			1.19 (26.08)	0.05		
5	2.31 (77.46)	0.58			0.61 (62.11)	0.03		
10	0.68 (91.80)	0.02			0.21 (86.95)	0.02		
15	0.20 (97.59)	0.01			0.08 (95.03)	0.01		

* Average three replication
Y Regression equation
RL_{50} Residues limit
Value in parentheses are % decrease

Table No. 2 Effect of various decontamination process, yield and terminal residues of fenropathrin and fluvalinate in/on pigeonpea pods

		Fenpropathrin				Fluvalinate			
		80 g.a.i.ha^{-1}		160 g.a.i.ha^{-1}		40 g.a.i.ha^{-1}		80 g.a.i.ha^{-1}	
Days	Decontamination Process	Residues (ppm)	± SD	Residues (ppm)	± SD	Residues (ppm)	± SD	Residues (ppm)	± SD
0	Initial	1.34	0.04	3.12	0.94	0.93	0.03	1.66	0.45
	Washing	0.86 (35.82)	0.27	1.95 (37.50)	0.98	0.54 (41.93)	0.18	0.84 (50.60)	0.44
	Cooking	0.34 (74.62)	0.54	0.49 (84.29)	0.95	0.12 (87.01)	0.27	0.24 (85.54)	0.02
5	Initial	0.61	0.48	1.19	0.91	0.39	0.24	0.61	0.21
	Washing	0.37 (39.34)	0.44	0.95 (20.16)	0.87	0.30 (23.07)	0.23	0.51 (16.39)	0.16
	Cooking	0.05 (91.80)	0.45	0.15 (87.33)	0.86	0.02 (94.87)	0.28	0.06 (63.93)	0.22
Grain yield (Control) (q/ha^{-1})	**10.58 ± SD 0.60	**17.85	0.26	**18.35	1.03	**13.80	0.53	**15.19	0.43
Terminal Residues After harvest	Straw + Pod cover	0.57	0.28	1.41	0.12	0.68	0.25	1.14	0.38
	Grain	BDL		BDL		0.02	0.01	0.06	0.01

Residues ppm average of three replication

** Yield of grain

BDL = Below Detectable Limit