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Dissipation of Lindane on Okra Under Subtropical Conditions at Ludhiana, Punjab, India

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Okra, *Abelmoschus esculentus* (L.) Moench, is an importance vegetable crop extensively grown in Punjab. This crop suffers heavy losses due to the ravages of many insect pests, of which, cotton jassid *Amrasca biguttula biguttula* (Ishida) and fruit borers, *Earias vitella* (Fabricius) and *Earias insulana* (Biosduval) are the most destructive. These two pests can cause upto about 70 per cent loss in the yield of okra. A number of organochlorine , organophosphorous, carbamate and synthetic pyrethriods have been recommended for management of various pests of okra (Anon. 2000). With the banning of HCH, the use of lindane has been found to be very effective against cotton jassid and fruit borers on okra (Brar *et al* 1994).

Since the fruit harvest in okra crop is generally done at short intervals, there are chances for more contamination of fruit with pesticide residues. It has been well recognized that the treated commodities will invariably contain residues of the insecticides. Thus, the knowledge about the fate of chemical that remains on the plant is very important from public health point of view. Since limited data is available, the present studies were undertaken to ascertain whether the residues of lindane are toxicologically acceptable following their use according to good agricultural practices and to work out safe waiting periods for the health of the consumers.

MATERIALS AND METHODS

A supervised field trial was conducted at Entomological Research Farm, P.A.U., Ludhiana to estimate the residues of lindane. Okra, variety Punjab 7,was raised according to recommended agronomic practices (Anonymous, 2000). The crop was sown in July, replicated thrice for each treatment in 100 m^2 plots. The treatments evaluated were, lindane (Kanodane 20 EC) @ 350 and 700 g ha^{-1}. The insecticide was applied twice, the 1^{st} application was made 21 days after sowing and the 2^{nd} at 50 per cent fruit formation. Samples of marketable size okra fruits were collected from treated plots before and 0,1,3,5,7, and 10 days after the second application.

A finely chopped representative 50 g sample was blended thrice using 100, 50 and 50 ml acetonitrile in a high speed blender. The acetonitrile extracts were filtered

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into IL separatory funnel through a glass wool plug, diluted with 600 ml 10 per cent sodium chloride solution and partitioned into hexane (2 x 100 ml). The combined hexane fractions were dried over anhydrous sodium sulfate and concentrated to about 5 ml under vacuum at $<30^0$C.

The cleanedup of the sample extract was accomplished on silica get (60-120 mesh) prewashed with dichloromethane and acetone, and activated at 120° C for 1 h. The sample extract was mixed with 20 g activated silica gel, 10 g sodium sulfate anhydrous and 100 mg activated charcoal powder in a 100 ml beaker. After thorough mixing, the above mixture along with dichloromethane was transferred to a stoppered glass column (60 cm long, 2 cm i.d.) plugged with cotton. Allowed the contents of the column to stand until the solvent above the silica gel layer becomes colourless. Eluted the column with 150 ml mixture of dichloromethane : acetone (1:1, v/v). Concentrated under vacuum to about 5 ml and the residues of lindane were estimated by gas-liquid chromatography equipped with ^{63}Ni electron- capture detector (ECD). A glass column (1m x2mm i.d.) packed with 1.5% OV-17+1.95% OV-210 on Chromosorb W HP (80-100 mesh) was used for estimation of residues. The temperatures of injector, column and detector were maintained at 210, 190 and 240^0C. Nitrogen flow rate was maintained at 40 ml per minute. Under these operating conditions lindane eluted at retention time of 2.20 minutes.

Sample of okra fruit fortified with 0.01 mg kg^{-1} of lindane and analyzed by following the above methodology, revealed that more than 90 per cent of the insecticide was recoverable. The minimum detection limit of lindane was worked out to be 0.01 mg kg^{-1}. The residue data has been presented as such without incorporating any correction factor with respect to recovery studies.

RESULTS AND DISCUSSION

The average initial deposits of lindane were found to be 2.58 and 5.11 mg kg^{-1}, when the insecticide was applied @ 350 and 700 of g ha^{-1}, respectively. One day after the application, it dissipated to the extent of 62.8 and 72.5 per cent, respectively, at recommended and double the recommended dose application rates (Table 1).

The half- life of lindane at both these dosages was found to be 1.07 days. Patel *et al.* (2001) reported initial deposits of 1.639 and 5.87 mg kg^{-1}, when EC formulation of lindane was applied @ 350 and 700 g a.i. ha^{-1}, respectively. The residues of lindane dissipated at a faster rate with half-life values ranging from 0.9 to 1.0 day.

The maximum residue limit (MRL) of lindane on vegetable and fruits has been fixed at 3.00 mg kg^{-1} (Agnihotri, 1999). In the present study, lindane residues dissipated below its MRL just after one day of its application in both the treatments. About 95 per cent of the lindane residues declined after 5 days of its application at both the dosages (Table 1). Gopal and Mukherjee (1993) also

Table 1. Mean* and range of lindane residues (mg kg^{-1}) on okra.

Days after application	Dose applied @ g a.i. ha^{-1}			
	350	Per cent dissipation	700	Per cent dissipation
Before 2nd application	BDL (BDL - BDL)	-	BDL (BDL - BDL)	-
0	2.58 (2.38 – 2.80)	-	5.11 (4.34 – 5.52)	-
1	0.96 (0.82 – 1.10)	62.8	1.42 (1.25 – 1.60)	72.5
3	0.35 (0.28 – 0.42)	86.4	0.54 (0.48 – 0.61)	89.6
5	0.14 (0.11-0.18)	94.6	0.23 (0.19 – 0.26)	95.6
7	0.02 (0.01 – 0.03)	99.9	0.05 (0.04 – 0.06)	99.9
10	(BDL - BDL) BDL	100.0	(BDL - BDL) BDL	100.0
$t_{1/2}$	0.70 days		0.54 days	

*Mean of three replications
BDL = Below detectable level of 0.01 mg kg^{-1}
Figures in parentheses indicate range of residues

reported fast dissipation of lindane residues on chick pea leaves, with a half- life of 4 days. Rapid dissipation of lindane on cowpea pods has also been reported by Dethe *et al.* (1995) after application of lindane at 250-500 g a.i. ha^{-1} on green cowpea pods. Half –life of 1.85 and 1.96 days has also been reported when lindane was applied on chickpea @ 400 and 800 g a.i. ha^{-1} respectively (Madan *et al* 2000).

Joia *et al.* (1998) reported initial deposit of 1.23 and 0.06 mg kg^{-1} on cauliflower and brinjal, respectively, when lindane was applied @ 350 g a.i. ha^{-1}. These levels are much lower than its MRL of 3.0 mg kg^{-1}.

Two sprays of lindane applied @ 400 and 800 g a.i. ha^{-1} on vegetable pea, 1st at 4 week after germination and 2nd at pod initiation stage, resulted in lindane residues

Table 2. Effect of washing under tap-water on 0-day fruits of okra treated with lindane @ 700 g a.i. ha^{-1}

Residue level (mg kg^{-1})				
Before washing	Mean	After washing	Mean	Per cent reduction
4.34		1.47		
5.52	5.11	1.76	1.62	68.3
5.46		1.63		

ranging from 0.006 to 0.008 mg kg^{-1} in pea grains of 1st, 2nd and 3rd pickings done 5,6 and 7 days after 2nd sprays (Madan *et al* 1998). In general, lindane degrades rapidly when applied as emulsifier or dust formulation on various crops (Kathpal *et al.* (1995).

Washing of 0-days fruits of okra treated with lindane @ 700 g a.i. ha^{-1} under tap water for 2-3 minutes resulted in decline of lindane residues to the extent of 68.3 per cent (Table 2).

The present findings also reveal rapid decline of lindane residues ($t_{1/2}$ = 0.70 and 0.54 days) on okra when applied @ 350 and 700 g a.i. ha^{-1}, respectively. The fruits are safe for consumption just one day after application of the insecticide. The consumers can further ensure safety by washing the fruits thoroughly with water before use.

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