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BIOEFFICACY AND RESIDUES OF ENDOSULFAN IN PIGEONPEA (*CAJANUS CAJAN* (L.) MILLSP.) AT MEDIUM ALTITUDE HILLS

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Pigeon-pea (*Cajanus cajan* (L.) Millsp) is an important crop in India and also grown at medium high altitude hills of Meghalaya. The crop is attacked by a number of insect-pests. The major insect-pests are pod boring weevil (*Apion clavipes* Gerst.), pod-borer (*Heliothis armigera* Hubner), banded blister beetle (*Mylabris pustulate* Thunb.), flea beetle (*Monolepta* sp.) etc. of these, *Apion clavipes* is most serious pest (Sachan, 1981). Endosulfan has been recommended to control these pests specially pod borer in other parts of the country (Sahu *et al,* 1991; Rai, 1991) at medium high altitude hills (Sachan, 1981). Anonymous (1982) reported endosulfan very effective and economically beneficial to control pod-boring weevil in Meghalaya. The present study was undertaken to investigate the persistence and degradation pattern of endosulfan in green pods and in harvested grain and husk to find out the waiting period to avoid the hazards to consumers.

Field experiments were conducted at ICAR Research Complex Farm, Barapani, Meghalaya 91.56° N longitude and 25.24° E Latitude and 962 m above mean sea level. The crop was sown on 9th July, 1992 in 3 M x 3 M plot size having three replications for each treatment in simple randomised block design. The variety of pigeon pea was PDA-10. The distances between row to row and plant to plant were kept 40 cm. and 30 cm. respectively. All relevant agronomic practices were followed to raise a good crop. The crop was sprayed twice ie. on 4th November, 1992, and on 26th November, 1992, at pod formation stage and seed development stage, respectively. The concentrations of endosulfan (Thiodan 35 EC) were 0.05, 0.10 and 0.20%, using 800 litres of water per hactare. The residues were estimated after second spraying. The crop was harvested on 23rd December 1992.

The pod borers (pod borer and pod boring weevil) were counted visually on ten randomly selected plants in each replication after the first spraying till harvest. Three hundred pods were taken from each treatment and observed for damage. The yield of grains of 10 randomly selected plants were taken into account from each replication. The samples (pods) were collected from each replication of each treatment as well as from control plots after one hour of spraying to determine the initial deposits. Subsequently the samples again collected on 1, 3, 5, 7, 10, 12, 15, 18 and 21 days after the sprayings to study the dissipation and degradation of endosulfan in field condition. The representative sample of 25 g was taken from each replication after chopping and then extracted with 75 ml of n- haxane after blending them in

mixer properly. The clean up procedure of Kathpal and Dewan (1975) and estimation of endosulfan by spectrophotometric method of Maitlen *et. al.*, (1963) was followed. A regression equation (Y = 0.0058 + 0.005) was set from standard curve to calculate the residues from field samples. The half life values were calculated with the help of Hoskins Formula (1961). The meteorological data of the study period were collected and presented in Table 2.

Bioefficacy of endosuffan against pod borers

The plots treated with endosulfan were found to have significantly lower population of pod borers. Though they were non-significant among them. The percent grain damage by pod boring weevil had significantly lower damage in 0.10 and 0.20% treatment to 0.05% though they could not differ significantly in between (Table1). Rai, (1990) found lowest seed damage (6.5%) in endosulfan (0.07%) treated plots. Anonymous (1986) recorded endosulfan (0.10%) very effective to control pod borers in Meghalaya, which was just behind the monocrotophos (0.075%). These studies confirms the present investigation.

Yield of grain

The highest yield was recorded in 0.02% treated plots. All the treatments significantly superior over control. Plots treated with 0.10 and 0.20% yielded significantly higher to 0.05% treatment but they could not differ significantly in between. Rai (1991) also reported highest yield (19.4 q/ha) in endosulfan (0.07%) treated plots, which is in accordance to the present findings (Table I).

Residues of endosulfan in/on Pigeon pea:

Pods : The initial deposits in pods of pigeon-pea were recorded 4.526, 7.112 and 10.474 ppm for the respective corresponding dosages. These residues dissipated to 57.14 to 65.45% (av. 60.62%) within 3 days and reached below detectable level in 12 to 18 days. These residues were found to reach below the tolerance limit of 2 ppm in 2-6 days. The half lives (RL 50) were 2.08, 2.43 and 2.76 days, waiting periods T (tol) 2.67 4.10 and 6.52 days and time to reach below detectable level 18.55, 22.65 and 27.63 days, respectively for the above dosages (Table 2). Verma and Pant (1976) found initial deposits on the pods of pigeonpea to the extent of 4.43 to 5.75 ppm after spraying of endosulfan @ 0.07% which dissipated to 0-0.78 ppm within 14 days. The half-life was 1.45 days. Yadav *et al* (1988) recorded the initial deposits of 3.27 and 5.92 ppm on pods of pigeonpea after spraying endosulfan 0.07 and 0.14 % respectively. These initial deposits reached below the tolerance limit of 2 ppm within 6 days and reached below detectable limit within 20 days. The present findings are in accordance to the above results.

Persistence in grain and husk : The residues were estimated in harvested grain and husk (pod shells and leaves). The residues could not be detected in both from any treatment which confirms the results of Yadav *et al* (1988).

It is, therefore, inferred that the grains of pigeonpea are safe for consumption to human and husk for cattle if the pigeonpea crop in sprayed with endosulfan in above dosages.

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Table 1: Bioefficacy of endosulfan against pod borers and effect on yield of pigeonpea grain

Treatments	Av. Pest population /10 Plants after spraying		Av. Percent pod damage		Av. Percent grain damage		Av. Grain yield	
	Pod borer	Pod Boring Weevil	Pod borer	Pod boring weevil	Pod borer	Pod boring weevil	yield/10 plant	Kg/ha
1. Endosulfan 0.05%	6.33	7.00	2.62	5.45	3.70	6.00	89.86	698.91
2. Endosulfan 0.01%	4.00	4.67	1.80	2.34	1.82	2.48	151.07	1174.52
3. Endosulfan 0.20%	2.00	4.33	1.35	1.69	1.58	1.97	164.86	1282.24
4. Control	28.00	32.33	26.57	36.46	30.16	42.04	61.09	475.15
SE (m) ±	1.863	1.680	0.720	1.895	1.149	0.813	8.289	64.505
CD (P=0.05)	6.429	5.798	2.483	6.539	3.966	2.804	28.601	222.559

Table 2. Dissipation of endosulfan in pigeanpea crop

Days After Treatment	0.05% Residue (ppm)	0.05% Reduction (%)	0.10% Residue (ppm)	0.10% Reduction (%)	0.020% Residue (ppm)	0.020% Reduction (%)	Av. Reduction (%)
0	4.526	-	7.112	-	10.474	-	-
1	2.716	39.39	4.009	43.63	6.078	41.97	41.86
3	1.940	57.14	2.457	65.45	4.267	59.26	60.62
5	1.164	74.28	1.681	76.36	2.974	71.61	74.08
7	0.647	85.70	0.905	87.28	2.198	79.01	84.00
10	0.129	97.15	0.647	90.90	1.422	86.42	91.49
12	BDL	100.00	0.129	98.19	0.647	93.82	97.34
15	-	-	BDL	100.00	0.129	98.77	99.39
18	-	-	-	-	BDL	100.00	100.00

Regression equation

	Y=2.061-0.145x	Y=2.136-0.124x	Y=2.290-0.109x
RL_{50} (Days)	2.08	2.43	2.76
Ttol (Days)	2.67	4.10	6.52
TBDL(Days)	18.55	22.65	27.63

Meteorological data : (From 26.11.92 to 17.12.92)

Av. maximum temperature	19.3°C (Range 16.7 - 21.8°C)
Av. minimum temperature	7. 1° C (Range 4.8 -10.7°, C)
Av. relative humidity	77 % (Range 61 - 95 %)
Total rainfall	16.5 mm
Total no. of rainy days	5