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Repellent Action of some Insecticides Against *Oryctes Rhinoceros*

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ABSTRACT

The effectiveness of Aldrex, Aldrin and BHC used as repellents for the control of the coconut black beetle were investigated. Each insecticide was tested at two levels and three application frequencies of 4,8 and 12 weeks.

Aldrex was used as 5.6 ml/litre (0.14%) or 2.8 ml/litre (0.07%). Aldrin 2½% dust and BHC 10% dust were used mixed with sand in the ratios, insecticide to sand of 1: 2 and 1: 4. The Aldrex was poured to the cabbage area and the dusts were used as axil placements.

A highly significant correlation was observed between growth rates of palms and beetle attacks necessitating a correction in the analysis for insecticide effects.

Aldrex at 5.6 ml/litre and BHC 10% dust as the 1: 4 mixture with sand were significantly effective as repellents.

The seasonal attack pattern on young palms indicated a correlation between attacks and rainfall, attack peaks occurring approximately seven weeks after a rainfall peak.

INTRODUCTION

The black beetle *Oryctes rhinoceros* L. is the most frequently occurring pest of coconut in Sri Lanka. In the past, the damage done by the black beetle has been minimal and has often gone unnoticed. Field surveys (Perera, unpublished) have indicated that black beetle attack on coconut palms increase with human habitations and the creation of more decaying organic matter. Catastrophic factors such as cyclones, as experienced recently in Sri Lanka, the increased production of coconut fibre dust and saw dust and their unmethodical use as soil ameliorants have also contributed to an increase in black beetle activity. The eradication of breeding sites is the most important and most effective control method, but is often beyond the control of individual land owners. The increase in the incidence of black beetle damage to coconut has made it necessary to reassess and further investigate the control measures recommended (CRI leaflet No. 39). Nirula (1955) studied the control of *O. rhinoceros* using a range of insecticides both in dust form and liquid form. The successful use of Naphthalene balls placed in leaf axils for the prevention of adult beetle attacks on palms is also reported (Anonymous, 1980).

Benzene hexachloride (BHC) sprayed on to *O. rhinoceros* breeding grounds such as cowdung heaps and decaying vegetable refuse was found to produce 70 to 99% control of larval populations (Nirula, 1955). These studies when extended to protect the crown were found to be unsuccessful. The insecticide, in most instances, was removed by wind, rain etc. and rendered ineffective.

The present investigation was designed to study the effectiveness of three, time-tested, relatively cheap, insecticides used as repellents against the black beetle. Insecticides recommended for field application as repellents should be cheap due to the necessity for their extensive use often over large areas.

MATERIALS AND METHODS

The Experimental Site

The experiments were conducted on 5—8 year old palms under uniform growth conditions in an estate at Wennappuwa on the North Western Coast of Sri Lanka.

Insecticides

The insecticides tested in this investigation were Hexachloro hexahydro dimethano naphthalene (HHDN) in the liquid form as Aldrex 20%, and the dust form as Aldrin 2½% and Benzene hexachloride as BHC 10% dust.

The commercial preparation of Aldrex 20 was diluted so that the fluid applied contained 2.8 and 5.6 ml of Aldrex per litre at the respective levels.

The commercial preparation of 2½% Aldrin dust and 10% BHC dust were mixed separately with washed white sand in the ratio of 2 parts by weight of sand to one of insecticide and four parts of sand to one of insecticide at the two treatment levels.

Treatments

The experiment consisted of six treatments with each insecticide, at two levels and three frequency intervals, and was replicated five times.

The treatments were as follows :

1. Aldrex at 2.8 ml/litre applied at 4 weekly, 8 weekly and 12 weekly intervals.
2. Aldrex at 5.6 ml/litre applied at 4 weekly, 8 weekly and 12 weekly intervals.
3. 1:2 mixture of Aldrin 2½% dust and sand; axil placement at 4 weekly, 8 weekly, and 12 weekly intervals.
4. 1:4 mixture of Aldrin 2½% dust and sand; axil placement at 4 weekly, 8 weekly and 12 weekly intervals.
5. 1:2 mixture of BHC 10% dust and sand; axil placement at 4 weekly, 8 weekly and 12 weekly intervals.
6. 1:4 mixture of BHC 10% dust and sand; axil placement at 4 weekly, 8 weekly and 12 weekly intervals.

Application of insecticides

Two hundred mililitres of the diluted Aldrex solution were poured on to the cabbage area of each palm ensuring thorough and uniform coverage of the normal attack area, which is usually between the first and the fourth fully opened frond bases.

The mixture of insecticide (Aldrin or BHC) dust and sand were put into 8 cm x 10 cm cloth bags, each bag containing 200 g of the mixture. Three insecticide filled bags containing the appropriate mixture were placed in the second, third and fourth frond axils for each treatment.

Observations and recordings

Prior to insecticide application the last (most recently) fully opened frond was paint marked and beetle attacks (characterised by geometric cuts) on the last five fully opened fronds were recorded as Oryctes damaged or undamaged.

RESULTS AND DISCUSSION

The results were analysed using the transformation $\sqrt{x + 0.5}$

A high variability between palms (C.V=33.5%) was observed in the rate of production of leaves in 5 to 8 year old palms. This difference in the rate of production of leaves or the growth rate was also found to be directly connected with the extent of damage inflicted on a palm by a single attack of the beetle. Thus a rapidly growing palm which may produce up to 1.2 fronds per month would show up to 3 or 4 fronds damaged per beetle attack whereas a slow growing palm would seldom suffer more than 2 fronds damaged per beetle attack.

A highly significant (P=0.001) correlation (r=0.6994) was observed between the growth rate and the frequency of beetle attack, palms with a higher growth rate being more susceptible to beetle attack than palms with a slower growth rate. Thus in the final analysis of results for treatment effects a correction was made for growth rate variability using covariance analysis.

The results (Table 1) reveal,

a. a significant difference in the number of beetle attacks/palm/year, between the control and the insecticide treated palms.

b. a significant interaction between forms of insecticide and levels of application.

c. a significant interaction between frequency and levels of application.

Table 1. *Adjusted analysis of variance — Mean beetle attacks/palm/year*

Source	*d.f.*	*S.S.*	*M.S*	*F*
Control vs Insecticide ...		1.1393	1.1393	7.02*
Between forms of insecticide (I)	2	0.6667	0.3334	2.06
Between levels (L) ...	1	0.1189	0.1189	
Between frequency of application (W)	2	0.4975	0.2488	1.53
I x L	2	1.0555	0.5277	3.25*
I x W	4	0.4119	0.1030	
L x W	4	1.6490	0.8245	5.08*
I x L x W	4	0.1709	0.8245	
Error	56*	9.0830	0.0427	
Total	74			

*less 1 degree of freedom for correction.
Coeff : of var. = 17.32%

Table 2. *Adjusted means of beetle attacks/palm/year*

Control			*Observed*	*adjusted*
			7.75	7.59(2.84)
Insecticide	*Application Frequency (Weeks)*	*Level*		
Aldrin	4	1:2	6.75	6.64 (2.67)
	8	1:2	5.00	5.91 (2.53)
	12	1:2	3.50	4.83 (2.31)*
	4	1:4	4.25	4.27 (2.18)*
	8	1:4	3.50	4.49 (2.23)*
	12	1:4	6.00	5.86 (2.52)
B. H. C.	4	1:2	5.50	5.14 (2.37)*
	8	1:2	5.75	4.90 (2.32)*
	12	1:2	6.00	4.72 (2.28)
	4	1:4	4.00	2.64 (1.77)*
	8	1:4	4.25	3.68 (2.04)*
	12	1:4	3.75	4.53 (2.24)*
Aldrex	4	5.6 ml/litre	5.50	4.46 (2.23)*
	8	5.6 ml/litre	5.75	4.04 (2.13)*
	12	5.6 ml/litre	4.00	4.25 (2.18)*
	4	2.8 ml/litre	3.50	3.24 (1.93)*
	8	2.8 ml/litre	7.00	5.85 (2.52)
	12	2.8 ml/litre	8.25	7.61 (2.84)

Average critical difference = (0.33)
The transformed values are given in parenthesis
*Significant at p = 0.05

Insecticide application produced an overall significant repellent action on *O. rhinoceros* (Table 1). With BHC 10% dust significant repellent action was obtained at both levels and at all frequencies of application but the lower level (1:4) was more effective than the higher level (1:2).

Aldrin dust was less effective than BHC at all levels and application frequencies but still gave significant results with the 1:4 ratio in the 4 and 8 weekly application.

The axil placement of a mixture of BHC 10% dust and sand in the ratio 1:4 (lower level) produced better results than Aldrin dust or BHC 10% dust mixed with sand in the ratio 1:2 (higher level). This is apparently due to the fact that the more concentrated mixture tends to cake and harden when exposed and thereby looses its effectiveness.

Using Aldrex at the higher concentration of 5.6 ml/litre significant repellent action was obtained at all frequencies of application, but at the lower concentration of 2.8 ml/litre, significant repellent action was observed only at 4 weekly applications. The best results of all the treatments were obtained using BHC in the 1:4 ratio at 4 weekly intervals. (Table 2)

Comparable repellent action was produced by BHC - sand as a 1:4 mixture and Aldrex at 5.6 ml/litre. Thus either Aldrex or BHC 10% dust could be used as an effective repellent.

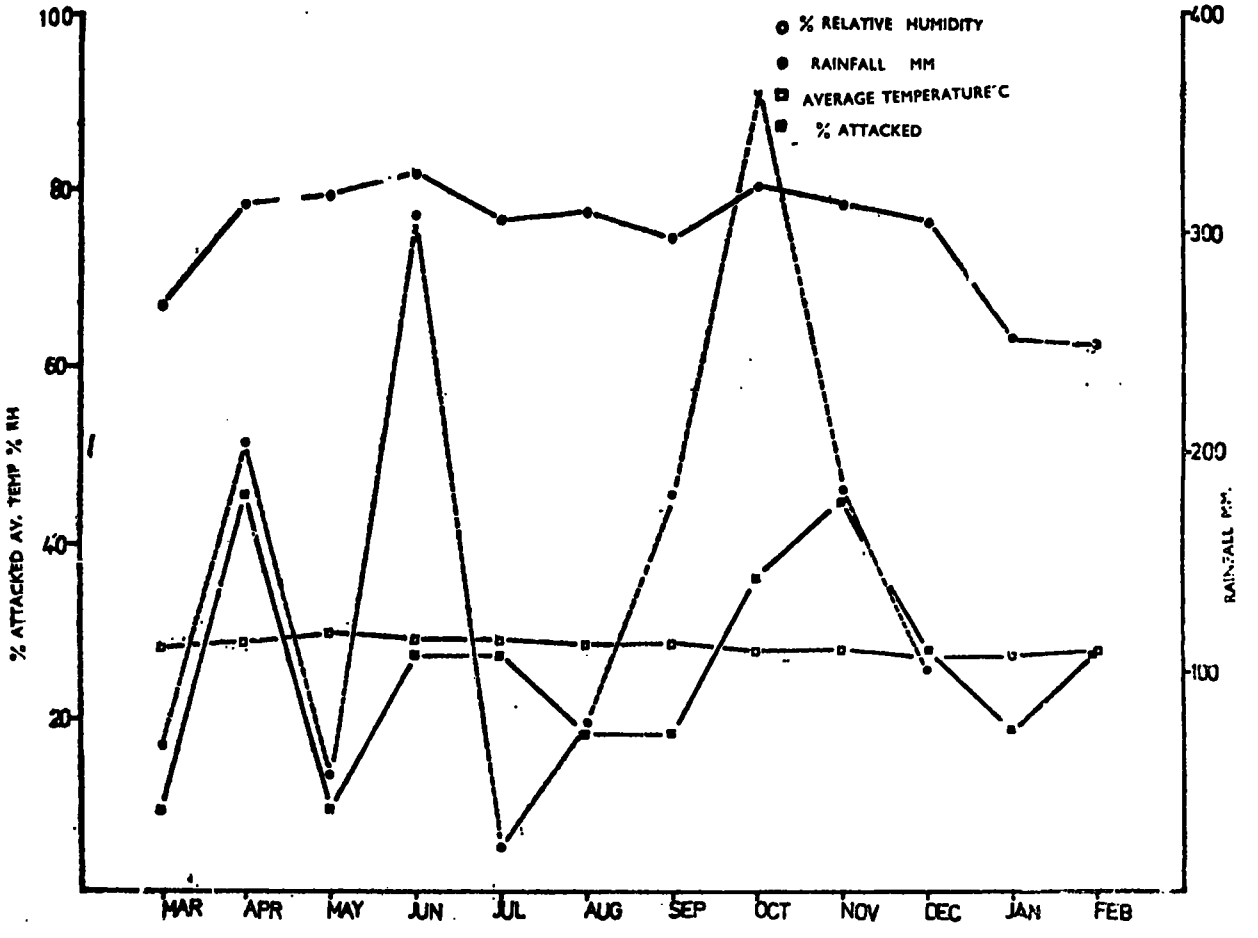

Fig. 1. The influence of weather factors on the pattern of attack by *O. Rhinoceros*.

On prevailing market prices, Aldrex treatment would cost about 20 cts. per application per palm whereas a single application of BHC would cost about 50 cts. and a single application of Aldrin would cost about Rs. 1.70.

Table 3. *Correlation of beetle attacks and rainfall*

Period Prior to attack (weeks)	*Correlation coefficient (r)*	
1	0.2342	
2	0.2355	
3	0.4095	
4	0.1510	
5	0.0832	
6	0.3931	
7	0.6268*	*P=0.05
8	0.1536	
1+2	0.3604	
2+3	0.5566	
3+4	0.3548	
4+5	0.1662	
5+6	0.2799*	
6+7	0.5939	

An examination of rainfall data for a possible correlation with beetle attacks show a significant correlation between rainfall peaks and beetle attacks seven weeks later. (Table 3 and Fig. 1) This correlation could indicate a possible effect of rainfall on a life stage of the pest. Nirula (1955) has recorded that during dry weather the larvae pupate sufficiently deep in the soil and the beetles resulting from them do not come up or emerge till the soil above is wetted.

Thus greater care to prevent adult black beetle damage should be taken six to seven weeks after a rainfall peak. The inspection of young palms for fresh black beetle attack should be intensified during this period. Aldrex at 5—6 ml/litre or BHC 10% dust mixed with sand in the proportion of one part of insecticide to four parts of sand could be used as a repellent to prevent black beetle attack. Approximately 200 ml of diluted Aldrex (5—6 ml/litre) should be poured to the cabbage area of each palm to be treated. In the alternative three bags containing approximately 200 g. of the BHC - sand 1:4 mixture should be placed in the 2nd, 3rd and 4th leaf axil. The treatments should be repeated once every 2 months or more frequently.

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REFERENCES

Anonymous (1980). Rhinoceros beetle - Insecticide. *United Plantations Research Department*. 16th Annual Report 1980; 76—78.

Anonymous (1976). The black beetle pest and its control. *Coconut Research Board, Leaflet No.* 39.

Nirula, K.K. (1955). Investigations on the pests of coconut palm. Part II *Oryctes rhinoceros* L. *Indian Cocon.* J. 8 (4) : 30—79.