USE OF NEW PESTICIDES OF PLANTS ORIGIN FOR THE CONTROL OF BRUCHIDS

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ABSTRACT

Asarone,its dichlorocycloproplyl analogue and its three alkyl oxime ethers viz., ethyl, propyl and hexyl oximes of asaraldehyde have been tested as contact poison against the eggs and adults of Callosobruchus chinensis.
The results show that all the four derivatives are toxic to the eggs and also reduce the fecundity of adult to 20% to 60%. The treatment of host seeds with different doses of various derivatives decreases the number of eggs laid on them. Citriodora oil of Eucalyptus and Eucalyptus oil extracted from two species of Eucalyptus have been found to show good fumigant action against bruchid species. The citriodora oil and Eucalyptus oil exhibit LD_{50} values 0,044/1000 cc and 0,05/1000cc respectively against the adults of C. maculatus and are two times more effective than asarone.

INTRODUCTION

Asarone , its dichlorocyclopropyl analogue and alkyl oximes ethers of asaraldehyde when tested as contact poison and for repellent action found effective against the eggs and adults of Callosobruchus chinensis.

Acorus calamus Linn., commonly called as sweetflag, grows wild in the hilly areas of the country and is cultivated as a commercial crop in Mysore. The rhizomes of this plant are known for their insecticidal activity.This has been noticed in the powdered rhizomes (Mironov, 1940; Denisov,1943 ; Subramaniam, 1942,1949 ; Israel and Vedamurthy, 1953 ; Pandey,1976) as well as in their extracts with different organic solvents (Trehan,1956 ; Dixit et al., 1956 ; Mukerjee and Govind, 1959 ; Trehan and Pajni, 1960 ; Paul and Agarwal, 1965 ; Deshmukh and Borle,1975 ; Deshmukh et al. 1982 ; Rajendran and Gopalan, 1979 ; Teotia and Tewari, 1977 ; Pandey et al. ,1977). The active ingredient present to the extent of 15-20% in the rhizome oil was recognised by Baxter et al. (1960) as asarone, has been found effective against various pests (Saxena and Srivastava,1972 ; Agarwal et al. ,1973 ; Yadava, 1971). Saxena and Rohdendorf (1974), Saxena and Mathur (1976) and Tikku et al. (1978) have shown than, besides acting as a chemo-sterilant, asarone also causes a loss in fecundity.
Saxena et al. (1977) also confirmed these observations and further noted that asarone has a mode of action different from juvenoïds and antijuvenoïds and that toxic property of asarone is due to the propenyl side chain and not due to three methoxyl groups substitute on the nucleus. The present report deals with evaluation of asarone and its three derivatives for their ovicidal and fecundity reducing properties when used as contact poison and repellent against Callosobruchus chinensis.

Eucalyptus trees are known to possess a strong allelopathic action and adversely affect the growth of herbaceous vegetation in their vicinity (del Moral and Muller, 1969,1970). The toxicity is reported to be due to certain volatile terpenes which are released from the leaves and whashed down to the soil which is rendered unsuitable for the sustenance of under-canopy animals and plants (Baker and Smith, 1902 ; del Moral and Muller, 1970 ; Al-Mousawi and al Naib, 1976). The trees also remain free from insect attack. Suspecting the toxicity due to their essential oils, trials have been conducted with the oils extracted from Eucalyptus citriodora and E. globulus as fumigants against the adults of Callosobruchus maculatus (fabr.)

MATERIAL AND METHODS

The culture of Callosobruchus chinensis and C. maculatus was maintained on the seeds of Vigna radiata (mung) at 30°C and 70% R.H. The samples of Asarone and its four derivatives i. e.,Dichlorocyclopropyl analogue of Asarone (D.C.A.), ethyl oxime ether of Asaraldehyde (E.O.A.), propyl oxime ether of asaraldehyde (P.O.A.) and hexyl oxime ether of Asaraldehyde (H.O.A.) were provided by Dr. D.B. Saxena, Division of Agricultural Chemicals, I.A.R.I., New Delhi.
The detailed procedure for the preparation of various derivatives of Asarone has been reported by Saxena et al. (1989). All the pesticides were emulsified in distilled water by using Triton X-100 as an emulsifier and 1% stock solution was prepared in each case.

Citriodora oil of Eucalyptus and Eucalyptus oil extracted from Eucalyptus citriodora and E. globulus and containing respectively citrionella 83.89% (I) Cineole 91.33% (II) as effective agents were obtained from the fresh leaves (250gms) of the two species by co-distillation with water in an essential oil trap for $2^{1/2}$ hrs. The oils being lighter than water were separated easily.

OBSERVATIONS

A. ASARONE AND ITS DERIVATIVES

1. Ovicidal action

Three to four hour old eggs of C. chinensis were treated with varying concentrations of Asarone, its dichlorocyclopropyl analogue and three oxime ethers of Asaraldehyde. The mortality of the eggs was recorded after 6 days. The data were analysed statistically and the probit analysis results of the data are given in Table 1.

TABLE 1

Name of the oil	LD 50 mg/1000cc	LD 50 ml/1000cc	Fiducial limits LD50 ml/1000cc
1. Citriodora oil of Eucalyptus	37,4	0,044	0,056 0,034
2. Eucalyptus oil	46,0	0,050	0,068 0,034

RESULTS AND DISCUSSION

The results show that asarone has a very strong ovicidal action against C. chinensis, as compared to its derivatives. Asarone and its substituted compounds have the following order of toxicity - as roethyl oxime ether of asaraldehyde, dichloro cyclopropyl analogue of asarone, propyl oxime ether and hexyl oxime ether of asaraldehyde. Saxena and Srivastava (1972) reported that the eggs laid on filter paper impregnated with upto 15 cc of 100 ppm oil solution in acetone reduced the hatching to 66% in 0-12 hr. old eggs and to 50% in 96-124hr. eggs of Dysdercus koenigii. Mukerjee and Govind (1959) reported 82% mortality in the eggs of Bombyx mori with 2% concentration of ether extract of A. calamus rhizomes.

The role of Asarone in causing loss in fecundity has also been observed previously. According to Saxena and Srivastava (1972), the powdered rhizomes of Acorus calamus when mixed with infested grains reduced the oviposition in C. chinensis, Sitophilus Oryzae, Corcyra cephalonica and Trogoderma granarium. A similar loss of fecundity has been reported in the case of Dysdercus koenigii (Saxena and Mathur, 1976). It has also been established that loss of fecundity due to asarone in the result of regression of ovarioles in the vitellarium part as studied in Therombia domestica (Saxena and Rohdendorf, 1974), Dysdercus koenigii (Saxena et al. 1977), Trogoderma granarium (Koul et al., 1977) and C. chinensis (Tikku et al., 1978).

Repellent action of asarone as well as its toxic action as a fumigant has not been studied so far. However, the ether extract of whole rhizomes of Acorus calamus had been found to repel the larvae of Athalia proxima when their food consisting of raddish leaves were dipped in 0,5% to 50% extract (Pandey et al., 1977). Likewise the joint repellent and fumigant action of the powdered rhizomes had been noted against the adults of stored grain pest, Callosobruchus chinensis when 1 to 2% of the material was mixed with the gram seeds (Pandey et al. . 1976). Pure asarone is a stronger repellent than its four derivatives.

Out of natural oils from indigenous materials used for pest suppression, Citriodora oil of Eucalyptus and Eucalyptus oil are the first to be tested fumigants for direct toxic action. The noted LD50 values of the two oils against C. maculatus are slightly higher than LD50 of Ethylene dibromide and EDCT mixture against the same pest (Murthy and Srivastava, 1971). The LD50 value is however, less than that of Carbon tetrachloride and EDCT mixture against Trogoderma granarium and Sitophilus oryzae (Doharay and Khalsa, 1976).

Table 2 : Showing toxicity of oxime ethers of asaraldehyde against eggs of C. chinensis.

Compound	Heterogeneity at p = 0,05	Regression equation	LD50	Fiducial limits of LD50	Relative fecundity
1. Asarone (I)	X^2 (3)=2,034	y=1,30x+8,137	,003855	,002512 ,006020	1
2. D.C.A. (III)	X^2(3)=3,99	Y=1,039x+7,273	,006457	,004169 ,01318	0,59
3. Ethyl oxime ether of asaraldehyde (IV)	X^2(3)=2,11	Y=1,38x+8,297	,004083	,002951 ,005888	0,94
4. Propyl oxime ether of asaraldehyde (V)	X^2(3)=2,037	Y=1,088x+7,415	,006012	,004074 ,01072	0,64
5. Hexyl oxime ether of asaraldehyde(VI)	X^2(3)=1,384	Y=1,03x+7,104	,008913	,005754 ,002397	0,43

In none of these cases was the data found to be heterogeneous.
Y = Probit kill
X = Log dose
LD50 = Dose calculated to give 50 % mortality of eggs.

TABLE 3 : Showing average fecundity of C. chinensis after their treatment with asarone and derivatives.

Dose %	Mean oviposition						
	1	0,75	0,5	0,25	0,1	0,01	Control
Compound							
I. Asarone	9,10±0,24	17,4±2,13	30,2±2,87	34,3±4,81	35,9±5,26	49,3±2,17	62,3±4,19
III D.C.A.	29,7±1,47	33,4±1,55	32,9±2,97	34,0±4,54	39,4±3,97	49,7±3,68	64,3±3,75
IV. E.O.A.	12,0±0,73	21,9±2,96	36,8±3,63	37,0±3,63	37,4±4,11	50,1±3,84	57,7±2,83
V. P.O.A.	21,9±0,98	25,3±4,34	35,1±2,49	35,3±2,85	34,9±3,82	52,3±3,69	59,7±3,11
VI. H.O.A.	28,8±0,72	28,6±4,09	34,0±4,21	36,6±3,40	36,4±1,90	54,7±4,04	59,6±3,51

(Observations based on 3 replications of 10 pairs each).

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UTILISATION DE NOUVEAUX PESTICIDES D'ORIGINE VEGETALE DANS LA LUTTE CONTRE LES BRUCHES (COLEOPTERA: *BRUCHIDAE*)

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Résumé

L'asarone, son analogue le dichlorocyclopropyl et ses trois alkyles oxime-éthers, à savoir, ethyl, propyl et hexyl-oximes d'asaraldéhyde ont été étudiés en tant que poisons de contact sur les oeufs et les adultes de *Callosobruchus chinensis*. Les résultats montrent que les quatre dérivés sont relativement moins toxiques pour l'oeuf que l'asarone. En outre, le traitement par ces dérivés réduit aussi la fécondité des adultes de 20 à 60 %. Les détails de la préparation des dérivés et les mesures de leur toxicité sont présentés. L'action répulsive de ces dérivés a également été étudiée sur les adultes de *C. chinensis*. le traitement des semences-hôtes à différentes doses de différents dérivés a non seulement fait chuter d'une manière considérable le nombre d'oeufs pondus sur celles-ci, mais a aussi provoqué une mortalité appréciable chez les oeufs pondus.

L'huile "citriodora" d'*Eucalyptus* et l'huile d'*Eucalyptus* extraites de deux espèces d'*Eucalyptus*, ont présenté une bonne action fumigène sur les espèces de bruches. L'huile citriodora et l'huile d'*Eucalyptus* ont présenté des valeurs de LD50 de 0,044/1000 cc et 0,05/1000 cc respectivement pour les adultes de *C. maculatus* et étaient deux fois plus efficaces que l'asarone.