

PESTICIDAL POTENTIAL OF SOME SELECTED TROPICAL PLANT EXTRACTS AGAINST *CALLOSOBRUCHUS MACULATES* (F) AND *CALLOSOBRUCHUS CHINENSIS* (L) (COLEOPTERA: BRUCHIDAE)

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ABSTRACT

Plant oils obtained from leaves and other parts of 20 different plant species were bioassayed under laboratory conditions for their ability to protect stored legumes from damage by cowpea weevil (*Callosobruchus maculatus*) and adzuki bean seed weevil (*Callosobruchus chinensis*). Three plant oil extracts showed some bioactivity, nine plant oil extracts caused significant adult mortality in both species and eight had none. Six plant oil extracts, black pepper, lemon grass, clove seeds, neem, custard apple, and sacred basil inflicted between 41 to 100% egg mortality in both species in the order of 60, 60-67, 70, 90, 91 and 100% respectively.

INTRODUCTION

The cowpea weevil, *Callosobruchus maculatus*, can reproduce both in the field and in storage. In order to protect legumes in warehouses especially in third world countries we often have recourse to synthetic pesticides with their attendant dangers of user safety, high cost, development of resistant strains and toxic residues. To avoid such undesirable consequences, scientists have focussed their attention on the use of less hazardous practices or substances to protect stored products.

Historical usage of nicotine and pyrethrum has encouraged scientists to focus their attention on alkaloids, flavonoids, terpenoids and other secondary compounds to be used as pest control agents (Harbourne 1977). The effectiveness of plant oils in controlling insect pest infestations in grain legumes has been effectively demonstrated by several researchers in Asia (Mummigatti and Raghunathan 1977; Varma & Pandey 1978). The oils extracted from the kernels of the Mee plant (*Madhuca longifolia*) significantly lowers the oviposition and egg hatchability of *Callosobruchus maculatus* in Sri Lanka (Ranasinghe & Dharmasena 1987). Natural compounds are likely to provide effective, environmentally safe, easily biodegradable and narrow spectrum pesticides (Attri & Prasad, 1980; Saxena, 1987). Previous research on plants has indicated the efficacy of solvent extracts (Lambert *et al* 1985) in the preservation of cowpea against insect pests. In this study the results are reported of the laboratory evaluation of the efficacy of the plant oils of 20 different plant species against cowpea weevil (*C. maculatus*) and adzuki bean seed weevil (*C. chinensis*) in Sri Lanka.

Twenty different plant species belonging to different families were selected for the present

study (Table 1) based on the following characteristics: relative absence of insect damage, taxonomic closeness to families known to possess biologically active compounds, usage of plants as pesticides in rural agriculture, traditional knowledge as reported by extension workers.

The Cowpea variety MI 35 used in this study were purchased from the Department of Agriculture and handpicked to remove infested seeds and other debris. Seeds that showed no visible signs of weevil attack were separated, bulked and transferred into a kilner jar (IL) covered with fine mesh for aeration and equilibrated at ambient temperature (25-30°C) and RH (70-80%) for 3 weeks to remove all evidence of prior infestation by the cowpea weevil before bioassay.

The culture of *C. maculatus* was collected from domestic stores and reared in the laboratory as described by Olaifa & Erhun, 1988. Adults emerged from this culture were used for the bioassay within 48h of emergence. The remaining insects were used to start a new culture so that cultures with emerging adults are available continuously. A similar procedure was adopted to culture *C. chinensis*.

Fresh green leaves of the selected plants were chopped in a blender, weighed and transferred to conical flasks containing 95% ethanol at the ratio of 10g/150ml. The flasks were held at room temperature for 5 days with occasional daily shaking before filtering the extract through Whatman No. 1 filter paper. The leaf residues were washed twice with 5-ml ethanol, and the pooled filtrate was concentrated to 0.5 ml in a rotary evaporator, weighed and transferred to a volumetric flask. A 10% (w/v) emulsion of the extract was obtained by addition of water containing 0.5% (v/v) Triton X-100 stored in a refrigerator and used within 2 days.

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Table 1: Toxicity of the Ethanol Extracts of the leaves of 20 plants to *C. maculatus* and *C. chinensis*

Plant Species	% Corrected Mortality					
	Day 1		Day 2		Day 3	
	C.c	C.m	C.c	C.m	C.c	C.m
<i>Capsicum frutescens</i>	35	40	45	48	60	60
<i>Myristica fragrans</i>	00	00	00	00	00	00
<i>Piper nigrum</i>	35	40	48	50	55	60
<i>Citrus reticulata</i>	10	12	10	08	12	14
<i>Cymbopogon citratus</i>	50	60	50	60	65	67
<i>Artocarpus heterophyllus</i>	05	08	12	11	15	17
<i>Gliricidia sepium</i>	00	00	00	00	00	00
<i>Eugenia caryophyllata</i>	50	60	60	60	71	70
<i>Ricinus communis</i>	00	00	00	00	00	00
<i>Dillenia retusa</i>	40	44	50	56	50	58
<i>Azadirachta indica</i>	50	60	60	65	80	90
<i>Cajanus cajan</i>	00	00	00	00	00	00
<i>Cassia occidentalis</i>	06	09	12	13	15	18
<i>Anona reticulata</i>	80	80	80	90	90	91
<i>Mangifera indica</i>	00	00	00	00	00	00
<i>Eupatorium odoratum</i>	00	00	00	00	00	00
<i>Ocimum sanctum</i>	80	80	80	90	100	100
<i>Capsicum annum</i>	30	35	43	50	48	45
<i>Dioscorea polygonoides</i> wild	00	00	00	00	00	00
<i>Hibiscus rosasinensis</i>	00	00	00	00	00	00

The beetles were sprayed directly with 1 ml of different concentration of a crude extract under Potters Precision tower at a pressure of 2.5 kg/cm². The controls were sprayed with water. Mortality was recorded every 24h for 5 days and corrected by Abbot's formulae (Busvine, 1972).

Different volumes (0.5, 1.5, 3) µl plant oils of *O. sanctum*, *A. reticulata* and *A. indica* obtained by extraction as described above were made up to 30 µl with redistilled acetone in a covered Petri dish (9cm diameter) by shaking the Petri dish for a few seconds and immediately the seeds were introduced into it. The solution was used to coat uniformly on 50 seeds of the cowpea. After 10 min. when the acetone had dried up, the seeds were transferred into 150 ml translucent plastic cups with firm cover, and 5 males and 5 females of freshly emerged *C. maculatus* (0-24h) were introduced. The seeds were coated with ordinary acetone in the control treatment. There were three replicates for each treatment and all the cups were incubated at ambient temperature for 18 days. Egg count, the number of emerged adults and other parameters were determined.

Crude Ethanol (CE) extracts of 20 different plant species showed biological activity as reflected by mortality inflicted upon the treated *Callosobruchus* spp. (Table 1).

Extracts of *Myristica fragrans*, *Gliricidia sepium*, *Ricinus communis*, *Cajanus cajan*, *Mangifera indica*, *Eupatorium odoratum*, *Dioscorea polygonoides*, and *Hibiscus rosasinensis* showed no

toxicity while those of *Citrus reticulata*, *Artocarpus heterophyllus* and *Cassia occidentalis* had little toxicity. *Capsicum annum* and *Dillenia retusa* plant extracts were slightly toxic causing 45% and 58% mortality in the *C. maculatus* group. *C. frutescens* and *Piper nigrum* were moderately toxic while those of *Eugenia caryophyllata* caused fairly high (70%) beetle mortality. The highest bioactivity (90 – 100% mortality) was manifested by the extracts of *Azadirachta indica*, *Anona reticulata* and *Ocimum sanctum*.

Mortality of the beetles caused by the bioactivity was gradually reaching a maximum in 72h. The absence of low level of toxicity exerted by most plant extracts may not be the true reflection of the bioactive potentials of the plants as a whole. The distribution of bioactive compounds often varies in different plant parts. Neem kernel has more azadirachtin than leaves and other tissues (Kossou 1989) while leaves of *N. tabacum* have six times more bioactive compounds than root, stalk or inflorescences. (Rao and Chakraborty 1982).

The possession of highly bioactive compounds of plants such as *O. sanctum*, *A. indica* and *A. reticulata* which are grown widely in Sri Lanka offer an opportunity for developing them as alternatives to hazardous pesticides. Ketoh *et al* (2000) reported that *C. schoenanthus* oil contained up to 61% of piperitone and 23.4% careen- 2 as major constituents. *Cymbopogon citratus* oil is rich in citral (gevanial 34.6% and neral 50.9%). Citronellal (35.4%), Citronellol (9.7%), Geraniol (23.5%) and occidentol (6.5%) were the major components of *C. nardus* oil (Ketoh *et al* 2000).

Data obtained with these 3 plant oils indicated that oils of *O. sanctum* at 1.5 µl and *A. reticulata* at 3.0 µl completely inhibited oviposition and adult emergence (Table 2). A mean of 8.2 eggs were laid on seeds treated with *O. sanctum* oils at 0.5 µl and a comparable number of emerged adults were recorded. *A. indica* oils did not inhibit oviposition completely at any of the 3 doses tested. This indi-

Table 2: The Effect of Plant Oils on egg deposition and adult emergence of *C. maculatus*

Oils	Dose(µl)/ 50 seeds	Mean of Eggs	no. Mean no. of adults (emergence)	%damaged seeds
<i>Ocimum sanctum</i>	0.5	8.2 ± 2.1	7.0 ± 2.7	14.0 ± 2.5
	1.5	00	00	nd
	3.0	00	00	nd
<i>Anona reticulata</i>	0.5	10.1 ± 2.0	9.4 ± 2.1	16.0 ± 2.1
	1.5	5.2 ± 2.1	3.4 ± 1.6	9.0 ± 2.2
	3.0	00	00	nd
<i>Azadirachta indica</i>	0.5	10.2 ± 2.1	11.2 ± 2.2	14.0 ± 1.1
	1.5	6.8 ± 1.1	3.2 ± 1.6	6.0 ± 1.4
	3.0	2.8 ± 0.9	2.1 ± 1.1	6.0 ± 0.9
Control		76.6 ± 4.8	56.8 ± 2.6	59.4 ± 3.8

nd = no determination

* *C. maculatus* (C.m) *C. chinensis* (C.c.)

cated that the volatile oils of *O. sanctum* and *A. reticulata* effectively protected stored cowpea from infestation by *C. maculatus* and insecticidal activities of these two plants used traditionally for preserving cowpea appear to reside in the ethanolic extracts. It was found that insecticidal activity of *O. sanctum* observed is due to the presence of linalool in the leaves.

Schoonhoven (1978) indicated that 100 ml of selected vegetable oils effectively protected cowpea against the pulse beetle *Zabrotes subfasciatus*. Plant oils used in this study were more efficient than the vegetable oils reported by Messina & Renwick (1983) and Pereira (1983). The non-bitter state of a plant oil used is an added advantage over neem oil which is known for its bitter taste.

The relatively small amounts of oils required their effectiveness and the simple technology of extraction will make these plant oils a better candidate for seed dressing purposes for cowpea storage. With increase of prevailing prices of insecticides, the application of plant oils would be an inexpensive control method against *C. maculatus* and *C. chinensis*.

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