PROCEEDINGS
OF THE
24th ANNUAL MEETING

August 15 to 20, 1988

Ocho Rios, Jamaica

Editor:
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University of the Virgin Islands

Published by:
Caribbean Food Crops Society

PRELIMINARY INVESTIGATION ON THE ADVERSE EFFECTS OF EXTRACTS OF *Azadirachta indica* AND *Artocarpus incisa* ON THE REPRODUCTIVE PHYSIOLOGY OF THE CATTLE TICK, *Boophilus microplus*

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ABSTRACT

Topical application of 0.4 µg per tick of an ethanol extract of Neem (*Azadirachta indica*) seed inflicted about 25% mortality on the engorged *B. microplus* and inhibited oviposition and embryonic development by 60 and 50% respectively.

Direct spraying of 1 ml, 50% crude petroleum ether extract of the Breadfruit (*Artocarpus incisa*) leaves on the ticks inflicted about 40% mortality and reduced oviposition by about 55% and egg-viability by 75%. The present report is the first ever on the acaricidal activity of a plant extract.

INTRODUCTION

Adverse environmental effects of modern organic pesticides have focussed attention once again on insecticides of botanical origin. During the past two decades extensive research on biologically active plant extracts have demonstrated that Neem (*Azadirachta indica*) is a promising source of effective and economical insect toxicant and repellant (Ahmed and Grainge, 1986; Atal and Kapur, 1982; Attri and Prasad, 1980; Grainge et al, 1985; Ketkar and Ketkar, 1985). Extracts of the leaves of *A. incisa* are also found to have high insecticidal activity (Williams et al, 1988).

Cattle ticks pose a serious threat to livestock farmers in the tropics; in the Commonwealth Caribbean itself, the losses due to the acarids are estimated to be about US$62 million (Rawlins and Mansingh, 1987).

Organic acaricides have been providing satisfactory control of ticks in many parts of the world, but in Australia and South Africa, *Boophilus microplus* have developed high levels of resistance to the commonly used chemicals. The continued dependence of organic acarides do pose potential hazards of their residues to non-target organisms and the consumers.

The socio-economic conditions in the Caribbean demand the availability of cheap and safe acaricides for the management of cattle ticks. The present

project was therefore initiated to explore the acaricidal activity of Jamaican plant extracts which could be of significance to small farmers.

The preliminary results presented herein are the first ever reported on the acaricidal action of any plant extracts.

MATERIALS AND METHODS

Extract of Neem kernel was provided by Dr.S.P. Singh of the Indian Agricultural Research Institute, New Delhi, India. The method employed involved extraction from ground kernels in ethanol, which was partitioned between hexane and methanol. In the present experiment, the hexane fraction of the extract was assayed.

Freshly collected leaves of *A. incisa* were chopped in a blender and 10g of the chop was kept in a flask with 150 ml of acetone or 98% ethanol at room temperature of 27 - 30°C. After 120 hrs, acetone was decanted and evaporated in a rotor evaporator to dryness. The residue was partitioned between methanol and petroleum ether (30 to 40°C) and after drying both fractions were re-dissolved in acetone and assayed on ticks.

The greenish ethanol extract was mixed with activated charcoal(3.6 g/150 ml extract), and heated for 15 seconds in a hot water bath at 78°C. The yellowish extract thus obtained was filtered and partitioned between hexane and methanol. The fractions were collected separately, dried and redissolved in acetone and assayed on ticks.

Fully engorged ticks were collected from cattle and treated with extracts after 4 or 48 hours of collection. Neem extract was applied topically on the dorsum of ticks using a Hamilton micro-applicator. Breadfruit extracts were sprayed directly on the ticks under Potter's Tower at a pressure of 2.5 kg/cm^2.

Thirty ticks in three replicates of 10 each were treated with each dose of an extract or with acetone (controls). The treated ticks and the control were kept at room temperature (27 - 30° and 50 - 60% rh) in plastic match boxes and allowed to lay eggs until death. Every two days, the eggs in each match box were weighed and kept in a test tube for six weeks for embryonic development and hatching.

RESULTS AND DISCUSSION

Table 1 presents data on the survival and reproductive physiology of *B. microplus*, after treatment with Acetone (AE), petroleum ether (PE), methanol (ME), ethanol (EE) and hexane (HE) extracts of *A. incisa* and hexane extract of *A. indica* (AI). Only AE, ME and AI inflicted over 20% mortality on the ticks, the highest being with 64% of AE. All the extracts had inhibited oviposition by about 30 to 70% in the tricks treated four hours after engorgement, the order of efficacy of the extracts being AE 64% > AI > PE > HE > EE > ME. In these ticks, AE, EE, AE, HE and ME also inhibited hatching of the eggs by 59, 55,51, 42 and 39%. All the eggs which were non-viable were malformed in shape.

It is interesting to note that the inhibitory action of PE, EE, HE and

Table 1. Adverse effects of extracts of A. incisa and A. indica on the survival, oviposition and egg hatching of the tick Boophilus microplus.

Extract	Tick age[a]	Dose[b]	Mortality %	Inhibition (%) Oviposition	Hatching	% egg Malformed
Control	4	-	0.0	-	-	1.5
	48	-	0.0	-	-	2.0
A. incisa	4	50%	20.0	10.42	13.6	22.9
Acetone	4	64%	46.7	70.00	59.0	44.0
Pet. ether	4	50%	16.7	55.3	27.3	29.8
	48	50%	6.7	58.8	83.0	93.7
Methanol	4	50%	23.3	29.7	11.0	11.1
	48	50%	20.0	28.8	13.6	20.0
	4	2 µl	10.0	29.2	39.2	20.0
	48	2 µl	6.7	10.1	29.5	18.2
Ethanol	4	2 µl	13.3	37.4	55.0	49.0
	48	2 µl	10.0	16.3	48.8	32.0
Hexane	4	2 µl	16.7	40.4	41.8	40.0
	48	2 µl	16.7	22.7	52.5	52.0
A. indica	4	2 µl	25.6	57.4	51.0	38.5
	48	2 µl	23.2	24.9	59.1	50.0

a. hours after collection of engorged ticks

b. Percent concentration of crude extract sprayed, or µl of 20% crude extract applied topically.

AI on embryogenesis and hatching of eggs was not affected by the stage of ovarian development in the ticks; in fact the inhibition was about 83% when ticks were treated with AE, 48 hours after engorgement.

Inhibition of oviposition by *B. microplus* after treatment with sub-lethal doses of certain acaricides has been demonstrated by Mansingh and Rawlins (1979). Ecdysterone and several juvenile hormone mimics were also found to inhibit oviposition by about 73 and 96% (Mansingh and Rawlins, 1977). It is thus possible that the mode of action of the extracts of *A. incisa* and *A. indica* on the ticks is similar to that of juvenile hormone mimics which are analogous to extracts of coniferous plants.

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