ACTIVITY OF NEEM, NUTMEG AND PINE OILS AGAINST THE LIGHTBROWN APPLE MOTH

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SUMMARY

Larvicidal activity of neem, nutmeg and pine oils against the lightbrown apple moth (LBAM) (*Epiphyas postvittana*) was studied using 0.01, 0.05, 0.25, 1.25, and 6.25% aqueous emulsions incorporated into artificial diet. All three oils had activity against LBAM. The LC_{50} values were 1.17, 1.47, and 0.44% for neem, nutmeg, and pine oils respectively. These oils may have potential for use as insecticides in integrated pest management.

Keywords: neem oil, nutmeg oil, pine oil, lightbrown apple moth, *Epiphyas postvittana*

INTRODUCTION

The demand for reduced usage of synthetic pesticides has resulted in extensive searches for suitable biologically based pesticides (Cutler 1988; Arnason *et al* 1989).

Plants and plant extracts having insect toxicant properties have been summarized by Holyoke and Reese (1987). During the past decade, compounds derived from neem (*Azadirachta indica*) have been reported to affect settling, oviposition, feeding behaviour and the fecundity and metamorphosis of many insect species (Schmutterer 1990). Azadirachtin has been shown to be one of the major contributors to the activity of neem against insects (Butterworth and Morgan 1968).

This study reports investigations on the activity of neem, nutmeg (*Myristica fragrans*) and pine (*Pinus radiata*) oils against the lightbrown apple moth (LBAM) (*Epiphyas postvittana*).

METHODS

Insect rearing diet (Singh 1983), was prepared with finely ground ingredients. When set, 7 g of diet was placed in a plastic bag (125 mm x 150 mm) and rolled to a uniform thickness of 1.1 mm. The diet was then cut into 15 mm x 15 mm squares (0.067 ± 0.0074 g), freeze-dried and used in the bioassay.

The treatments consisted of aqueous emulsions of neem oil (T.B. Ekanayake & Sons, Colombo, Sri Lanka), nutmeg oil (Bronson & Jacob NZ Ltd, Auckland), and pine oil ("Pine oil 80%", B & J NZ Ltd) at concentrations of 0.01, 0.05, 0.25, 1.25, and 6.25%. The oils were emulsified with 0.05% Citowett. The blank control was a 0.05% solution of Citowett. Three replicates were prepared per treatment. Each replicate consisted of four treated (freeze-dried) diet squares placed in a petri dish.

The emulsions (150 μ l per diet square) were applied as drops to 12 random positions on the diet square. Up to 40 neonatal LBAM larvae were then transferred into each petri dish. The petri dishes were then sealed with parafilm and held at 20 °C. Mortality of the larvae was assessed under the microscope after 48 hours by counting the numbers of live and dead larvae.

Azadirachtin content of the neem oil was determined by reverse-phase HPLC using a modification of the method described by Isman (1990).

RESULTS AND DISCUSSION

At 0.01 and 0.05% none of the oils had any significant effect on larval mortality (Table 1). At concentrations of 1.25% or above, all oils significantly increased larval mortality with the pine oil eliciting the greatest response. Table 2 shows the LC_{50} and

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TABLE 1: Proportional LBAM larval mortality on neem, nutmeg, and pine oil incorporated in artificial diet (analysis of variance done on arcsine transformed data).

Treatment	Concentration (%)	Mean ¹ proportional larval mortality	No. of insects
Neem	0.01	0.0871 (8.7)	96
	0.05	0.0167 (1.7)	76
	0.25	0.1577 (15.7)	65
	1.25	0.7688 (69.5)	59
	6.25	1.2000 (93.2)	96
Nutmeg	0.01	0.0955 (9.5)	61
	0.05	0.1977 (19.6)	69
	0.25	0.1602 (16.0)	64
	1.25	0.4360 (42.2)	64
	6.25	1.5708 (100.0)	97
Pine	0.01	0.1122 (11.2)	49
	0.05	0.1363 (13.6)	62
	0.25	0.2289 (22.7)	51
	1.25	1.5708 (100.0)	81
	6.25	1.5708 (100.0)	93
Untreated		0.0621 (6.2)	76
LSD (0.05)		0.1207	
LSD (0.01)		0.1625	

¹ Transformed means. Backtransformed percentage mean mortality in parentheses.

LC₅₀ values obtained for the three oils and their 95% confidence intervals for LBAM. The probit response curves for the three oils were significantly different from each other (P<0.05).

The observed activity of neem oil is attributable to the azadirachtin content. The sample of oil used for these tests had less than 300 µg/g of azadirachtin (samples containing up to 4026 µg/g have been reported (Isman *et al* 1990)). Oil of nutmeg, which is used as a food flavour, consists of many monoterpenes and alcohols and it is known to have mammalian toxicity when ingested in large quantities (Windholz *et al* 1983). Oils of various pine species are also complex mixtures of monoterpenes and other natural products (Windholz *et al* 1983) and they have been shown to have oviposition deterrence (Javer *et al* 1987) and feeding deterrence (Richmond 1985) to other insect species. Results from this trial are sufficiently encouraging to continue evaluation of these natural products against insect pests in orchards.

TABLE 2: Estimates of LC₅₀ and LC₉₀ (%) for neem, nutmeg and pine oils for LBAM mortality.

Oil type	LC ₅₀ (95% CI)	LC ₉₀ (95% CI)
Neem	1.17 (0.53-1.95)	3.10 (1.85-6.08)
Nutmeg	1.47 (0.69-2.65)	3.91 (2.18-9.18)
Pine	0.44 (0.22-0.77)	1.16 (0.67-2.81)

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