

SHORT COMMUNICATION

Bio-repellents for Land Leeches

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ABSTRACT

Oils of *Callistemon rigidus* (bottle brush), *Zanthoxylum armatum*, DC. syn. *Zanthoxylum alatum* Roxb (*timur*), *Azadirachta indica* (*neem*) and synthetic repellent *N, N*-diethyl-meta-toluamide (DEET) and dimethyl phthalate (DMP) were evaluated for leech repellency properties and persistence on cloth. In statistical analysis, bio-repellents were found at par with DMP. Bottle brush oil afforded better protection against land leeches than *timur* oil, *neem* oil and synthetic repellent DMP at all the three concentrations evaluated. However, DEET was found superior to all the repellents evaluated and remained effective for 19.8 days at 0.93 mg/cm² followed by 7 days and 6.3 days at 0.56 mg/cm² and 0.37 mg/cm² treatment, respectively, while bottle brush oil was found effective for 13 days at 0.93 mg/cm².

Keywords: Bio-repellents, synthetic repellents, dimethyl phthalate (DMP), *timur* oil, *neem* oil, land leeches, *N, N*-diethyl-meta-toluamide (DEET)

1. INTRODUCTION

Land leeches are adaptive terrestrial class of annelids, well known for their biting nuisance to man and domestic animals in sub-Himalayan mountain range. Sanguivorous nature of leeches with hirudin in their saliva causes serious loss of blood and resulting wound takes fairly long time to heal. Infestation of land leeches is very common in sylvan habitats having moist and humid climate. They aggregate in places away from sunshine due to attraction of certain micro-climatic factors. Field control of leeches with insecticides and chemicals has been tried with limited scope and success but found not feasible due to involvement of vast forested area, difficult terrain and irreversible damage to ecosystem and non target organisms. Use of repellents as personal protection measures seems to be the most acceptable solution to prevent leech bite. Repellent-impregnated cloth sleeves for legs

found to give protection up to 90 days¹. Essential oils and extract of plants were also used with promising results^{1,2}. Repellents of plant origin are preferred over synthetic repellents as prolonged use of the later could be harmful due to their toxicity and chemical nature³⁻⁶.

In the present investigation, repellent properties of the *Callistemon rigidus* (bottle brush), *Zanthoxylum armatum*, DC. syn. *Zanthoxylum alatum* Roxb (*timur*) and *Azadirachta indica* (*neem*) oil-impregnated cloth have been evaluated against land leeches and compared with synthetic repellents *N,N*-diethyl-meta-toluamide (DEET) and dimethyl phthalate (DMP).

2. MATERIALS & METHODS

The area selected for the study was the Tawang valley which is located at 27.33' north latitude and 91.48' east longitude in

Arunachal Pradesh at 3200 m on Himalayan range in the northeastern part of India. It is a district headquarter township, mainly inhabited by *Monpas*, *Adis* and *Tibetians*. The climate of Tawang is fairly cold (21.5 °C to 7.0 °C) and remains snowbound for three months (December to February). Extreme change of climate is observed during May to August due to heavy rainfall (0.2 mm to 48.0 mm) and rise in temperature (19.0 °C to 21.5 °C). Relative humidity ranges between 75 per cent and 100 per cent. The moist and humid climate causes heavy infestation of land leeches in jungles, hill slopes and pathways. Leeches remain inactive during heavy rain and hot weather⁷ but become active during light drizzle. Present trials were carried out during June to July. The temperature and relative humidity recorded were 20.0 °C to 21.5 °C and 70 per cent to 100 per cent, respectively. Rainfall and soil temperature ranged between 0.2 mm and 48.6 mm and 17.1 °C to 17.3 °C, respectively. Infestation of leeches was very high in the study area. It was mainly dominated by *Haemadipsa zeylanica*, the defender of mountains with *Haemadipsa sylvestris* and *Haemadipsa ornata*.

The essential oils of bottle brush and *Zanthoxylum armatum* were obtained by steam distillation of leaf/seed pericarp. *Neem* oil was obtained from Unjha Ayurvedic Pharmacy, Unjha, N. Gujarat. The two synthetic repellents DEET and DMP procured from Fluke Buch, Switzerland and High Purity Chemicals, New Delhi, respectively were also evaluated as reference.

Methodology described by Nath¹, *et al.* was adopted for evaluation of repellents and their persistence on cloth against land leeches. White poplin cloth sleeves (90 cm × 60 cm) were stitched (for legs) and impregnated with desired quantity of repellents dissolved in acetone (260 ml) for one pair of sleeves. Field trials were conducted with leech repellent concentration of 2 per cent (0.37 mg/cm²), 3 per cent (0.56 mg/cm²) and 5 per cent (0.93 mg/cm²). In all instances, cloth sleeves were treated with repellents 24 hr prior to conducting the experiments. Six volunteers (five treated and one control) were taken to a leech-infested area. Two-cloth sleeves treated

with two different repellents at the same concentration were given to each subject for wearing on both legs as per Round Robin or incomplete block design test^{1,8,9}. Subjects were asked to walk through the leech-infested foot-track on the hill slope for 10 min. Simultaneously, a control subject wearing untreated cloth sleeves was also asked to walk through the same path. Leeches attached to untreated cloth sleeves were recorded as control landing. Number of days between impregnation and first landing/attachment of leeches on cloth sleeves was recorded as the protection period¹, i.e., persistence of repellents on cloth. Ten observations were made during a day. To minimise the subject preference, if any, subjects were given cloth sleeves with new combination of repellents by rotation on each successive day of experiment. Five sets of experiments were conducted with one control (untreated) in each set. The treated and untreated (control) cloth sleeves were kept in polythene bags separately for each concentration during the days of experiments. Trials were conducted during early hours of the day when the leeches become active. Data obtained were analysed as per Fisher's F-test.

3. RESULTS & DISCUSSION

Results of the field trials revealed that the herbal oil of bottle brush afforded better protection than *timur* oil, *neem* oil and synthetic repellent DMP at all the three concentrations. Bottle brush oil exhibited higher persistency (13 days) at 5 per cent (0.93 mg/cm²) treatment, while *timur* oil, *neem* oil and DMP afforded protection for 11.5 days, 7 days and 11.8 days, respectively. However, synthetic repellent DEET exhibited the highest persistency (19.8 days) at the same concentration and maintained its supremacy although the experiments (Table 1).

Statistical analysis of the data revealed that synthetic repellent DEET exhibited the highest persistency than the other three repellents, affording maximum protection time in all the treatments. Bottle brush oil afforded significantly better persistency than *timur* oil, *neem* oil and DMP at 2 per cent (0.37 mg/cm²) treatment. At 3 per cent

Table 1. Results of persistency of repellents on cloth against land leeches.

Repellent	Conc (mg/cm ²)	Adjusted mean (days)	Variance ratio	Tabulated F value at 1% level	LSD
Bottle brush oil	0.37	4.5*	24.623	5.41	1.02
<i>Timur</i> oil		2.3			
<i>Neem</i> oil		2.3			
DEET		6.3*			
DMP		3.3			
Bottle brush oil	0.56	4.8*	17.952	5.41	1.12
<i>Timur</i> oil		3.8			
<i>Neem</i> oil		3.3			
DEET		7.0*			
DMP		3.5			
Bottle brush oil	0.93	13.0	78.675	5.41	1.60
<i>Timur</i> oil		11.5			
<i>Neem</i> oil		7.0			
DEET		19.8*			
DMP		11.8			

Control: 26-34 leeches/man hr

* Least significant difference, P value > 0.01

No. of replicates: 5

concentration, bottle brush oil was found at par with *timur* oil and significantly better than *neem* oil and DMP. However, no significant difference was observed in protection time among bottle brush oil, *timur* oil and DMP at 5 per cent (0.93 mg/cm²).

Comparing the experimental data obtained with earlier observations made by Nath¹, *et al.* it was observed that much lower concentrations of DEET and DMP were required in the present trials to achieve the identical results. Persistence on cloth of bottle brush oil, *timur* oil and *neem* oil was much longer than the oils of Cinamon and Citronella¹⁰. Saxena⁷, *et al.* also used much higher concentration of seed extract. Kumar¹¹, *et al.* obtained 7.25 hr and 2.5 hr of protection with DEET and DMP, respectively when applied at 0.5 mg/cm² directly on skin. In the present trial, 3.3 days to 4.8 days protection was obtained with 0.56 mg/cm² treatment of bio-repellents on poplin cloth sleeves. Similarly, DEET and DMP also

provided protection for 7 days and 3.5 days, respectively. Results of the experiment further conformed the earlier observations of Nath¹, *et al.* It was also observed during trials that users prefer cloth sleeves impregnated with bio-repellents than the synthetic repellents like DEET and DMP. This may be due to natural fragrance, compatibility and long association of bioproducts with mankind.

Many plants are known to produce chemicals with insecticidal and repellent properties which are environmentally safe than the synthetic ones. Among these, *neem* has created a lot of interest due to its anti-larval and repellent properties¹². To add, essential oils of *timur* and bottle brush can be good bio-repellent for haematophagous insects and leeches.

Impregnation of cloth with desired concentration of repellents preferably of bio-origin seems to be a practical proposition to get rid of the bites of leeches in the jungle rather than through chemical control, affecting the environment.

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