

Acaricidal Activity of Volatile oil from Lemon and Citronella Grasses on Tropical Cattle Ticks

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ABSTRACT

Volatile oil was obtained from lemon grass (*Cymbopogon citratus* stapf.) and citronella grass (*Cymbopogon nardus* Rendle.) leaves by steam distillation. The yields were 0.39% and 0.68% from the fresh leaves of lemon and citronella grasses respectively. Oil yield from dried leaves of lemon and citronella grasses were 0.52% and 1.20%, respectively. The stems and roots gave very less amount of oil. The oil was diluted with 95% ethanol and tested for acaricidal activity on larvae and engorge female cattle ticks (*Boophilus microplus*) by dipping method. The oil from fresh lemon grass showed high larvicidal activity (1-2 h after dipping) at the concentration of 1:8, 1:12 and 1:16 (oil/ethanol; V/V), while the oil from fresh citronella grass exhibited high activity at concentration of 1:8 and 1:12 (V/V). On the engorge female ticks, the lemon grass oil concentration of 1:2, 1:3 and 1:4 (oil/ethanol; V/V) exhibited high acaricidal activity on 5 days after dipping, but the citronella oil showed high activity at concentration of 1:2 and 1:3. The oil from dried leaves of both grasses showed weaker acaricidal activity on both larvae and adult ticks. *In vivo* acaricidal bioassay, the ethanol dilution 1:3 (V/V) of both oils were tested by spraying to the tick on cattle. The pre-engorge stage ticks collapsed and died on cattle's skin while the collected engorge female ticks could not laid and died at 5 days after spraying.

This indicates that volatile oil from lemon and citronella grasses can be practically used for controlling cattle ticks.

Key words : acaricide, lemon grass oil, citronella oil, tropical cattle ticks

INTRODUCTION

It is well known that tropical cattle ticks (*Boophilus microplus*) make a large economic loss in developing livestock, especially cattle. The body weight gains or milk productions were decreased after heavy tick infestation. Ticks are being the vector to transmit protozoan and infection diseases in cattle. Tick eradication need time, labors and cost of control. Particularly, the tick can develop resistant strains against synthetic insecticides (O'Sullivan and Green, 1971; Roulston, 1971; Drummond, 1977; Howell, 1977). Therefore, new acaricides originated from plants are in great demand. Our previous screening works revealed some plants showing high acaricidal

activity. (Chungsamarnyart et al., 1988, 1990b, 1991 a, b, c). The ethanol extract of citronella grass also showed relatively high larvicidal activity but its volatile oil and lemon grass oil have not yet been tested. The volatile oil from lemon and citronella grasses have shown insecticidal, repellent or attractant activities on mosquitoes and flies (Grainge and Ahmed, 1988). This study was conducted to show the possibility of using the citronella and lemon grasses oil for controlling the tropical cattle ticks.

MATERIALS AND METHODS

The fresh and dried leaves, stems and roots of lemon and citronella grasses were steam distilled.

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The oil were collected from the uppermost part of the water. The oil and its ethanol diluted oil were tested for acaricidal activity on larvae and engorge female tropical cattle ticks. For the larvae, the oil was diluted with 95% ethanol into 1:8, 1:12 and 1:16 (V/V). The larvicidal activity of oil was tested by dipping method where the mortality of larvae were checked at 1-2 h after dipping. The acaricidal activity on adult ticks of oil was also tested by dipping method with the ethanol dilution of 1:0, 1:2, 1:3, and 1:4 (V/V). The mortality of ticks were observed at 24, 48 h and 5 days after dipping (Chungsamarnyart et al., 1990 a).

The corrected mortality of larvae and adult ticks were calculated by Abbott's formula (Abbott, 1925). The mean (%) of corrected mortality was the average of 5 replications (20 adult ticks/replication, 200-400 larvae/replication).

In vivo, acaricidal activity of both kind of oils were tested by spraying with 1:3 (V/V) ethanol dilution. The engorge female ticks were collected at 90 min after spraying prior their natural dropping from cattle. The dropped ticks will be non observation. The mortality of engorge ticks were observed at 24, 48 h and 5 days after collecting. The pre-engorge ticks on the cattle were observed every 24 h until 5 days. The control ticks were sprayed with 95% ethanol.

RESULTS

Steam distillation of the fresh and dried leaves of lemon grass yielded 0.39% and 0.52% (W/W) volatile oil, respectively. The oil yields of fresh and dried leaves of citronella grass were 0.68% and 1.20% (W/W) respectively. The oil yield from stems and roots of both grasses were minimal and could not collected.

The acaricidal activity on tick larvae of the oil from fresh lemon grass exhibited high activity with 1:8, 1:12 and 1:16 (V/V) ethanol dilution, while the oil from fresh citronella grass showed high activity with 1:8 and 1:12 (V/V) ethanol dilution. Therefore, the oil from fresh lemon grass has stronger larvicidal activity than the oil from fresh leaves of citronella grass (Table 1). The oil from fresh leaves of both grasses exhibited higher larvicidal activity than the oil from dried leaves since the oil from fresh leaves showed high activity with more dilution than the oil from dried leaves (Table 1).

The acaricidal activity on adult ticks of the oil from fresh and dried leaves of lemon grass showed high activity with 1:0 to 1:4 (V/V) ethanol dilution and 1:0 to 1:3 (V/V) ethanol dilution, respectively (Table 2). The oil from fresh and dried leaves of citronella grass exhibited high activity with 1:0 to 1:3 and 1:0 (V/V) ethanol dilution, respectively (Table 2).

Table 1 Larvicidal effects of lemon grass oil and citronella oil on tropical cattle ticks.

Volatile oil from leaf	Dilution (V/V) oil:ethanol	Corrected Mortality (Mean, %) ¹ 1 - 2 h after dipping
Lemon grass oil fresh leaf	1 : 8	95.81 a
	1 : 12	92.11 a
	1 : 16	92.15 a
Lemon grass oil dried leaf	1 : 8	98.78 a
	1 : 12	97.80 a
	1 : 16	69.26 bc
Citronella oil fresh leaf	1 : 8	95.78 a
	1 : 12	92.79 a
	1 : 16	58.13 cd
Citronella oil dried leaf	1 : 8	93.92 a
	1 : 12	76.92 b
	1 : 16	45.83 d

¹ Mean (%) with the same letter are not significantly different of corrected mortality of 5 replications (200-400 larvae/ rep.). LSD .05 = 13.52

Table 2 Acaricidal effects of lemon grass oil and citronella oil on the engorge female tropical cattle tick.

Volatile oil from leaf	Dilution (V/V) oil : ethanol	Corrected mortality (Mean, %) ¹		
		24 h ²	48 h ³	5 D ⁴
Lemon grass oil fresh leaf	1 : 0	92 ab	100 a	100 a
	1 : 2	30 cd	75 bc	90 a
	1 : 3	29 cd	74 bc	89 a
	1 : 4	13 ef	39 d	85 a
Lemon grass oil dried leaf	1 : 0	87 b	99 a	100 a
	1 : 2	34 c	88 ab	96 a
	1 : 3	20 de	46 d	67 b
	1 : 4	19 de	44 d	60 b
Citronella oil fresh leaf	1 : 0	100 a	100 a	100 a
	1 : 2	21 de	70 c	89 a
	1 : 3	20 de	70 c	86 a
	1 : 4	4 f	24 e	66 b
Citronella oil dried leaf	1 : 0	100 a	100 a	100 a
	1 : 2	14 ef	48 d	65 b
	1 : 3	14 ef	36 de	63 b
	1 : 4	3 f	24 e	41 c

1 Mean (%) of corrected mortality of 5 replications (20 ticks/rep.); values with different letters in the same column are statistically significantly different.

2 LSD .05 = 10.26,

3 LSD .05 = 13.80

4 LSD .05 = 13.58

The results demonstrated that the oil from fresh lemon grass showed highest acaricidal activity, and the oil from dried leaves of both grasses exhibited lower activity than the oil from fresh leaves.

In vivo acaricidal activity bioassay, the ticks on cattle were sprayed with the ethanol diluted oil from fresh leaves. The 1:3 (V/V) ethanol dilution of both oil showed high activity as *in vitro*. The pre-engorge ticks collapsed and died on the cattle's skin at 48 h after spraying (Fig. B), while all the collected engorge ticks were non laying and dead at 5 days after spraying (Fig. C). The control ticks, (ethanol sprayed ticks) engorged and laid the eggs 3 days after collection.

DISCUSSION

Steam distillation yields of lemon grass oil (0.39% W/W) and citronella oil (0.68%, W/W) obtained higher than previously reported at 0.16% and 0.30% (V/W), respectively. (Wasuwat and Sunthonthanasart, 1988). However, the volatile oil yield of both grasses depends on humidity of soil (Miyazaki

and Taki., 1955; Yang, 1968). The cooling of condenser system during distillation also effects oil yield. A simple and effective distillation system will be further developed for the farmers.

The volatile oil from both fresh and dried leaves of lemon grass showed stronger acaricidal activity than the oil from citronella grass (Table 1). The corrected mortality of tick larvae and adult ticks were similar after dipping with more ethanol dilution of lemon grass oil and less dilution of citronella grass oil (Table 1 and 2). This exhibited that the lemon grass oil has higher acaricidal activity than citronella grass oil. This might due to their different chemical components. The major constituent (75-85%) of volatile oil of lemon grass is citral, while the major constituent of citronella oil is citronellal (Windholz, 1983). The ethanol extract of citronella grass has shown relatively high larvicidal activity (Chungsamarnyart et al., 1988). It might indicated that some active volatile oil lost during evaporation of the ethanol. However, this work had not yet been elucidated the active acaricidal substance in citronella oil. The citronella oil was reported to contain d-limonene having insect-

ticidal activity (Karr and Coats, 1988; Powers et al., 1988; Karr et al., 1990). Further study is needed to identify the active substances or to test the activity of each identified substance.

The acaricidal activity of oil from dried leaves of both grasses were less than the oil from fresh leaves

(Table 1 and 2). It is presumed that the oil from dried leaves loss some active volatile components and or the active components are transformed during drying period.

The acaricidal activity of both oil on cattle ticks has not yet been reported. The insecticidal activity of

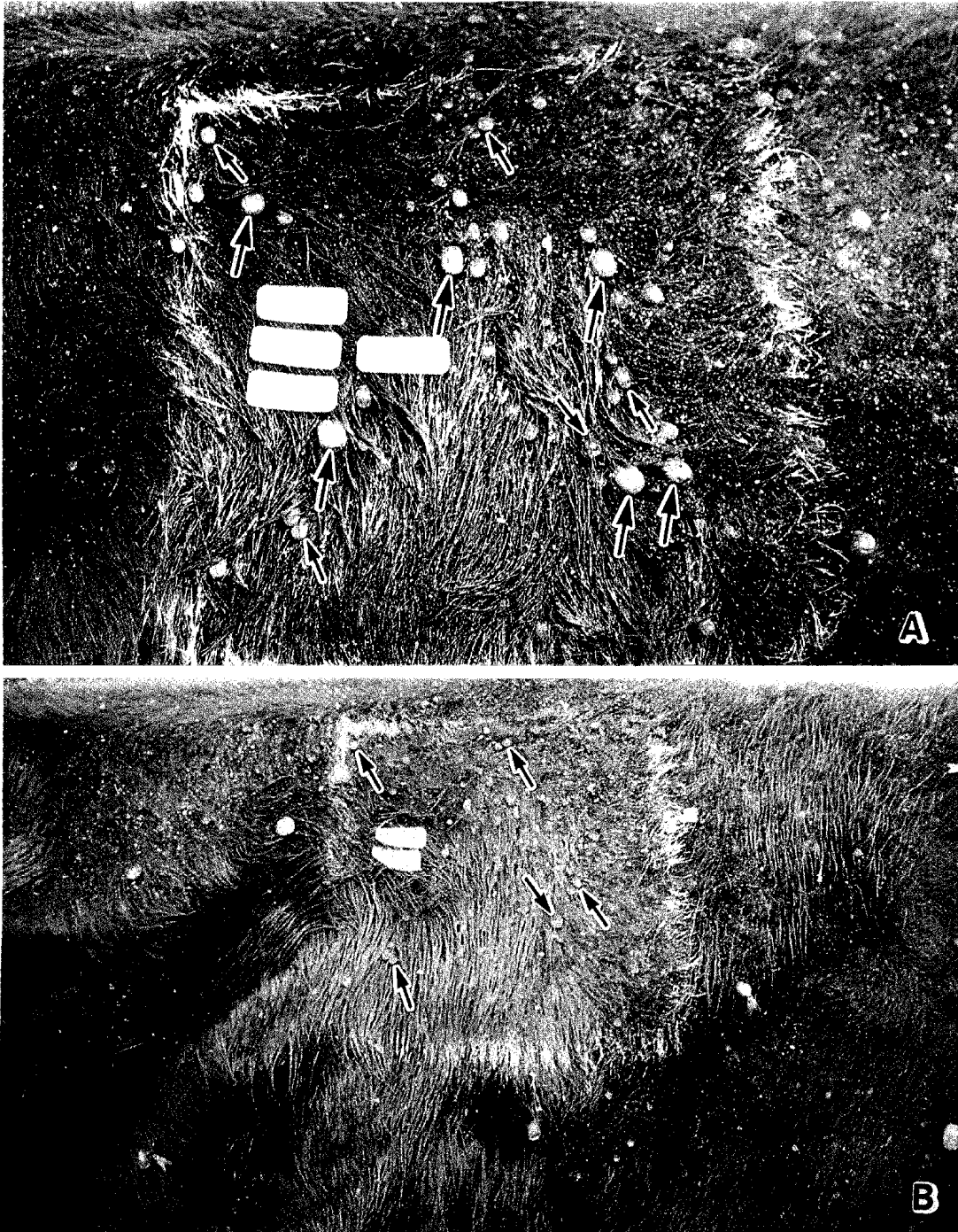


Figure A-B Live ticks on cattle's skin were sprayed with 1:3 (V/V) ethanol diluted volatile oil from fresh leaves of citronella grass; 15 min after spraying (Fig. A) and 48 h after spraying (Fig. B). Six engorge female ticks (Fig. A, large arrows) were collected after 90 min after spraying. The pre-engorge ticks (Fig. A, small arrows) were collapsed and dead on the cattle's skin at 48 h after spraying (Fig. B, small arrows).

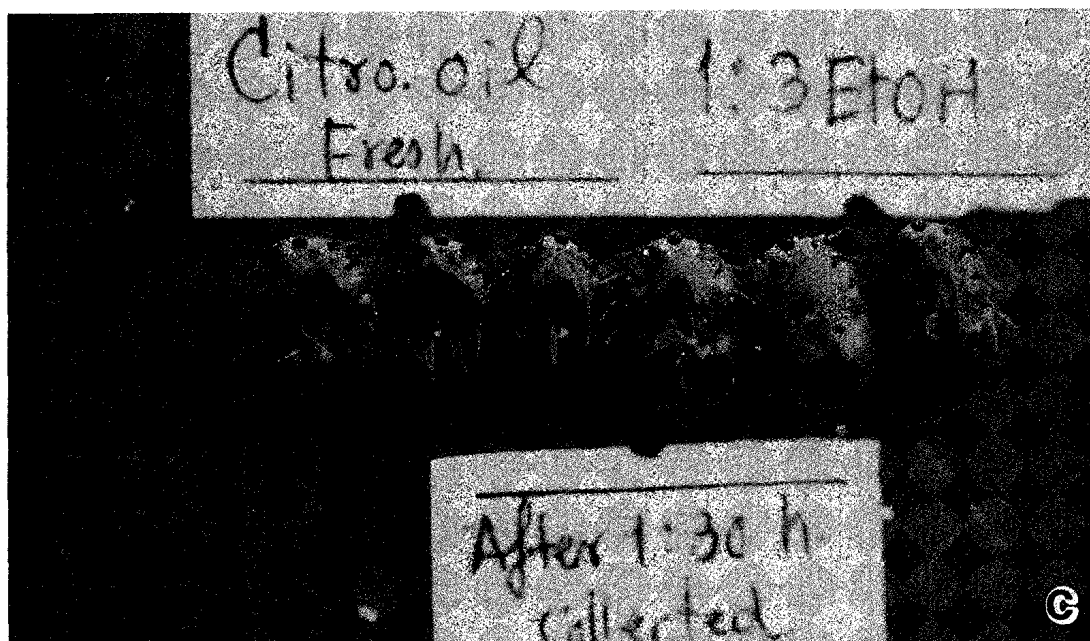


Figure C The six collected engorge female ticks were non laying and dead at 5 days after spraying. The ticks were in upside down position.

both oil have been shown only on mosquitoes and house fly (Grainge and Ahmed, 1988). In addition, citronella oil has been shown to exhibit the repellent activity on screwworm and the attractant activity on fruit fly (Granige and Ahmed, 1988). Unfortunately, this work had not yet observed the repellent and insecticidal activities on *Tabanus* (horsefly) which also bite and suck the blood from cattles. Further study on repellent activity of both oil will be performed.

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