



Australian Government
**Rural Industries Research and
Development Corporation**

Use of Tea Tree Oil Against Buffalo Flies in Cattle

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by Lex Turner

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Foreword

Continued development of an environmentally sustainable and profitable Australian tea tree oil industry would be enhanced by demonstrating proof of concept for innovative applications and new and effective product uses. The Australian tea tree oil industry has established international leadership in marketing, value-adding, and product reliability and production.

Anecdotal evidence exists that suggests the use of tea tree oil as an insect repellent / insecticide. However, a preliminary experiment failed to demonstrate conclusively that tea tree oil provided any protection against cattle buffalo fly when mixed at 5% in commercial mineral oils used in commercial cattle backrubbers.

No changes are recommended for the industry as a consequence of this research, although further research may show a more efficacious formulation or application technique that may show more promise in the future.

This project was funded from industry revenue matched by funds provided by the Australian Government.

This report, an addition to RIRDC's diverse range of over 2,000 research publications, forms part of our Tea Tree Oil R&D Program, which aims to support the continued development of an environmentally sustainable and profitable Australian tea tree oil industry that has established international leadership in marketing, in value-adding, and in product reliability and production.

Most of our publications are available for viewing, downloading or purchasing online through our website www.rirdc.gov.au.

Craig Burns
Acting Managing Director
Rural Industries Research and Development Corporation

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Abbreviations

Tea Tree Oil (TTO)

Holstein/Friesian (HF)

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Executive Summary

What the report is about

This research project investigated the efficacy of the application of tea tree oil against buffalo flies on dairy cattle. The cattle industry needs to have alternatives to the presently used chemicals available to treat buffalo flies as the buffalo flies are developing resistance. Consumers are concerned about the environmental, worker health and chemical residues in food issues that are associated with the use of these chemicals. A natural product could assist the cattle industries to become more sustainable and responsible.

If a new market could be developed for the tea tree oil then this could help sustain this native tree industry. These types of new markets would help the tea tree oil industry enhance our Australia 'green' agricultural image.

Who is the report targeted at?

This report is targeted at research managers and producers in the tea tree oil and cattle industries.

Background

The cattle industries need more natural parasite control strategies available to reduce chemical environmental, safety and food residue concerns and to assist or replace the present chemicals to which the parasites are developing resistance. This trial used tea tree oil in commercial backrubbers, through which chemicals registered to control buffalo fly are applied to cattle. If proof of concept was demonstrated, this would provide a possible low maintenance, low cost application technique for use with tea tree oil that would have achieved widespread industry acceptance.

Aims/objectives

Demonstrate efficacy of tea tree oil applied through conventional backrubbers as a possible alternative natural product for the control of buffalo fly. A successful product would benefit the Australian cattle industries, the tea tree oil industry and the Australian economy.

Methods used

A preliminary replicated trial was conducted to demonstrate the efficacy of tea tree oil in controlling buffalo flies through application in an oil based formulation through commercial backrubbers.

Results/key findings

No real or significant reduction in buffalo fly numbers was seen between the treated and untreated groups of cattle, even though some paddock and animal effect variability may suggest a positive response in some individual situations.

Implications for relevant stakeholders for

As the results of the trial were not positive there are few implications for the associated industries, the community or the policy makers. The cattle industries should note that this statistical trial did not reflect the industry anecdotal reports of the value of tea tree oil against buffalo flies on cattle.

Recommendations

No recommendations were developed from this research. Further testing is necessary to demonstrate that tea tree oil has potential against buffalo flies on cattle.

Introduction

Background to the project

The tea tree oil research program aims to support the continued development of an environmentally sustainable and profitable Australian tea tree oil industry that has established international leadership in marketing, in value-adding, and in product reliability and production. One tea tree oil research program strategy is to demonstrate proof of concept/efficacy for innovative applications.

There is evidence that tea tree oil has some possible insecticidal, antiseptic and wound healing qualities that may assist in wound healing or prevention. There is some anecdotal evidence that this may provide some protection against external parasites and biting flies; such as the significant impact of buffalo flies on health, welfare and production in cattle. However there is no evidence of any controlled experiments to prove this control. If proven, these qualities could result in a tea tree oil product for use against external parasites on cattle, that would help this tea tree program objective by opening the door for marketing opportunities for a potential innovative product. The cattle external parasite control market place is dominated by synthetic chemical products, and a natural product would significantly enhance the Australian industry 'green' agricultural image.

Buffalo flies are biting flies that feed on the blood of the cattle by biting them regularly (10-40 times per day), and spend most of their adult life on cattle. Buffalo flies are recognised as one of the most important animal health problems in cattle. They are found across the northern parts of Australia and their yearly distribution fluctuates significantly depending on seasonal conditions. With climate change, their permanent distribution is slowly spreading south as the flies either adapt or find more suitable sites to survive the winters. Most of Queensland can be infested if seasonal conditions suit the flies.

The irritation and subsequent lesions caused by buffalo fly biting disrupts grazing leading to reduced growth rates and to reduced milk production in dairy cattle, as well as losses due to hide damage, transmitted *Stephanofilaria* worms, reduced libido, increased incidence of 'pinkeye' infection, and the costs associated with treatment of cattle against the flies.

These losses in production were quantified in a published report (Jonsson and Mayer 1999) which examined losses in milk yield and live-weight gain in dairy cattle. The analysis model in this report predicted a threshold number of flies ($n = 30$) below which no adverse effects would be noted. The report found that at a moderate level of infestation ($n = 200$) loss in milk yield was 2.6 ml/fly/day and loss in weight gain was 0.14 g/fly/day. Weight losses of 15 kg over a 100 day fly season due to moderate infestations averaging 200 buffalo flies per day, have been recorded in Australian beef cattle (Peter *et al.* 2005).

Present control relies mostly on synthetic chemicals. Whilst these have been effective, the flies are becoming more resistant to many of the presently used chemicals. Consumers are also demanding a reduction in chemical use in the food producing industries to reduce chemical environmental contamination, reduce chemical exposure of rural workers and reduce chemical residues in all food products.

There are many different methods of chemical application; some of which give long term protection and others have to be applied regularly. The most economical application method utilises back-rubbers installed in the paddock, with cattle quickly learning to go to these rub the insecticidal and repellent chemicals onto the area where the flies are biting and give seasonal protection without handling the cattle.

If successful, this work could lead to development of a reasonably low-cost natural product for buffalo fly control that is simple to apply and avoids the present issues of chemical control. The first step in developing a commercial product is to demonstrate that the active ingredient has some protective effect against the parasite.

Objectives

Conduct an initial screening test to demonstrate potential efficacy of tea tree oil as a natural product to protect cattle from the effects of external parasites such as buffalo fly.

Methodology

Cows were monitored for levels of clinical evidence of irritation and fly presence from September 2007 to February 2009, to identify a potential period of sufficient buffalo fly activity to achieve a good chance of demonstrating potential efficacy of tea tree oil for protection against buffalo fly. In late January 2009, buffalo fly numbers were deemed to be sufficient to commence an experiment on 2 February 2009, that was completed on 6 April 2009.

This trial involved a randomised block design with two replicates each of three treatments (tea tree oil, oil formulation without tea tree oil and control), allocated at random to 6 paddocks with paddocks as the experimental unit. The cows were generally Friesian cows with two cows that were classified as Friesian cross; with the 18 animals ranging from 0 to 100% dark pigment.

The cows were grouped on pre-treatment fly counts with animals randomly allocated to treatment groups after being grouped on pre treatment fly counts.

Prior to allocation of cows to the trial, buffalo fly numbers were counted on all 18 cattle on three consecutive days and cows were ranked for buffalo fly numbers on each day. These rankings were averaged for each cow and the cow numbers were placed in order from the most resistant animal to the most buffalo fly susceptible animal.

The nine cows with the lowest average rankings for buffalo fly numbers were allocated separately to the other nine cows. Three groups of three cows were formed from these nine animals and were allocated at random to the treatments. The three groups were formed from one cow from the lowest ranked group of three, one cow from the next lowest ranked group of three and one cow from the other three. This allocation from the ranked groups of three was done at random. The same was done for the other nine cows so that there were six treatment groups of three animals replicating the three treatments.

Paddocks

The six paddocks (naturally open grass country) containing a water trough and shade; 5 naturally shaded with trees, and one paddock with a constructed shade shelter provided. While the paddocks were well grassed at the start of the trial, the cattle did require some hay before the end of the trial.



Figure 1. Aerial view of the 6 paddocks used in the trial showing the troughs (where backrubbers were placed), trees and constructed shade (the blue square)

Application

The tea tree oil were applied in a backrubber at 5% concentration mixed in the commercial oil formulation supplied for backrubbers.

The backrubbers used in the trial were commercially available backrubbers. Backrubbers are usually an absorbable material into which a treatment solution is added, and secured on a chain that suspends the 'rubber' across a walkway so that cattle go under them and rub on them when passing; usually on a daily basis. The timing of the treatment therefore is usually reasonably constant while the backrubbers area charged with the treatment solution.

The backrubbers in this trial were situated across the gateways to the waters in each paddock (except the control paddocks) so cattle had to go under the backrubbers each time they went in for a drink. Frames were constructed to support the backrubbers, the fence and the oil mixtures. The backrubbers were applied following the manufactures instructions. Hessian bags were added to the backrubbers on 24 February (3 weeks into the trial) to improve the efficiency with which the treatments were applied to the cattle.



Backrubbers in position



Using the backrubbers on the first day



With the bags added to improve coverage



The cattle using the bags

Figure 2. Photos of the backrubbers and application method

Buffalo fly counting method

Detailed buffalo fly counts were conducted at approximately weekly intervals for 10 weeks from commencement of the trial in early February 2009, until April 2009.

Buffalo flies are a constant parasite of cattle and feed regularly (10-40 times each day), and perish quickly without these regular feeds. Although they leave the host when disturbed and to lay eggs in the dung, they return quickly and do not stay away from the host for any length of time.

Buffalo fly counting is usually done quickly to minimise the need for repeat counts due to disturbances from swishing tails and other factors. Fly numbers are quite variable on the cattle depending on many factors and counting (estimating) is done quickly to obtain representative numbers. Depending on buffalo fly numbers, counts are done singly, in groups of five or ten, or in groups of fifty or one hundred (Holdsworth *et al* 2006). It is usually done through binoculars to better enable counting of flies on dark patches of hair; under certain environmental conditions, the buffalo flies preferentially rest on the areas of black hair on the Friesian cows. When the cattle are quiet enough the binoculars would not be needed but usually it is difficult to get close enough to the cows to count without binoculars.

The buffalo flies were counted on one side of the cattle and all counts are recorded as side counts. For any particular day, counts were done as consistently as possible.

Eye irritation

Clinical signs of irritation around the eyes of cattle occur when buffalo flies are thick and the cattle have been exposed to the buffalo flies for a lengthy period. The extent of these signs were recorded and compared between groups at the end of the trial. This irritation is usually seen as reddened, bald and maybe crusty areas.

A scoring system was developed for this comparison.

1. no visible signs
2. mild weeping response (dry fluid)
3. mild crust
4. raised crust
5. crust with blood
6. extensive raised crust
7. raised crust with blood
8. extensive raised crust with blood.

Analysis

Results were analysed over two time periods as the back rubbers were improved after the buffalo fly count on 23 February 2009. Buffalo fly counts were analysed by repeated measures analysis. In addition, counts at each time point were analysed using a generalised linear mixed model assuming a poisson error distribution. The paddock was considered the experimental unit for analysis.

Results

Repeated measures analyses showed no differences between the groups for the period 2-23 February. Time was very significant but the interaction between time and group was not significant. This was confirmed from analyses at each time point with generalised linear mixed model assuming a poisson error distribution. For the remainder of the trial (24 February to 6 April 2009), repeated measures analyses showed no differences between the groups. Time was very significant but the interaction between time and group was not significant (Table 1).

The mean counts for time and group are given in Tables 1 and 2.

The generalised linear mixed model analyses confirmed the repeated measures analyses. The results of the analyses at each time point are given in Tables 3 and 4.

Table 1. Means for the period 2-23 February (no bags on the backrubbers)

Dates	2.02.09	5.02.09	10.02.09	17.02.09	18.02.09	23.02.09	Std error
Means	56.1	98.3	95.1	87.2	81.5	178.9	13.43
Groups	Control		Oil		TTO		Std error
	121.7		87.9		89.0		15.29

Table 2. Means for the remainder of the trial (24 February to 6 April 2009) (with bags)

Dates	24.02.09	2.03.09	3.03.09	6.03.09	10.03.09	16.03.09	23.03.09	24.03.09	27.03.09	30.03.09	6.04.09	Std error
Mean	238.1	280.0	233.9	277.0	201.9	184.4	206.0	183.1	187.5	156.4	100.7	23.94
Groups	Control			Oil			TTO			Std error		
	229.8			204.9			178.6			35.65		

Table 3. Mean log counts (back transformed mean counts in original scale in brackets) and average standard errors at each time point for the period 2-23 February (no bags on the backrubbers)

Date	2.02.09	5.02.09	10.02.09	17.02.09	18.02.09	23.02.09
Control	4.44(84.6)	4.53(93)	4.61(100.5)	4.53(92.6)	4.55(95)	5.49(241)
Oil	3.65(38.3)	4.36(78.3)	4.57(96.5)	4.51(90.8)	4.26(70.8)	5.03(152.3)
TTO	3.82(45.4)	4.76(116.2)	4.44(84.9)	4.3(73.7)	4.37(78.8)	4.83(125.4)
ave SE	0.341	0.347	0.305	0.28	0.227	0.356

Table 4. Mean log counts (back transformed mean counts in original scale in brackets) and average standard errors at each time point for the remainder of the trial (24 February to 6 April 2009) (with bags)

Date	24.02.09	2.03.09	3.03.09	6.03.09	10.03.09	16.03.09
Control	5.54(255.7)	5.67(290)	5.41(224.2)	5.57(262.5)	5.31(203)	5.35(210.5)
Oil	5.3(199.3)	5.57(262.5)	5.73(307.5)	5.74(310.8)	5.49(242.8)	4.99(147.4)
TTO	5.38(216.7)	5.66(287.5)	5.14(170)	5.55(257.7)	5.03(153.1)	5.19(180)
ave SE	0.439	0.216	0.255	0.159	0.303	0.37
Date	23.03.09	24.03.09	27.03.09	30.03.09	6.04.09	
Control	5.46(235.8)	5.43(227.4)	5.44(230.9)	5.29(198.2)	5.11(165.7)	
Oil	5.24(188.8)	5.23(186.2)	5.27(193.4)	4.87(130.3)	4.25(69.8)	
TTO	5.26(193.3)	4.86(129.2)	4.87(129.8)	4.76(117.1)	3.98(53.5)	
ave SE	0.196	0.34	0.285	0.461	0.367	

Mean fly counts of the paddocks were graphed (Figure 3) against time in an attempt to understand the change with time, to further demonstrate that the tea tree oil was not efficacious against buffalo flies when applied in a backrubber.

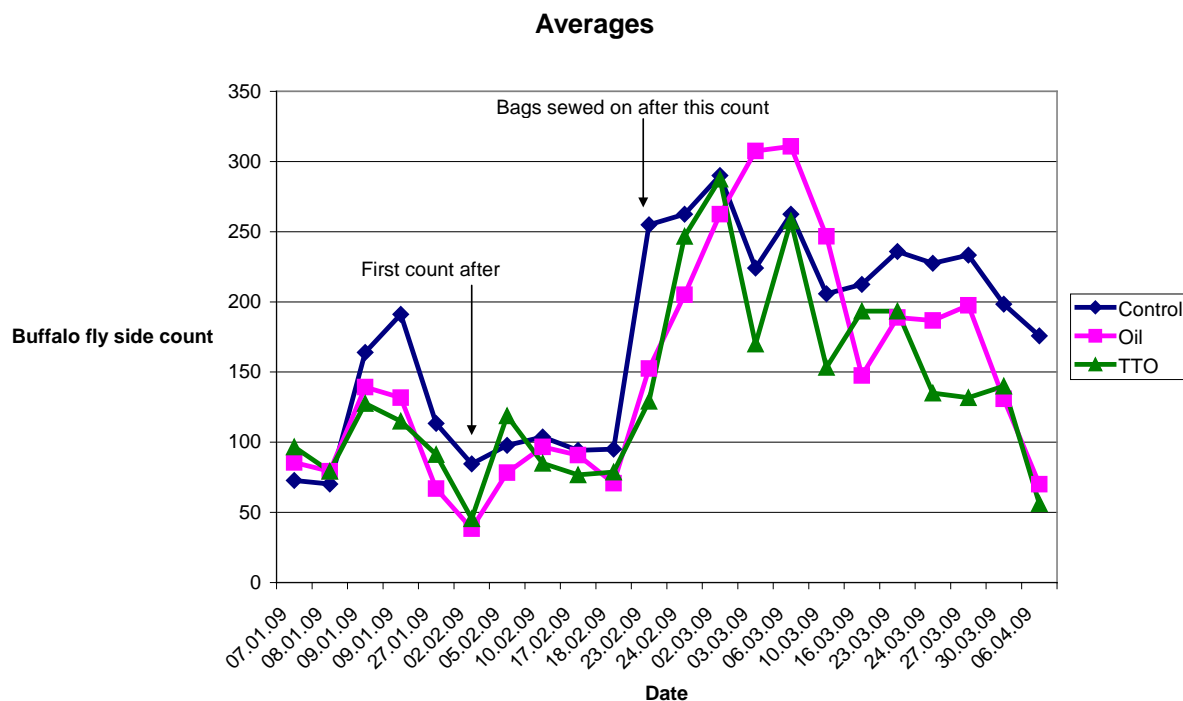


Figure 3. Graph of the mean buffalo fly numbers of each treatment during the trial

Further analysis showed that whilst weather data had some effect, even when combined, wind speed, wind direction, pressure & temperature only explained 32% of the variation in mean counts. The variation in mean counts explained by the weather variables were:

- pressure and wind direction - 15.46%;
- pressure and temperature - 18.59 %;
- wind speed and wind direction - 20.05%;
- wind speed and pressure temperature - 23.97%;
- wind speed, wind direction and pressure - 26.52%;
- wind speed, wind direction and relative humidity - 28.46%;
- wind speed, wind direction, pressure and temperature - 32.07%.

Implications

There are no positive implications for either the tea tree oil industry or cattle industries from this trial as the tea tree oil did not prove to be efficacious against buffalo flies on the cattle. Even if some efficacy could be shown, future research may have to demonstrate no adverse effects of using tea tree oil.

Recommendations

Based on the results of this preliminary trial and subsequent desktop studies, no further research is recommended for either the tea tree oil industry or cattle industries, as the tea tree oil was not shown to be efficacious against buffalo flies when applied in a backrubber.

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The cattle industry needs alternatives to the presently used chemicals available to treat buffalo flies, as the buffalo flies are developing resistance. Consumers are concerned about the environmental, worker health and chemical residues in food issues that are associated with the use of these chemicals. A natural product could assist the cattle industries to become more sustainable and responsible.

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Cover photo: Top left: Backrubbers in position, Top right: Using the backrubbers on the first day
Bottom left: With the bags added to improve coverage, Bottom right: The cattle using the bags

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