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Trials with chlorpyrifos (Dursban) as a systemic insecticide against the cattle louse

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Data for louse control are presented chiefly on chlorpyrifos (Dursban) 0,0-diethyl 0-(3, 5, 6-trichloro-2-pyridyl) phosphorothioate and fenchlorphos in one trial and chlorpyrifos and famphur in three trials. These animal systemics were tested on 168 dairy calves in four herds located in three regions of the North Island, New Zealand. Louse control, following single backline, dermal applications, showed 80 per cent, 87 per cent and 100 per cent with dosages of chlorpyrifos at 5 mg, 13 mg and 20 to 200 mg per kg, respectively, and 100 per cent and 93 per cent with dosages of famphur at 20 mg per kg, respectively. Poor louse control (24 to 58 per cent) with fenchlorphos was expected since this compound requires two applications 14 days apart. Ovicidal effect was demonstrated with chlorpyrifos and famphur. Minor scurfing and hair loss occurred on some calves with all compounds, but hair coats were normal 28 days after treatment. Calves given 100 mg to 200 mg per kg chlorpyrifos showed signs of organophosphate toxicity from 5 mins to 90 mins post-treatment but were normal thereafter.

RESULTS from early investigations in Canada on the use of animal systemic insecticides for control of cattle grubs, *Hypoderma* spp, also showed effective kill of biting and sucking lice (Rich 1960, Rich and Khan 1964, Rich 1966). These insecticides included coumaphos (Asuntol), crufomate (Ruelene) and famphur (Warbex). Famphur was the only one of these organophosphate compounds that was later developed as a single pour-on treatment for the control of cattle lice. Fenchlorphos (Korlan, Nankor, Rolac) and fenthion (Tiguvon) were later developed as effective pour-on treatments for cattle lice except that they required two treatments 14 days apart (Nickel 1971).

The efficacy of chlorpyrifos (Dursban) as a single spray treatment for the control of cattle lice, *Damalinia bovis* and *Linognathus vituli*, was reported by Buchanan and Coles (1971). Laboratory and field studies by these workers showed that this compound was ovicidal and residually active on cattle skin for two weeks after spraying. Studies by Loomis and others (1972) on the use of animal systemic pour-on treatments in Australia showed that a single application of chlorpyrifos at 60 mg per kg was 99 per cent effective for the control of the cattle tick, *Boophilus microplus*. These results encouraged additional investigations on the development of a low volume high concentrate "spot-on" formulation of chlorpyifros against cattle lice. This report deals with the results from four herds comprising 168 calves in three areas of the North Island, New Zealand.

Materials and methods

Dairy heifer calves of approximately equal age and of Friesian and Friesian-Jersey cross were used in all trials. Treated groups were kept in separate paddocks during the entire period for trials I and II and for 14 of the 22 day period in trial IV. Calves in trial III were pastured together. Calves in trials I and II were weighed, and average weights were estimated visually in the other trials.

Ready-to-use oil formulations of the insecticides used in these trials included 40 per cent chlorpyrifos, 0,0-diethyl 0-(3,5,6-trichloro-2-pyridyl) phosphorothioate, at 5, 13, 20, 40, 100, 150 and 200 mg per kg; 40 per cent fenchlorphos, 0,0-dimethyl 0-2,4,5, trichlorophenyl phosphorothioate, in two different formulations (a and b, differing only in per cent of absorptive diluents) each at 24 mg per kg; and 13·2 per cent famphur, 0-(dimethylsulfamoyl) phenyl 0,0-dimethyl phosphorothioate, at 20 and 26 mg per kg. The insecticides were applied to the mid-line area between the pin bones by the use of plastic disposable syringes (Terumo, 5,10, and 20 ml capacity) and a 2 ml tuberculin syringe for dosages less than 1 ml (Trial II).

Louse populations were assessed at frequent intervals by parting the hair many times at seven sites on both sides of the calves: head, neck, brisket, dewlap, shoulder, middle of back, and flank. An average rating was determined from the total sites on each calf following modification of the techniques used by Buchanan and Coles (1971) and Kettle (1972). Louse infestations were rated numerically as follows: 0 = negative, 1 = 1 to 50 lice in less than 10 per cent of the hair partings and at a few sites only, 2 = 50 to 200 lice in 50 per cent of the hair partings at nearly all sites, 3 = 200 to 500 lice in all hair partings at all sites, 4 = 500 to 1000 lice in all hair partings at all sites but appearing in clusters, 5 = 1000+ and visible at ends of hairs from a distance of 60 cm without parting the hair. Per cent louse control was obtained by the formula: (Pre-treatment rating — Post-treatment rating ÷ Post-treatment rating) × 100. The long-nosed cattle louse, *Linognathus vituli*, was present on all calves in the four trials. The biting louse, *Damalinia bovis*, was found in too few numbers to warrant evaluation.

Hair samples were taken from the brisket of two to three calves in various treatment groups on the inspection dates, placed in labelled plastic bags, and returned to the laboratory for microscopic examination. This procedure was included to determine ovicidal activity of the different insecticides tested. Louse egg condition was diagnosed as viable (tan colour, firm, with embryonic structures often visible) and non-viable (semi-transparent, deflated, with embryonic structures completely dissolved or sometimes visible). Flat, transparent eggs with the operculum missing were not counted.

Results

Table 1 shows results from the application of three animal systemic insecticides used in the four trials. Chlorpyrifos and famphur showed excellent louse control (100 per cent in all

TABLE 1: Efficacy of animal systemic insecticides for control of *Linognathus vituli* on calves

Treatment	Dosage mg/kg	Dosage ml/animal	Calves Total No	Calves Avg. wt. kg	Average louse rating on days post treatment 0	1	2-3	6-7	12-15	21-22	25-28
Trial I Waireka, treated 31.10.74											
chlorpyrifos	20	3·0	8	61	2·6	0·1	0	0	0	0	
chlorpyrifos	40	6·2	8	62	2·6	0.6	0	0	0	0	
fenchlorphos-a	24	3·6	8	60	2·6	0·4	1·4	1·1	1·2	2	
fenchlorphos-b	24	3·7	8	62	2·6	1·0	1·7	1·5	0·7	1·1	
control	0	0	8	57	3·0	3·0	3·0	3·6	3·6	2·9	
Trial II Waireka, treated 21.11.74											
chlorpyrifos	5	0·74	7	60	2·4	1·7	0	0	0		0·5
chlorpyrifos	20	3·2	7	65	2·3	1·0	0	0	0		0
chlorpyrifos	100	17·7	1	71	1·0	0	0	0	0		0
chlorpyrifos	150	28·5	1	76	1·0	0	0	0	0		0
chlorpyrifos	200	33·5	1	67	1·0	0	0	0	0		0
famphur	20	9·8	7	65	2·0	0·9	0	0	0		0
Trial III Hamilton, treated 19.11.74											
chlorpyrifos	20	3·5	23	70	1·6		0	0	0		0
chlorpyrifos	40	7·0	22	70	1·8		0·02	0	0		0
famphur	20	10·6	23	70	2·1		0·08	0	0		0
Trial IV Inglewood, treated 12.12.74											
chlorpyrifos	13	1·6	18	50	2·2		0		0	0·3	
famphur	26	10	18	50	2·6		0		0·1	0·2	

trials except IV. An exception in the overall efficacy of chlorpyrifos was evident in trial II where a low dosage of 5 mg per kg gave only 80 per cent control. In trial IV louse control was 81 and 92 per cent, respectively, but the presence of louse carriers in the famphur-treated group may have been responsible since both treatment groups were placed in the same paddock following the second week post-treatment inspection. These so-called carrier calves had been repeatedly sprayed (three to four times with diazinon) during the prevlous two months by the dairy farmer. The poor levels of ousie control (23 and 58 per cent) with fenchlorphos were expected as this compound is recommended for use via pour-on applications 14 days apart.

Analysis of egg viability on hair samples taken from some of the treated groups is shown in Table 2. In general, there was a greater ratio of viable to non-viable louse eggs on hair samples taken before animal treatment or from a control group (trial I). An exception of this was the sample received from the famphur-treated group in trial III. A decreasing number or zero count of viable eggs were observed in post-treatment samples from chlorpyrifos- and famphur-treated calves in all trials. These results demonstrate the ovicidal effect of these two compounds at dosage rates of from 10 to 20 mg per kg. The poor ovicidal effect of famphur and to a lesser extent with chlorpyrifos in trial IV, may again be due to the presence of the louse carriers detected in this group of calves. These same data, however, support the louse ratings shown in Table 1. As expected, fenchlorphos did not show any ovicidal effects.

With the exception of the three calves given from 100 mg to 200 mg per kg of chlorpyrifos in trial II, there were no signs of adverse effects in any calves following treatment with the three compounds. Minor scurfing and hair loss occurred on nine of 93 chlorpyrifos-treated calves, on seven of 16 fenchlorphos-treated ones, and on four of 25 famphur-treated calves in trials I, II and IV. Hair coats on these calves were normal within 21 to 28 days post-treatment. Hair damage did not occur on calves tested in trial II. The three calves treated with 100, 150, and 200 mg per kg chlorpyrifos showed acute signs of organophosphate toxicity beginning five minutes after treatment. These signs included nervousness with alternation of standing and recumbency, slight muscular tremors, slight to moderate salivation, and diarrhoea. All three calves were normal within 90 minutes after treatment.

The results of these trials provide additional evidence concerning the systemic activity of chlorpyrifos against external parasites of cattle. The ovicidal activity of this compound on eggs of the cattle louse, *L vituli*, supports the original finding by Buchanan and Coles (1971). Chlorpyrifos as a single low dose treatment for cattle louse control may offer special advantages over commercially available compounds such as a single high dose pour-on or a two-treatment low dose spot-on.

TABLE 2: Analysis of louse egg viability on hair samples from animal systemic treated and untreated calves

Treatment	mg/kg	Egg Condition* by days post-treatment 0 V	0 NV	2 V	2 NV	6 V	6 NV	12 V	12 NV
I. Waireka									
chlorpyrifos	20							0	28
fenchlorphos	24							13	12
Control	0							35	21
III. Hamilton									
chlorpyrifos	20	31	8	0	1	0	5	0	20
chlorpyrifos	40	22	18	1	17	0	25	0	33
famphur	20	19	47	2	3	0	20	0	44
IV. Inglewood									
chlorpyrifos	13	80	14			13	142	8	40
famphur	26	71	17			21	59	7	44

*V = viable eggs, NV = non-viable eggs

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