EFFECTS OF SOME INSECTICIDES ON INFESTATIONS OF THE SHORT-NOSED CATTLE LOUSE

J. A. SHEMANCHUK, W. O. HAUFÉ AND C. O. M. THOMPSON
Canada Agriculture Research Station, Lethbridge, Alberta

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ABSTRACT

Commercially available pesticides were tested for the control of the short-nosed cattle louse, *Haematothrius eurytremus*. A single treatment with 0.5 percent dieldrin or malathion at a rate of 2 gallons per head at a pressure of 400 pounds was effective. Chlordane, lindane, and toxaphene applied at the same rate were effective with two treatments at 16-day intervals. DDT was the least effective under these conditions.

No significant difference in effect on louse populations was observed between sprays of suspensions prepared from wettable powders and emulsions prepared from emulsifiable concentrates of lindane, Co-Ral, Korlan, and malathion.

Three treatments of Trolene administered orally at rates of 100 mg./kg. at 75 mg./kg. at intervals of 11 and 9 days were effective against louse infestations. Trolene at 10 mg./kg./day and 5 mg./kg./day fed to cows for 22 days reduced the louse populations but did not provide complete control.

A louse population index, consisting of the total number of lice at 52 sites, each of 2 square centimeters in size, on the animal's body is described.

INTRODUCTION

The short-nosed cattle louse, *Haematothrius eurytremus* (Nitz), is a pest of range cattle in western Canada. Normally the louse populations on range cattle increase during the fall to a peak in the winter and decrease with the onset of warm weather in the spring and summer. Bulls tend to carry noticeable populations during the summer. Heavy infestations of the short-nosed cattle louse cause severe anemia in cattle (7). Hemoglobin and erythrocyte values returned to normal within 5 to 7 weeks when lice were destroyed. Partial control of lice was found to be ineffective in restoring blood values to normal. Therefore, only insecticides providing long louse-free periods should be considered for use.

Practical louse control, including the use of commercially available insecticides, has been described by Haufe (3). This paper summarizes the experiments that have served as the basis for recommendations of certain chemicals in controlling lice on beef cattle.

MATERIALS AND METHODS

Experimental Animals

Mature beef cows and steers raised in southern Alberta and heavily infested from natural sources with *H. eurytremus* were used in these tests.

Assessment of the Louse Populations

The counting technique was designed to provide an index to represent the variation in numbers and density of lice on individual animals. It consisted of 23 sampling sites replicated on each side of the animal and distributed as follows: two behind and below the ear; six spaced uniformly along the side and neck; six along the side of the brisket; six along the back line, and three on the side of the tail head. Six sites were distributed along the crest of the neck. Thus there were 52 sampling sites for each animal. The total number for the 52 sites was recorded as the index.

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1 Contribution from the Veterinary-Medical Entomology Section.
2 Present address: Burroughs Wellcome & Co. (Canada) Ltd., Montreal, Que.
Each sampling site was an area $\frac{1}{2} \times 4$ centimeters or 2 square centimeters. A pencil (or preferably a Scoopula*) with a mark at 4 centimeters from the tip was used to part the hair at each site and the total number of visible lice in the exposed area were counted for the length of 4 centimeters. Counts were reliable for populations of 70 lice within the 2-square-centimeter area, but populations above 70 were recorded as 70+. Therefore, the estimates recorded for higher populations are lower than the actual number of lice at the site.

**Spraying Techniques**

Information on spraying pressure, quantity of spray fluid required to treat an animal, emission rate from nozzles, and timing of treatment had to be obtained before control experiments could be set up.

The suitable pressure was determined by spraying individual mature cows with 0.5 per cent malathion emulsion in a squeeze (Figure 1a) with a spray pump equipped with a variable pressure adjustment and a calibrated tank (Figure 1b). The cows were sprayed at pressures of 100, 200, 300, and 400 pounds and with a 3/64-inch disk in a cone nozzle. Brushing and spraying simultaneously at a pressure of 100 pounds was also tried. After each treatment the wetting properties at each pressure were observed.

The emission rates for nozzles with 3/64- and 4/64-inch disks were determined by taking the average time required to deliver 1 gallon of 0.5 per cent wettable powder or emulsion mixture at a pressure of 400 pounds.

The amount of spray required to cover the entire surface of the animal's body was determined by individually spraying mature cows with fall and winter hair coats in the squeeze with $\frac{1}{2}$, 1, 2, and 4 gallons of 0.5 per cent malathion emulsion at a pressure of 400 pounds, using a 3/64-inch disk. The lice were counted before treatment and again 2 weeks after treatment.

Appropriate intervals between treatments with pesticides with or without residual properties were estimated from the data on life history and development provided by Craufurd-Benson (2).

**Experiment 1**

Commercial insecticides were tested on mature cows heavily infested with *H. eurysternus* as follows:

<table>
<thead>
<tr>
<th></th>
<th>Amount applied (gallons)</th>
<th>Dosage ($C_i$)</th>
<th>No. of animals treated</th>
<th>No. of treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlordane (E)*</td>
<td>1</td>
<td>0.5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>DDT (WP)*</td>
<td>2</td>
<td>0.5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Dieldrin (E)</td>
<td>2</td>
<td>0.5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lindane (E)</td>
<td>2</td>
<td>0.05</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Malathion (E)</td>
<td>1</td>
<td>0.5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.25</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Toxaphene (E)</td>
<td>2</td>
<td>0.5</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

*E = Emulsions prepared from emulsifiable concentrates

*WP = Suspensions prepared from wettable powders

A sprayer equipped with a calibrated stainless steel tank was used to spray animals restrained in a squeeze at a pressure of 400 pounds with a cone spray gun fitted with a 3/64-inch disk. Where two treatments were used the interval between treatments was 16 days. Control animals were kept separate from the treated animals.

**Experiment II**

This experiment was conducted to compare the effects of suspensions prepared from wettable powders and emulsions prepared from emulsi ble concentrates of lindane, Co-Ral', Korlan', and malathion. The experiment was set up on a factorial design using two naturally infested animals per group. Two gallons of 0.5 per cent formulation per animal were applied with a cone spray gun fitted with a 3/64-inch disk at a pressure of 400 pounds. After treatment the groups were kept in separate pens.

**Experiment III**

Six 2-year-old steers heavily infested with lice, in two groups of three animals each, were treated orally three times with Trolene® with intervals of 11 and 9 days. The animals in one group received 100 mg./kg. at each treatment and those in the other group received 75 mg./kg.

**Experiment IV**

Twenty-four heavily infested mature cows were divided into three groups of eight animals. The first group was fed Trolene at the rate of 10 mg./kg./day for 22 days. The second group was fed 5 mg. kg. day for 22 days. The third group was untreated. The desired amount of Trolene was determined for each animal, mixed with rolled oats, and fed to the animals individually. The control group was fed rolled oats without Trolene on the same basis as the treated groups. Individual feeding ensured full intake of Trolene.

**RESULTS AND DISCUSSION**

**Spraying Techniques**

Sprayers operating at pressures of 200 pounds or less were ineffective in wetting the animal to the skin. The droplets emitted from a nozzle with a 3/64-inch disk at pressures of 100 and 200 pounds were too coarse and on contact with the hair formed larger droplets that dropped off the hair without wetting the skin. At pressures of 300 to 400 pounds, the penetration of the spray through the hair was satisfactory, except for a few small patches where the spray at 300 pounds did not penetrate to the skin. Sprays at 100 pounds, combined with brushing with a stiff broom, were effective in wetting the animal. This operation can be carried out successfully only where cattle can be restrained. This type of application is practical for small herds or on animals requiring emergency treatments. Cattle can be sprayed successfully at 300 to 400 pounds pressure in a small crowding pen.

The average emission rate for a 3 64-inch disk was 1 gallon per 58 seconds for 0.5 per cent suspension of malathion wettable powder and 1 gallon per 52 seconds for emulsion. For a 4 64-inch disk the emission

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10, O-Diethyl O-3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl phosphorothioate
20, O-Dimethyl O-2.4,5-trichlorophenyl phosphorothioate
30, O-Dimethyl O-2.4,5-trichlorophenyl phosphorothioate
Figure 1a. (above) Cattle squeeze used to restrain cattle being sprayed and assessed for louse control.

Figure 1b. (right) Spray pump equipped with calibrated stainless steel tank and variable pressure control, used in applying exact amounts of spray.
rate was 1 gallon per 44 seconds for wettable powder suspension and 1 gallon per 41 seconds for emulsion. Therefore, at a pressure of 400 pounds, 1 gallon of emulsion is emitted through a 3/64-inch disk in slightly less than 1 minute, the minimum time necessary for an efficient operator to spray an animal.

Isolated colonies of lice were found on two animals 2 weeks after spraying with 2 quarts of 0.5 per cent malathion, while no lice were observed to survive on animals treated with amounts greater than 1 gallon of the formulation. This indicated that successful treatment requires adequate coverage of the animal’s body. In early fall treatments, when the hair coat was not too heavy, applications at a pressure of 400 pounds from cone spray nozzles required a minimum of 1 gallon per animal for complete coverage with 3/64-inch disks and 1.5 gallons per animal with 4/64-inch disks. Winter treatments for shaggy, heavily coated animals required 2 gallons per animal for proper wetting. Inexperienced operators or experienced operators working under unfavorable field facilities should use 2 gallons per animal to be on the safe side. Spray applications in excess of 2 gallons were found to be unnecessary.

From the data provided by Craufurd-Benson (2), the most suitable interval between spray treatments for insecticides with residual effect was calculated to be 16 days. Two spray treatments at 16-day intervals adequately encompassed the incubation period, the development of the three instars, and the pre-oviposition period, which is 38 days. For insecticides with no residual properties it was calculated and later determined that three treatments at intervals of 11 and 9 days were most suitable. The first treatment killed all the lice present on the animal at the time and therefore prevented any further oviposition. The second treatment affected all the lice that hatched after the first treatment but had not yet oviposited, and the third treatment affected the lice that required the maximum time to hatch. These intervals were found to be applicable to orally administered insecticides as well as to spray treatments with non-residual insecticides.

The timing of spray treatments should be such that the complete treatment is carried out before unfavorable weather sets in. In the prairie region of Canada spray treatments have to be completed by mid-November at the latest, before the weather turns unfavorable and the hair coat grows too heavy. Spraying during the winter is hazardous to cattle. However, it was determined that with severe infestations spraying can be done if the air temperature remains at 40°F. or higher for at least 4 hours, the time required for the animals to dry at that temperature.

**Experiment 1**

The effects of commercially available insecticides on populations of short-nosed cattle lice were variable (Figure 2).

One treatment with 2 gallons of 0.5 per cent emulsion of dieldrin per animal kept cattle free of lice for at least 170 days. Though very effective this compound is not recommended for control of cattle lice because of its persistence on the hide and in fat and milk (1). Radeleff *et al.* (6) showed that dieldrin was highly toxic to 2-week-old calves. They also reported
Figure 2. Effects of sprays of malathion, DDT, dieldrin, chlordane, toxaphene, and lindane on populations of *H. eurysternus*.
that dieldrin is cumulative in action and produces greater toxicity with repeated applications. This further disqualifies its use on livestock, especially where repeated treatments may be required.

One treatment with 2 gallons of 0.5 per cent emulsion of malathion per animal kept cattle free of lice for a period of at least 130 days (Figure 2). One treatment with 1 gallon at the same concentration was almost as effective. The 0.25 per cent emulsion provided relief from lice for approximately 80 days. No symptoms of toxicity were observed in animals sprayed with malathion. This is substantiated further by Radeleff et al. (6). Malathion does not possess the property of long active persistence (4) and, therefore, should be preferable to dieldrin. The effectiveness of one treatment with malathion was attributed to possible ovacidal action similar to that demonstrated in housefly eggs by Mehrota and Smallman (5).

Two treatments with 2 gallons per animal of 0.05 per cent lindane applied 16 days apart were effective in reducing louse populations but did not provide as good control as either dieldrin or malathion. At that concentration lindane is effective against mange mites and is therefore a practical dual-purpose treatment. For good louse control two treatments with lindane are required, but this necessitates more handling of the cattle. Although toxicity to very young calves has been reported (6), no toxic symptoms were observed in the mature cows used in this experiment.

Two treatments at an interval of 16 days with 2 gallons of 0.5 per cent chlordane were as effective initially as one treatment with 2 gallons of 0.5 per cent malathion, but the louse-free period was shorter. There was no visible toxicity to mature animals due to these treatments with chlordane.

Toxaphene at a concentration of 0.5 per cent was as effective initially in two applications with a 16-day interval as malathion or chlordane, but the louse-free period was much shorter.

On heavily infested cows DDT at a concentration of 0.5 per cent in two applications with a 16-day interval was least effective. DDT had been used frequently by ranchers on the animals obtained for these experiments and it is possible that the lice may have become DDT-resistant.

The post-treatment louse numbers on animals sprayed with water were temporarily reduced, especially where high pressures were used in application. The physical force of the pressure may have removed and/or damaged the lice, and this may account for the reduction. The results indicate that the mechanical aspect of treatment is a factor to be considered in the critical assessment of the effects of insecticides on lice.

Experiment II

Of the chemicals tested there was no apparent difference in effectiveness between suspensions of wettable powders and emulsions of emulsifiable concentrates (Figure 3). Emulsions of Korlan and lindane appeared to be slightly more effective than the wettable powders. A single treatment of 0.5 per cent lindane was more effective than two treatments of 0.5 per cent.
Figure 3. Comparison of effects of sprays of emulsions prepared from emulsible concentrates and suspensions prepared from wettable powders of Co-Ral, Koral, lindane, and malathion on populations of *H. eurysternus*. 
Figure 4. Effects on populations of *H. eurysternus* of three treatments of Troleene at 75 mg./kg. and 100 mg./kg. administered orally at intervals of 11 and 9 days.

The wettable powder of Co-Ral was more effective than the emulsion. This was probably due to the post-treatment residues of Co-Ral in the hair, as found by Khan and MacDougall* in another investigation.

**Experiment III**

Louse infestations were reduced for at least 80 days with three oral treatments of 100 mg./kg. and 75 mg./kg. of Troleene at intervals of 11 and 9 days (Figure 4). It was evident that after the first treatment at both dosages all the lice present on the animals' bodies were killed. The activity of the insecticide did not last long enough to kill the lice that hatched from the eggs and therefore two more treatments were required to encompass the whole life cycle. Mild diarrhea and diuresis were observed after each treatment. Oral administration required handling the cattle three times, which may be impractical under ranch conditions. This type of treatment may be used to advantage, however, where immediate action is necessary to prevent death and where weather is too cold for spraying.

**Experiment IV**

After the first day all animals accepted the Troleene-medicated feed. At the 10 mg./kg./day rate there was a 79 per cent drop in louse numbers during the first week of treatment (Table 1). No further mortality occurred during the entire feeding period. At 10 mg./kg./day for 22 days the total dosage was higher than that required to kill warble grubs (8). At 5 mg./kg./day the reduction in population was too small to be classed

*Unpublished data
Table 1. — Weekly mean population levels of lice on three groups of eight cows, of which two groups were fed low levels of Trolene for 22 days

<table>
<thead>
<tr>
<th></th>
<th>5 mg./kg./day</th>
<th>10 mg./kg./day</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Population index</td>
<td>% Reduction</td>
<td>Population index</td>
</tr>
<tr>
<td>Pre-treatment</td>
<td>1263</td>
<td>1399</td>
<td>821</td>
</tr>
<tr>
<td>During treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 week</td>
<td>1190</td>
<td>6</td>
<td>297</td>
</tr>
<tr>
<td>2 weeks</td>
<td>1192</td>
<td>6</td>
<td>419</td>
</tr>
<tr>
<td>3 weeks</td>
<td>1002</td>
<td>21</td>
<td>583</td>
</tr>
<tr>
<td>Post-treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 week</td>
<td>1116</td>
<td>12</td>
<td>409</td>
</tr>
<tr>
<td>2 weeks</td>
<td>991</td>
<td>22</td>
<td>592</td>
</tr>
</tbody>
</table>

as louse control in heavily infested animals. A mild diarrhea was observed in the animals given the 10 mg./kg./day treatment but not the 5 mg./kg./day treatment.

Even though the total consumption of Trolene through medicated feed at both dosages was high the control realized was disappointing. This may be due to the fact that by daily elimination of the compound the cumulative dose did not reach the minimum required to kill the lice. Trolene-mediated feed might be useful only as a dual-purpose control for both warbles and lice.

ACKNOWLEDGEMENTS

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REFERENCES

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