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RECENT INSECTICIDES: THEIR EFFICACY AS PLUNGE DIPS AGAINST THE BITING LOUSE, *DAMALINIA OVIS*, AND THE KED, *MELOPHAGUS OVINUS*, ON SHEEP

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RECENT INSECTICIDES: THEIR EFFICACY AS PLUNGE DIPS AGAINST THE BITING LOUSE, *DAMALINIA OVIS*, AND THE KED, *MELOPHAGUS OVINUS*, ON SHEEP

A. C. G. HEATH* and E. SUSAN MILLAR†

INTRODUCTION

AT the Wallaceville Animal Research Centre, Thomas (1958) and Greenwood (1964) have tested a number of insecticides against biting lice and keds on sheep. The present paper reports hitherto unpublished work by Millar (*nee* Greenwood) up to 1966 and more recent work carried out since her departure.

IN VIVO EXPERIMENTS

MATERIALS AND METHODS

All sheep used in the trials were plunge-dipped in a 500 litre dipping tank containing the insecticide‡. Each animal spent approximately 30 seconds in the dip and during that time it was immersed completely at least three times.

All insecticides used were emulsifiable concentrates except Dursban, Butimide and the mixture of RD 14639 + Butimide which were wettable powders. Dip strengths and the number of sheep used per group can be seen in Table 1.

All animals except those used in the 1968 trial were Romney lambs of mixed sexes, carrying a light to moderate louse and ked infestation at the time of dipping. In the 1968 trial, a mixture of Merino, Corriedale and Romney sheep of various ages were used (RD 14639: 4 Merinos; 2 Corriedales. Diazinon: 2 Merinos, 2 Corriedales, 1 Romney). After treatment the sheep were grazed on pasture. Where possible, an initial 1:1 ratio of treated and untreated infested sheep was maintained. When louse and ked populations eventually became established on treated sheep, these animals were kept with the flock and served as additional infestors.

In each trial, the treated and untreated sheep were run together and then separated on alternate weeks. The period between dipping and the first time that the sheep were run together varied from trial to trial. This period for the years 1964, 1966, 1968 and 1969 was 4, 8, 5 and 8 weeks, respectively. After this time an examination was made to estimate louse and ked numbers. The sheep were then run together for a

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‡*Insecticides*

Amiphos	*O,O*-dimethyl-*S*-2 (acetylamino)-ethyl dithiophosphate (Nippon Soda Company)
Bayer 9010	*O*, isopropoxyphenyl methylcarbamate
Bayer 9017	*O,O*- diethyl-*O*-(4-methylmercapto-3, 5-dimethyl phenyl) thionophosphoric ester
Bayer 9037	*O*-(8-hydroxychinolyl)-*O*-ethyl-phenyl-thionophosphate (Farbenfabriken Bayer A.G., Leverkusen, Germany)
Bromophos ethyl	*O,O*-diethyl-*O*-2, 5-dichloro-4-bromophenyl thionophosphate (Cela)
Butimide	Hydrated magnesium fluorosilicate (Boots)
C9491 EC 20d	*O,O*-dimethyl-*O*-2, 5-dichloro-4- jodophenyl thiophosphate (Ciba)
Carbophenothion	*S*-[(*p*-chlorophenylthio) = methyl]*O,O*-diethyl phosphorodithioate (Stauffer Chemical Company)
Diazinon	*O,O*-diethyl *O*-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate (Geigy)
Dursban	*O,O*-diethyl *O*-3, 5, 6-trichloro-2-pyridyl phosphorothioate (Dow)
Mobam	4-benzothienyl-*N*-methylcarbamate (Mobil Chemical)
RD 14639	3, 5-di-tertiary butylphenyl *N*-methyl carbamate (Boots)
SHG 1942	*O,O*-dimethyl-*O*-2, 5-dichloro-4-bromo phenyl thionophospate (Cela)
Supona	2-chloro-1-(2^1, 4^1-dichlorophenyl) vinyl diethyl phosphate (Shell)
VC-13	*O,O*-diethyl *O*-2, 4-dichlorophenyl thiophosphate (Virginia Carolina Chemical Corp.)
VCS-506	*O*-(2, 5-dichloro-4-bromophenyl) *O*-methyl phenylthiophosphonate (Velsicol Chemical Corp.)

TABLE 1: PERIODS OF PROTECTION AFFORDED BY THE TEST COMPOUNDS (IN WEEKS) AGAINST LICE AND KEDS

Dipping Date	*Insecticide*	*Strength in Dip (ppm)*	*No. of Sheep per Group*	*Protection Period* Lice	Keds*
June 9, 1964	Bayer 9037	200	5	13	at least 26
	VC-13	200		12	at least 26
	Carbophenothion	200		12	22
	SHG 1942	100		12	at least 26
	Butimide	1,200		11	at least 26
	Bayer 9010	250		5	at least 26
May 3, 1966	SHG 1942	200	5	11	at least 25
	Supona	200		11	at least 25
	Bayer 9017	200		11	at least 25
	Bromophos ethyl	200		9	at least 25
	RD 14639 + Butimide			9	at least 25
August 8, 1968	Diazinon	250	5	at least 16	at least 16
	RD 14639	500	6	13	at least 16
May 22, 1969	Diazinon	200	6	at least 23	at least 23
	Supona	50		17	at least 23
	Dursban	80		17	at least 23
	C 9491	40		9	at least 23
	VCS-506	90		9	at least 23
	Amiphos	1,000		7	at least 23
	Mobam	200		7	at least 23

*With all compounds except carbophenothion, no reinfestation by keds occurred over the whole of each experimental period. Therefore, the figures in the "keds" column refer to the length of the experimental period.

week and, as often as possible, were penned together for at least an hour on each fine day to increase the chances of louse and ked transfer. To avoid counting recently transferred parasites, the mobs were separated for a week and the treated animals examined thoroughly after this period for the presence of lice and keds.

The sheep were examined according to the method of MacLeod (1948). Lice were noted as being present or absent but keds and their puparia were expressed as a total count.

RESULTS

The results (see Table 1) are expressed in terms of the number of weeks that all the sheep in each group were protected against reinfestation with lice and keds. In each treated group, there were individuals that remained free of lice and keds (especially so in the case of lice) for longer than the protection periods given in the table. The reason for such variability is not known, but the type of wool may be an important factor affecting insecticide deposition and retention. Fine wool, in particular, has been found to retain insecticides for longer periods than coarse wool (Heath, unpublished).

IN VITRO EXPERIMENTS

METHODS

Concurrently with the 1968 field trials, some *in vitro* experiments were carried out to test further the susceptibility of keds to diazinon and RD 14639.

The insecticides were tested at three concentrations in de-ionized distilled water. Samples of previously untreated wool weighing 1.5 g were soaked in 20 ml of insecticide emulsion. Excess fluid was removed from the wool by squeezing and draining. About 10 ml of fluid was retained by the wool. Two controls were used, one of dry wool and one wetted with water.

TABLE 2: PERCENTAGE SURVIVAL OF KEDS ON TREATED AND UNTREATED WOOL. EACH FIGURE IS THE MEAN FOR THE 2 REPLICATES

	Hours after Treatment 0	0.5	1.0	1.5	2.0	2.5	3.0	17.0
Control (dry wool)	100	100	100	100	100	100	100	40
Control (damp wool)	100	90	80	80	70	50	50	20
Diazinon 0.0005%	100	90	85	60	35	35	15	0
0.01%	100	90	50	25	15	5	0	—
0.05%	100	95	0	—	—	—	—	—
RD 14639 0.0005%	100	100	85	75	70	50	45	0
0.01%	100	95	55	55	25	15	5	0
0.05%	100	100	45	15	0	—	—	—

There were two replicates at each concentration but only one of each control was used. Ten adult female keds collected one hour previously were placed on the wool in an incubator at 29 ± 1° C and examined at half-hourly intervals.

RESULTS

The results are set out in Table 2.

DISCUSSION

In field trials of this nature, it is difficult to draw firm conclusions about the efficacy of insecticides against lice and keds. The protection recorded for lice is probably a fairly true guide, but the natural decline of the louse population on the infestors as the trial progresses can mean that the rate of reinfestation declines at the same time. Climatic conditions may favour or inhibit louse populations and so influence the number available for transfer to the treated sheep.

On the other hand, keds have a very low reproductive potential compared with lice. More may therefore be lost by migration and death on treated sheep than can be replaced from the untreated infestors. Biting lice would suffer the same fate but their relatively high reproductive potential might offset the loss except when the population is declining.

The results of the *in vitro* tests using RD 14639 and diazinon showed the latter to have the greatest "knockdown" effect at the highest concentration. When the normally recommended dipping rates against lice and keds for RD 14639 and diazinon are compared (0.05% and 0.01%, respectively) it is seen that the carbamate killed keds a little quicker than the organophosphate. In the field trials, RD 14639 was used at 0.05% but the diazinon dip strength was 0.025%. The field trials and *in vitro* tests are therefore not strictly comparable, although comparisons could perhaps have been drawn if reinfestation by keds had occurred in the field.

The insecticides tested included 10 organophosphorus compounds, 5 carbamates and one inorganic compound. All of the compounds gave good results against keds, but against lice Bayer 9010, Amiphos and Mobam gave less than 8 weeks' protection when compared with other compounds examined synchronously.

SUMMARY

Sixteen insecticides comprising 10 organophosphorus compounds, 5 carbamates and 1 inorganic compound were tested against biting lice (*Damalinia ovis*) and keds (*Melophagus ovinus*), between 1966 and 1969.

The majority of the compounds gave reasonable protection against both insects. Factors influencing the results of field tests of this nature are discussed.

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