

Tests with Insecticides for Control of Lice on Goats and Sheep¹

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ABSTRACT

In laboratory tests, Angora goats infested with biting lice (*Bovicola* spp.) were dipped in 13 insecticides. All but 0.1% and 0.25% chlorobenzilate and 0.1% carbaryl freed goats of lice. In field tests, 22 herds of goats infested with biting lice and goat sucking lice (*Linognathus stenopsis* (Burmeister)) and 3 flocks of sheep infested with sheep biting lice (*Bovicola ovis* (L.)) were sprayed with 11 insecticides. All except 0.5% methoxychlor controlled existing populations of motile lice. Biting lice were con-

trolled from shearing to shearing on goats sprayed with 0.25% Ruelene® (*O*-4-*tert*-butyl-2-chlorophenyl *O*-methyl methylphosphoramidate) and on sheep sprayed with 0.25% General Chemical 4072 (2-chloro-1-(2,4-dichlorophenyl)vinyl diethyl phosphate) and 0.25% V-C 13 Nemacide® (*O*-2,4-dichlorophenyl *O*,*O*-diethyl phosphorothioate). Sucking lice were controlled from shearing to shearing on goats sprayed with 0.25% General Chemical 4072 and 0.25% Ruelene.

In the Edwards Plateau region of southwestern Texas, Angora goats, raised for mohair, are commonly infested with the Angora-goat biting louse (*Bovicola limbata* (Gervais)) and to a lesser extent with the goat biting louse (*B. caprae* (Gurlt)), the hairy goat louse (*B. crassipes* (Rudow)), and the goat sucking louse (*Linognathus stenopsis* (Burmeister)). These lice are of major concern to mohair raisers. Goats in heavily infested herds are often found in a severely weakened condition. The mohair is of poor quality and soiled by egg shells, nymphal exuvia, and louse excrement; considerable amounts of hair are often rubbed off by the animals.

In this same area, flocks of sheep are occasionally found infested with the sheep biting louse (*Bovicola ovis* (L.)). These lice are very irritating to the sheep, and biting and scratching often result in complete removal of large areas of wool from heavily infested individuals.

Lice on sheep and goats are usually controlled by dipping or spraying the animals with insecticides. In recent years Smith & Richards (1955) reported on the effectiveness of 4 chlorinated hydrocarbons and 7 organophosphorus insecticides for control of biting lice on goats. Moore et al. (1959) evaluated 7 insecticides as sprays for control of goat biting and sucking lice, and reported that Angora-goat biting lice on one ranch near Kerrville, Texas, were resistant to toxaphene.

Since 1959, new insecticides have been evaluated at Kerrville in laboratory and field tests for control of lice on goats and in field tests for control of lice on sheep. The results of tests with these new insecticides and of additional tests with others reported on in 1959 are presented herein.

LABORATORY TESTS.—To evaluate insecticides against goat biting lice, 1, 2, or 3 infested Angora goats were dipped in various concentrations of insecticides. After treatment the goats were placed in isolation pens arranged so that animals dipped in one insecticide were unable to come in contact with those dipped in other compounds. Mortality of lice was recorded at 1 day, 3 days, and weekly thereafter up to 1 month. Some animals were also checked at 2 and 3 months after treatment. The insecticides, formulations, and concentrations used in these tests were as follows:

Bayer 29493 (*O*,*O*-dimethyl *O*-[4-(methylthio)-*m*-tolyl] phosphorothioate), 50% wettable powder (W.P.), 0.05% carbaryl, 50% W.P., 1.0, 0.5, 0.2, 0.15, and 0.1%

chlorobenzilate, 25% W.P., 0.25 and 0.1% Delnav® (a mixture of 2,3-*p*-dioxanedithiol *S,S*-bis(*O*,*O*-diethyl phosphorodithioate) (70%) and related compounds), 25% W.P., 0.15% Dilan® (a mixture of 1 part of 1,1-bis(*p*-chlorophenyl)-2-nitropropane (Prolan®) and 2 parts of 1,1-bis(*p*-chlorophenyl)-2-nitrobutane (Bulan®)), 50% W.P., 0.25 and 0.1% ethion, 25% emulsifiable concentrate (E.C.), 0.5% Geigy G-30493 (*S*-(3,4-dichlorophenylthio)methyl *O*,*O*-dimethyl phosphorodithioate), 25% E.C., 0.25 and 0.1% Methyl Trithion® (*O*,*O*-dimethyl *S-p*-chlorophenylthiomethyl phosphorodithioate), 45% E.C., 0.1% Ruelene® (*O*-4-*tert*-butyl-2-chlorophenyl *O*-methyl methylphosphoramidate), 25% W.P., 0.5% Shell SD-4294 (dimethyl 2-(*alpha*-methylbenzyloxycarbonyl)-1-methylvinyl phosphate), 2 lbs./gal. E.C., 0.5% Stauffer R-1504 (*O*,*O*-dimethyl *S*-phthalimidomethyl phosphorodithioate), 25% W.P., 0.25 and 0.1% V-C 13 Nemacide® (*O*-2,4-dichlorophenyl *O*,*O*-diethyl phosphorothioate), 25% W.P., 0.1% Zectran® (4-dimethylamino-3,5-xyllyl methylcarbamate), 25% W.P., 0.1 and 0.05%

In these laboratory tests, lice were killed rapidly by all insecticides except 0.1% and 0.25% chlorobenzilate. No live lice were found at 1 and 3 days after treatment on three goats dipped in 0.1% carbaryl, but live lice were found on two of the three at 1 week posttreatment. No live lice were seen on any goats dipped in the other insecticides.

FIELD TESTS.—Since 1959, 22 herds of goats, totaling more than 5,500 head, have been sprayed for lice on ranches in the vicinity of Kerrville. All but one of the herds were moderately to heavily infested with biting lice, and 7 of the herds, totaling almost 1,200 head, were infested with sucking lice. In addition, 3 flocks of sheep, heavily infested with biting lice, were also treated. The insecticides used in these tests were Bayer 29493, carbaryl, Delnav, diazinon, Dilan, General Chemical 4072 (2-chloro-1-(2,4-dichlorophenyl) vinyl diethyl phosphate), malathion, methoxychlor, Ruelene, Shell SD-4294, and V-C 13 Nemacide.

The insecticides were applied with a power sprayer at a pressure of 250 to 300 psi. To insure that each animal was thoroughly covered, goats were sprayed in groups of 50 or less at the rate of 1 to 2 quarts per head, depending on the length of the mohair. In early tests the goats were exam-

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Table 1.—Field tests with 11 insecticides as sprays for control of biting (B) and sucking (S) lice on goats and sheep.

INSECTICIDE AND FORMULATION	CONCENTRATION (PERCENT)	TOTAL GALLONS OF SPRAY USED	NUMBER OF ANIMALS SPRAYED	TIME SINCE SHEARING	TYPE OF LICE	NUMBER OF ANIMALS FREE OF LICE/NUMBER OF ANIMALS EXAMINED, AT INDICATED DAYS POSTTREATMENT			
						1	7	30-90	120-190
<i>Goats</i>									
Bayer 29493 (50% W.P.) (25% W.P.)	0.1	145	428	6 weeks	B	10/10	—	7/10	—
		25	108	n.s. ^a	B	5/5	10/10	0/9	—
Carbaryl (50% W.P.)	.25	80	190	5 months	B	7/10	8/8	6/8	7/8
		50	212	n.s.	B	10/10	—	—	—
Delnav (25% W.P.)	.15	20	69	n.s.	B	9/10	10/10	6/8	0/5
Diazinon (25% W.P.)	.05	110	436	n.s.	B	7/7	7/7	8/8	4/8
		55	187	n.s.	B	4/4	8/8	10/10	—
Dilan (25% W.P.)	.5	20	78	n.s.	B	9/10	10/10	10/10	1/5
General Chemical 4072 (25% W.P.)	.25	130	360	2 months	B	7/8	8/8	11/11	2/8
					S	8/8	8/8	11/11	8/8
Malathion (50% E.C.)	.2	110	400	1 month	B	10/10	—	10/10	—
Ruelene (25% W.P.)	.5	93	243	6 months	B	0/10	10/10	—	—
					S	0/10	10/10	—	—
	.25	25	104	n.s.	S	4/5	5/5	9/9	7/7
		15	56	n.s.	B	8/8	7/7	12/12	10/10
	.2	150	438	1 month	S	8/8	7/7	12/12	8/10
					B	8/10	10/10	—	—
.1	50	135	6 months	B	10/10	10/10	—	—	
				S	0/10	0/10	—	—	
Shell SD-4294 (4 lbs/gal E.C.) (2 lbs/gal E.C.)	.25	90	339	n.s.	B	10/10	10/10	5/5	—
		50	154	n.s.	B	8/8	8/8	8/8	—
	.1 ^b	50	100	3 months	B	10/10	—	10/10	—
		60	218	n.s.	B	12/12	12/12	7/9	—
	.25 ^b	50	210	6 weeks	S	12/12	12/12	3/9	—
					B	7/7	8/8	6/6	—
(3.2 lbs/gal E.C.)	.1	120	453	n.s.	S	7/7	7/8	3/6	—
					B	6/6	6/6	5/5	—
V-C 13 (25% W.P.)	.25	20	76	1 month	B	7/7	7/7	11/11	12/13
					S	5/7	5/7	11/11	9/13
		50	190	n.s.	B	6/9	5/6	7/7	9/10
<i>Sheep</i>									
General Chemical 4072 (25% W.P.)	.25	70	124	8 months	B	1/5	8/8	9/9	7/7
Methoxychlor (25% E.C.)	.5	77	140	10 months	B	0/5	0/8	5/6	—
V-C 13 (25% W.P.)	.25	40	81	8 months	B	1/5	6/8	18/18	9/9

^a n.s. = newly shorn.

^b This herd sprayed with 0.1% Shell SD-4294, then resprayed after 6 weeks with 0.25%.

ined before treatment, at 24 hours, and in some instances also at 1 week after treatment, to determine initial kill of motile forms. In later tests the goats were also examined 1 to 3 months after treatment and, when possible, at the next shearing. The sheep were sprayed and examined by the same methods used for goats. All the sheep were in full fleece, and a minimum of 2 quarts per head was found to be necessary for thorough coverage. The results of these field tests with both goats and sheep are summarized in table 1.

DISCUSSION.—Smith & Richards (1955) dipped small groups of goats in various concentrations of insecticides

and found that most materials afforded good initial kill of lice and considerable residual effectiveness. In the present laboratory tests, goats dipped in most of the insecticides were freed of lice for the duration of the test. It is apparent that, in general, when small numbers of goats are thoroughly wetted and then held in isolation, most insecticides will kill motile forms of lice and prevent reinfestation by killing eggs or newly hatched nymphs.

In the field tests (table 1), motile forms of biting lice were eliminated by all but one treatment. (In one flock of sheep sprayed with 0.5% methoxychlor, one of six animals examined at 2 months posttreatment was still lightly

infested.) Most treatments had freed the animals of lice by 1 or 7 days after spraying, but 1 herd of goats and 1 flock of sheep sprayed with 0.25% V-C 13 Nemacide were not free of biting lice until 1 month posttreatment. Sucking lice were not controlled on the herd sprayed with 0.1% Ruelene.

As in experiments reported by Moore et al. (1959), the time taken for goats to become free of lice was in general dependent on the length of the mohair. Goats with 5 or 6 months' growth of hair sprayed with 0.5% Ruelene and 0.25% carbaryl were infested with lice at 1 day but free of lice at 7 days, but newly shorn goats sprayed at the same or lower concentrations of these insecticides were free of lice at 1 day.

An effective insecticide for louse control should combine complete initial kill with residual action. White (1962, personal communication), in a study of the life cycle of *Bovicola limbata* on the host, reported that the period from egg laying to emergence of the adult was 23 to 27 days. Since immature forms are difficult to detect, especially when present in small numbers, it was necessary to examine treated animals a month after treatment to determine whether the insecticide not only killed motile forms (as would usually be detected at 1 or 7 days) but also prevented reinfestation by killing eggs or newly hatched nymphs. Goats sprayed with 0.25% Dilan, General Chemical 4072, Ruelene, Shell SD-4294, and V-C 13 Nemacide, 0.05% diazinon, and 0.2% malathion, and sheep sprayed with 0.25% General Chemical 4072 and V-C 13 Nemacide, were free of biting lice when examined at 30 to 90 days posttreatment. But the goats sprayed with 0.1% Bayer 29493, 0.25% carbaryl, 0.15% Delnav, and 0.1% Shell SD-4294 were found infested with lice at

30 to 90 days posttreatment. These infestations could have been the result of lice or eggs that survived treatment and were not detected at earlier examinations, or of lice that were transferred to treated goats from untreated animals. One small herd of goats sprayed with 0.25% Ruelene was free of biting lice when examined at the next shearing, 6 months later. One herd sprayed with 0.25% Ruelene and one sprayed with 0.25% General Chemical 4072 were free of sucking lice at the next shearing, 6 months later. The sheep sprayed with General Chemical 4072 and V-C 13 Nemacide were free of biting lice at the next shearing, 4 months later.

The effectiveness of insecticides against biting and sucking lice can be compared by noting results with herds infested with both types. With one herd 0.1% Shell SD-4294 failed to control either type, although the lice were not detected until 30 days posttreatment. This herd was resprayed with 0.25% SD-4294, which controlled the biting but not the sucking lice. Ruelene at 0.1% was ineffective against sucking lice but controlled both types at 0.25%. V-C 13 Nemacide at 0.25% seemed slightly more effective against biting lice than against sucking lice, whereas General Chemical 4072 at 0.25% seemed slightly more effective against sucking lice. Of the four insecticides tested against both types of lice, General Chemical 4072 and Ruelene appeared to be the most effective.

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