

## D.D.T. for the Protection of Sheep against Blowfly Strike.

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THE concentrated effort which has been put into the study of the bionomics of the blowflies attacking sheep in the wool producing areas of the world, and the suggested means of controlling this scourge of the sheep industry based upon these studies have in the final analysis, been decidedly disappointing. In spite of the endeavours made in limiting the amount of carrion available for breeding by carcass disposal, reducing the numbers of blowflies by direct trapping methods, and by attempts at influencing larval competition in favour of harmless or less injurious species, little alleviation of the lot of the wool-grower has resulted.

In South Africa, Hepburn (1943), concluded that the principal species attacking sheep, *Lucilia cuprina*, breeds mainly on the living sheep during the summer months although use is made of carcass material in winter, a conclusion not supported by Mönning (1944), so far as the winter rainfall area of the Cape is concerned, where this species was found to be prevalent on sheep wherever climatic conditions rendered the fleece suitable for blowfly strike.

Mönning (1943), in evolving a blowfly dressing having an efficacy of 100 per cent. in destroying maggots on live sheep, attempted the control of *L. cuprina* by its large scale destruction on living sheep, which appear to be used by this species exclusively for breeding. He states: "It is obvious that if the fly can breed only on the sheep during several months of the year, the killing of all maggots in strike wounds should markedly decrease the incidence of blowflies or even exterminate them".

However logical the argument may be, the labour entailed in treating all affected sheep is very considerable and frequently almost beyond the means of many farmers. Blowfly spray which has been produced at Onderstepoort according to the formula of Mönning and distributed at a rate averaging 45,000 gallons per annum over the last two years (1945-1946) (sufficient to treat approximately 4,500,000 sheep per year), still seems to have influenced the incidence of blowfly strike in sheep to no measurable degree.

It would appear from observations made by one of the authors (R. du Toit) in the Umfolozi Game Reserve in Zululand, an undeveloped area harbouring many species of wild animals but no sheep, that all the species of blowflies including *Lucilia cuprina* occurring in the wool-producing areas are present there. It seems logical to conclude therefore, that in view

of the fact that *L. cuprina* is able to maintain itself in the absence of sheep, efforts made to exterminate it on sheep are foredoomed to failure, although some reduction in its numbers may be achieved.

In the normal course of events blowflies play an extremely important role in nature in assisting with the disposal of carcass material. They have been shown to be extremely valuable in the pollinating of certain plant species of economic importance and in fact fall naturally into the category of useful insects. It is only the habit which they appear to have acquired of breeding in the fleeces of high producing woolled sheep which has resulted in their being classed as injurious insects.

With these considerations in mind the ideal to be strived at is obviously the adequate protection of sheep against blowfly strike, a measure advocated by various authors in such measures as the breeding of less susceptible plain-bodied sheep, the fold removal or Mule's operation, jetting with arsenical preparations, and the rugging of sheep practised in Australia.

The advent of D.D.T. opened up a new field in so far as suggesting a means of protecting sheep against blowfly strike was concerned, in view of the long residual effect possessed by this insecticide.

A series of experiments was undertaken at Onderstepoort to determine the degree of protection afforded to sheep treated with D.D.T. by subsequently subjecting them to artificial strikes with first-stage blowfly larvae according to the method described by McLeod (1937). From the results obtained by this preliminary series of experiments it became apparent that the protection afforded was such as to justify its recommendation to the sheep farming community in general. In order to obtain sufficient information as to the value of the method under actual farming conditions a large-scale field experiment was planned during the summer of 1945-1946 in the Graaff Reinet district of the Cape Province, an area of typical low shrub or Karroo veld.

#### LABORATORY EXPERIMENTS AT ONDERSTEPOORT.

Preliminary experiments were conducted to ascertain the form in which D.D.T. should be applied with the view to studying safety, effectiveness, ease of application and economy. Solutions of D.D.T. in mineral and vegetable oils were considered dangerous for general use, particularly on account of irritation to the skin which frequently resulted with the use of mineral oil solvents. Powders containing D.D.T. were found to be less effective and difficult to apply, and finally an emulsion was decided upon which gave excellent protection with little or no skin irritation. This emulsion was produced in the form of a soluble or miscible oil capable of being diluted to the desired concentration with water in order to reduce bulk and minimize transportation costs.

The following formula was found to be satisfactory, but it must be borne in mind that it was arrived at empirically and the quantities given may vary slightly according to the quality of the ingredients used:—

Toluol: 71 c.c.

Pine Resin (Colophony): 10 gm.

NaOH solution (50 per cent.): 1.5 c.c.

D.D.T. technical (70 per cent. pp. isomer): 28.6 gm.

The resin is dissolved in the toluol and the sodium hydroxide solution added slowly with vigorous agitation until a clear transparent amber-coloured fluid results showing no deposit. Technical D.D.T. is then added and dissolved by agitation. This concentrate contains 20 per cent. para para isomer of D.D.T.

Although not conforming to the standard of a good emulsifiable oil the concentrate produced could be diluted to a satisfactory stable emulsion by shaking it up with an equal quantity of water and thereafter adding the water necessary to dilute it to the desired concentration.

The method of testing the protection afforded by this emulsion consisted in selecting an area approximately six inches in diameter on the rump of the sheep and thoroughly wetting the wool down to the skin by pouring the emulsion over the area and rubbing it in with the fingers.

The degree of protection afforded to sheep under laboratory conditions treated by this method and subsequently tested by means of artificial strikes is summarized in Table I.

TABLE I.

Sheep treated with Emulsion containing 5 Per Cent. p.p. D.D.T.	Sheep treated with Emulsion containing 2.5 Per Cent. p.p. D.D.T.	Untreated Control Sheep.	Number of Days after Treatment.
—	—	+++	14
—	—	+++	28
—	—	+++	49
—	+	+++	68
+	+	+++	75
—	—	+++	82
—	++	+++	89
—	+	+++	96
—	—	+++	103
+++	+++	+++	100

- indicates no development of larvae.  
 + a few larvae only developed.  
 ++ a fair number of larvae developed but strike showed no tendency to spread.  
 +++ many larvae developed and showed a tendency to spread over a considerable area.

Artificial strikes were examined on the third day. The conclusions arrived at from the preliminary work undertaken at Onderstepoort, were that a 5 per cent. p.p. D.D.T. emulsion gave a high degree of protection to treated sheep for a period of approximately three months.

#### FIELD EXPERIMENTS IN THE GRAAFF REINET DISTRICT.

The vast majority of blowfly strikes occur in the region of the breech due to soiling of the wool with urine in the case of ewes or soft faeces in both sexes. Body strikes are met with, however, in the region of the withers and elsewhere, particularly in wet weather but favoured sites appear to be the head region particularly between the head and closely coiled horns in rams and the region of the prepuce in rams and lambs.

The method of treating the sheep with D.D.T. employed in our field experiment consisted of spraying an emulsion of D.D.T. into the wool around the root of the tail and the entire breech region down to the hocks. A

stirrup type, double acting pump, fitted with a Fembre or Vermorrel type nozzle giving a finely atomized spray, conical in shape, was employed. The sheep was held by an assistant standing over the animal so as to present the tail towards the operator who directed the nozzle which was held at a distance of about four to six inches from the skin. During spraying the assistant parted the wool with his fingers to ensure thorough penetration of the spray down to the skin. Rams were treated on the head region and rams and lambs were similarly treated around the region of the prepuce where soiling of the wool by urine appeared to justify such treatment.

The number of sheep treated in the breech region which could be effectively treated with one gallon of the diluted emulsion averaged 25, representing thus approximately 180 c.c. per sheep.

The number of strikes which occurred in a total of 1,866 sheep with D.D.T. emulsion from 2.5 per cent. to 6 per cent. para para D.D.T. are compared with the strikes noted in 2,958 untreated control sheep in Table 2.

TABLE 2.

Name of Farm.	Ex-periment No.	Dura-tion of Ex-periment in Days.	TREATED.			UNTREATED CONTROLS.			Type of Grazing.
			No. of Sheep.	No. of Strikes	Per-centage of Sheep struck.	No. of Sheep.	No. of Strikes	Per-centage of Sheep struck.	
<i>A. Emulsions Containing 2.5% p.p. Isomer of D.D.T.</i>									
Uitkoms.....	1	28	173	0	0	227	6	2.6	Karoo Veld.
Uitkoms.....	2	38	26	0	0	25	13	52.0	" "
Kwaggasfontein.....	3	118	254	2	0.8	250	22	8.9	" "
Vrede.....	4	94	129	28	21.8	193	86	44.6	Lucerne Lds.
<i>B. Emulsions Containing 5% p.p. Isomer of D.D.T.</i>									
Doornbosch.....	5	25	70	1	1.4	78	21	25.4	Karoo Veld.
Kwaggasfontein.....	6	90	91	17	18.7	128	132	103.1	" "
Belmont.....	7	93	200	2	1	420	34	8.1	" "
	8	93	146	0	0	502	62	12.4	" "
	9	76	34	1	3	200	20	10.0	" "
Kindrew Estates.....	10	93	100	35	35	195	65	33.3	Lucerne Lds.
	11	93	44	16	36.3	113	39	34.5	" "
	12	96	81	25	30.8	79	77	97.4	" "
	13	96	61	21	34.4	71	69	97.1	" "
Vrede.....	14	92	80	13	16.3	80	43	53.8	" "
<i>C. Emulsion Containing 6% p.p. Isomer of D.D.T.</i>									
Kwaggasfontein.....	15	76	121	21	17.4	121	223	104.3	Karoo Veld.
Kindrew Estates.....	16	61	164	16	9.7	184	58	31.5	" "
	17	65	92	18	17.4	92	61	66.3	Lucerne Lds.

In the above seventeen experiments the untreated control sheep were allowed to run together with the treated sheep in the same paddocks in each case.

An analysis of the three sets of results obtained from the three dilutions of emulsion reveals the following:—

(a) 2·5% *p.p.* *D.D.T.*

582 sheep treated, 30 strikes 5·1% struck.

695 sheep untreated, 127 strikes 18·2% struck.

(b) 5% *p.p.* *D.D.T.*

907 sheep treated, 131 strikes 14·4% struck.

1,866 sheep untreated, 562 strikes 30·1% struck.

(c) 6% *p.p.* *D.D.T.*

377 sheep treated, 55 strikes 14·5% struck.

397 sheep untreated, 342 strikes 86·1% struck.

#### DISCUSSION OF RESULTS.

The laboratory experiment described, revealed an almost perfect protection afforded in both the groups of 10 sheep treated with 5% and 2·5% *p.p.* for a period slightly over 3 months. It was significant that in those cases where a few blowfly larvae succeeded in establishing themselves there was no tendency for the larvae to migrate into the surrounding wool, and they remained confined to an area of not more than one inch in diameter where the strike was originally initiated. In the case of the untreated control sheep, the skin showed a considerable degree of erosion with the strike tending to spread widely in all directions by the third day when the animals were examined and the larvae destroyed.

The results of the field experiment, in terms of the figures given in Table 2, appear to be considerably less encouraging, but a number of factors must be taken into account which did not operate in the case of the laboratory experiment and which had a profound bearing upon the results. In the first place the sheep were exposed to natural infection in the field and the strikes recorded were in almost all cases, in the region of the breech, an area in which the wool is exposed to soiling by urine and faeces. This is particularly evident in the case of the sheep running on lucerne lands, where a certain degree of diarrhoea is present, resulting in considerable soiling of the breech, with a consequent higher degree of attractiveness of these sheep compared with those on dry Karroo veld.

The strikes recorded in the total of 1866 sheep treated with the three dilutions of *D.D.T.*, revealed 11·5 per cent. of strikes compared with 34·8 per cent. of sheep struck out of 2,958 untreated control sheep. The 1,279 treated sheep running on dry Karroo veld showed 4·7 per cent. strikes, while 27·2 per cent. strikes were recorded amongst the 2,135 untreated control sheep. In the case of 587 treated sheep pastured on lucerne lands 26·5 per cent. of strikes were recorded compared with 53·5 per cent. out of the 823 untreated control sheep.

It must be mentioned that the vast majority of strikes recorded in all the treated sheep were small and showed little tendency to spread, and seldom was an individual sheep struck more than once during the course

of the experiment. Such strikes scarcely warrant treatment under ordinary farming conditions. Throughout the duration of the experiment very little rain was recorded and the falls were very unevenly distributed. The result was that blowfly activity was rather limited and the flies were inclined to be more active in those areas where rain had fallen, which accounts for the somewhat variable results obtained.

#### SUMMARY AND CONCLUSION.

Sheep treated at Onderstepoort with emulsions containing 5 per cent. and 2.5 per cent. para para isomer of D.D.T. on selected sites on the fleece, and subsequently tested on these treated sites by artificially induced strikes with first-stage larvae of blowflies, were protected for a period of approximately three months.

A field experiment in the Graaff-Reinet district of the Karroo is described in which sheep were sprayed in the breech region with emulsions containing 6 per cent., 5 per cent. and 2.5 per cent. of the p.p. isomer of D.D.T. A considerable degree of protection was afforded which was more apparent on sheep pastured on Karroo veld than on those running in lucerne lands.

The conclusion arrived at is that the treatment of sheep, according to the method described, with a D.D.T. emulsion containing 5 per cent. of the p.p. isomer will afford a degree of protection sufficient to reduce blowfly strike to a minimum during the periods of greatest activity. Treatment is best applied shortly after the first summer rains about September and again after the late summer rains in February.

#### LITERATURE REFERENCES.

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