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Practical Tests With Anthelmintics for Grazing Lambs

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Practical Tests With Anthelmintics for Grazing Lambs

C. V. Ross, J. G. Riley and G. C. Shelton

INTRODUCTION

Internal parasites continue to be one of the most serious problems of Missouri sheep raisers. However, new drugs are being discovered which may alleviate the problem.

Research Bulletin 773 reported a series of experiments comparing althelmintics under practical conditions with special emphasis on economic factors of sheep production. The series has been continued from 1961 through 1966 and experiments conducted during that time are reported in this bulletin.

MATERIALS AND METHODS

Spring lambs were used in all the tests. Except in the experiment conducted in Carroll County, all lambs were ear tagged and weighed individually. All fecal worm egg counts and hematocrits were determined for individual lambs prior to initiation of experiments.

Lambs were put into outcome groups based on body weight, worm egg counts, hematocrits, thrift, and sex, then assigned at random to treatments.

In all cases except those noted, lambs were weighed individually at bi-weekly intervals and individual hematocrits were determined. Composite fecal samples were collected and eggs were counted.

During the experiments, lambs which died were subjected to post-mortem examination by the Pathology Department of the School of Veterinary Medicine.

At the conclusion of each experiment, all lambs were weighed individually, inspected carefully by unbiased observers, and, in most cases, they were graded according to USDA standards. Individual fecal samples were taken and counted and individual hematocrit determinations were made for all lambs except where noted.

Experiments comparing standard phenothiazine, fine particle phenothiazine, and methyl phosphoramidate (Ruelene) for worming grazing lambs are reported in Bulletin 773.

Results of all three experiments reported in Bulletin 773 were similar and may be summarized as follows:

Methyl phosphoramidate (Ruelene) was superior to either of the other two anthelmintics in both experiments. Lambs treated with Ruelene made faster gains and had lower death losses, lower worm egg counts, and higher hematocrits.

Fine particle phenothiazine was also superior to standard phenothiazine. Death losses were lower, gains greater, worm egg counts lower and hematocrits higher from lambs treated with the more finely ground phenothiazine.

One further comparison was made in 1960; it is discussed in Experiment I of this bulletin.

RESULTS

Experiment I. Comparison of Standard Phenothiazine, Fine Particle Phenothiazine, and Methyl Phosphoramidate *(Ruelene).*

The object of Experiment I was to compare the efficiency of standard phenothiazine (particle size <3 microns), fine particle phenothiazine, and Ruelene for treating lambs on pasture. The experiment was conducted during the summer of 1961.

Thirty-six clipped native lambs were placed in outcome groups based on body weight, sex, and hematocrits and then assigned at random to the following treatments:

	Lot I	Lot II	Lot III
	Standard Phenothiazine	Fine Phenothiazine	Ruelene
No. of Lambs	12	12	12
Initial Dosage/lamb	12½ gm.	12½ gm.	3.3 gm.
Subsequent Dosages/ Lamb	25 gm.	25 gm.	5.0 gm.

All lambs grazed together for 86 days on a mixed lespedeza-bluegrass pasture. Initially the pasture was excellent, but after six weeks on test, dry weather reduced the quality and quantity of the forage.

All lambs were weighed and treated for parasites. Individual hematocrits and worm egg counts were made initially and at four, eight, and 12 week intervals.

Results are shown in Table 1.

During the first half of the experiment, pasture conditions were excellent due to frequent rains and heavy dews. Later, the weather was dry; pastures deteriorated to the extent that lambs actually lost weight.

There was little difference in average daily gains over the period of the experiment. All lambs appeared to be healthy; no deaths occurred.

Worm egg counts were lower and hematocrits were higher in the groups treated with fine particle phenothiazine and Ruelene. This confirms previous work indicating that fine particle phenothiazine was superior to the product with no guarantee of particle size.

TABLE 1--COMPARISON OF STANDARD PHENOTHIAZINE FIND PARTICLE PHENOTHIAZINE AND RUELENE FOR WORMING GRAZING LAMBS (Experiment I)

Treatments	Standard Phenothiazine	Fine Particle Phenothiazine	Ruelene
Lots	I	II	III
Number of Lambs	12	12	12
Days on Test	86	86	86
Initial Weight (lb)	59.2	59.5	59.3
Avg. Initial Worm Egg Counts per gm. Feces	9900	6155	4683
Avg. Initial Hematocrits (%) PCV[1]	25.7	27.4	25.8
Results at 28 Days			
Avg. daily gain (lb)	.23	.20	.27
Avg. worm eggs/gm. feces	4100	1833	2569
Avg. hematocrits (%) PCV	27.5	29.5	29.9
Results at 56 Days			
Avg. daily gain (lb)	.24	.25	.25
Avg. worm eggs/gm. feces	10683	4025	11109
Avg. hematocrits (%) PCV	23.4	26.9	24.9
Results at 84 Days			
Avg. daily gain (lb)	.08	.10	.07
Avg. worm eggs/gm. feces	5892	3758	1218
Avg. hematocrits (%) PCV	23.8	25.8	29.6

[1]PCV = Packed cell volume.

Experiment II. Comparison of Fine Particle Phenothiazine, Thiabenzole, and Ruelene Drenches.

A field trial was conducted in Carroll County during July and August, 1962. The objective of the experiment was to compare fine particle phenothiazine, Thiabenzole, and Ruelene as drenches for grazing lambs under field conditions.

One thousand and one clipped Texas spring lambs were used in the test.

The lambs were on the farm for seven weeks grazing excellent mixed grass-legume pasture which had not had sheep on it for at least 25 years. No anthelmintic had been given prior to turning on pasture.

The lambs were divided at random into three groups of 303, 360, and 338. The division was accomplished by weighing drafts of 30 to 40 lambs and putting them into three pens. Differences in sizes of drafts accounted for the difference in numbers on treatment. Lambs were ear tagged for permanent identification and branded to facilitate sorting. The groups were then assigned at random to the treatments shown below:

Anthelmintic Treatments of Lambs

	Lot II	Lot III	Lot I
Anthelmintic	Thiabenzole	Ruelene	Phenothiazine[1]
Dosage July 23	50 mg/kilo body wt.	125 mg/kilo body wt.	1 oz/lamb
Dosage Aug. 3	50 mg/kilo body wt.	125 mg/kilo body wt.	1.5 oz/lamb
Dosage Aug. 16	50 mg/kilo body wt.	125 mg/kilo body wt.	1 oz/lamb

[1]40% concentrate phenothiazine particles guaranteed to pass through a 3 micron screen.

One deviation from the plan was made at the end of the fourth week on test. Eleven of the weakest, most anemic lambs were removed from the groups treated with phenothiazine and were handled separately. They were treated with Ruelene and observed during the remainder of the trial.

On treatment days, the lambs were weighed on a livestock scale in drafts of approximately 30 lambs. Thirty lambs were selected at random from each treatment group. Individual blood samples were drawn from them for microhematocrits and fecal samples were taken for worm egg counts.

Records were kept of death losses, lot weights, hematocrits, and worm egg counts.

On the day that lambs were to be weighed and treated, they were sorted into treatment groups first. After they were weighed a small number from each draft were cut out for blood and fecal samples. After the blood and fecal samples were collected, all lambs were inspected visually and notes were taken on general appearances. Next, the lambs were drenched individually, using Victor automatic syringes. After being treated, the lambs were turned together and put back on pasture. Handling of the lambs was completed by noon. Hematocrit readings and helminth egg counts were completed later at the Pathology Laboratory of the School of Veterinary Medicine.

Results are shown in Table 2.

In spite of the fact that the pastures were grown on fields that had not been used for sheep for many years, the buildup of parasitic infection had reached critical levels within a seven-week period. Many lambs were obviously in need of treatment at the beginning of the test.

Lambs treated with Thiabenzole and Ruelene appeared to be healthier and more vigorous than those treated with phenothiazine. Lambs treated with Ruelene appeared more thrifty than those drenched with Thiabenzole.

Lambs treated with Ruelene had the highest hematocrits at the end of each of the two-week periods of the test. They were significantly higher ($P<.01$) than counts for those treated with phenothiazine each time. They were also significantly higher ($P<.01$ and $P<.025$) than the counts for those treated with Thiabenzole at the end of the two- and six-week periods. Differences approached significance at four weeks ($P<.10$).

TABLE 2--COMPARISON OF ANTHELMINTICS FOR GRAZING LAMBS
(Experiment II)

Treatments	Phenothiazine	Thiabenzole	Ruelene
Lots	I	II	III
No. Lambs	338	303	360
Initial Data on Lambs			
Avg. live wt. (lb)	58.2	57.1	58.5
Avg. hematocrits (%) PCV	25.6	28.2	26.3
Avg. worm eggs/gm feces	7400	6500	7570
Results at 2 Weeks			
Avg. live wt. (lb)	61.4	62.3	63.2
Avg. hematocrits (%) PCV	28.4	31.5[2]	34.8[1, 2]
Avg. worm eggs/gm feces	1933	1053	160
Death loss	5	3	5
Results at 4 Weeks			
Avg. live wt. (lb)	62.5	64.1	65.9
Avg. hematocrits (%) PCV	26.9	29.9[2]	34.7[2]
Avg. worm eggs/gm feces	1660	2100	480
Death loss	17	1	2
Results at 6 Weeks			
Avg. live wt. (lb)	69.1	70.5	73.5
Avg. hematocrits (%) PCV	22.8	24.7[2]	34.7[1, 2]
Avg. worm eggs/gm feces	2586	1873	273
Death loss	14	0	1
Change in Hematocrit (%) PCV	-2.8	-3.5	+8.4
Change in Worm Egg Count	-4814	-4627	-6297
Total Death Loss	36	4	8
Avg. Daily Gain (lb)	.26	.30	.36

[1] Significantly higher than other treatments.

[2] Significantly higher than phenothiazine.

Lambs treated with Thiabenzole had significantly higher erythrocyte levels ($P < .01$) than those treated with phenothiazine at the end of the four- and six-week periods.

Death loss was lowest for lambs treated with Thiabenzole. Only one lamb died after the first two weeks. Three lambs died in the group treated with Ruelene after the first two-week period. Death losses in the groups treated with Thiabenzole and Ruelene were low considering the degree of initial infection.

Losses in the group treated with phenothiazine were heavy during the second and third two-week periods. They would probably have been higher if 11 of the weakest lambs had not been removed from the test and treated with Ruelene. Nine of the 11 recovered and appeared healthy at the end of the test.

The observation in previous experiments that egg counts are an unreliable index of degree of infection with *Hemonchus contortus* was confirmed in this test.

An inspection of the lambs and hematocrit values in the phenothiazine group indicated anemia in most all of the lambs examined, but helminth egg counts were low in many of the anemic animals.

Gains of lambs were based on lambs remaining on the experiment; thus, those treated with phenothiazine were not penalized for lambs which died or were removed. Ruelene treated lambs had the fastest gains, and those which received Thiabenzole were intermediate. Gains were generally higher than should be expected, but it must be remembered that the lambs had been in drylot during the night before they were placed on test, and they were sorted before they were weighed. Thus, the initial weight was low due to shrink. When the final weight was taken, the lambs had been on pasture during the night, and they had access to feeders. Thus, they had some fill when they were weighed.

One interesting observation which was made at each weight period was the difference in mucous in the nostrils of lambs on the treatments. Lambs treated with Ruelene had much less nasal discharge and respiratory difficulty than the other two groups. Probably this was due to the elimination of the sheep nose bot, *Estrus ovis,* by the organophosphate compound (Ruelene). This would be an added advantage of the broad spectral biological activity of a compound such as Ruelene and it may have contributed to the increased gains observed in lambs of Group III.

Reaction of lambs to the drugs during and immediately after drenching appeared to be less among lambs treated with Thiabenzole than among lambs of either of the other two groups, but there were no deaths which could be attributed directly to toxicity of the drugs.

Experiment III. Comparison of Phenothiazine, Ruelene, and Thiabenzole.

Experiment III was conducted during the summer of 1962 using 32 clipped native lambs weighing approximately 45 pounds. The lambs had been grazing bluegrass pastures with their dams. They were weaned and grazed 75 days on ex-

cellent lespedeza grown on land which had been used for corn for several years and had had no sheep on it during that time.

The lambs grazed together for the duration of the test.

Anthelmintic treatments shown below were administered initially and at the end of four and six weeks on test.

Group	I	II	III
	Standard Phenothiazine	Ruelene	Thiabenzole
No. of Lambs	11	11	10
Dosage	1 oz 40% conc. per lamb	½ oz per lamb (contained 227 mg active material/cc)	50 mg/kg body wt

Results are shown in Table III.

TABLE 3--COMPARISON OF STANDARD PHENOTHIAZINE, RUELENE AND THIABENZOLE FOR NATIVE LAMBS ON LESPEDEZA PASTURE (Experiment III)

Treatment	Standard Phenothiazine	Ruelene	Thiabenzole
No. of Lambs	11	11	10
Days on Test	75	75	75
Initial Data on Lambs			
Avg. weight (lb)	45.7	44.2	45.6
Avg. hematocrit (%) PCV	21.1	23.2	21.3
Avg. worm eggs/gm feces	3245	2990	4610
Results at 4 Weeks			
Avg. daily gain (lb)	.28	.46	.44
Avg. hematocrits (%) PCV	24.5	38.8	32.1
Avg. worm eggs/gm feces	6727	1644	2210
Results at 10 Weeks			
Avg. daily gain (lb)	.22	.37	.31
Avg. hematocrits (%) PCV	24.5	28.6	30.9
Death losses from parasites	0	0	0

All lambs were heavily infected with parasites at the beginning of the experiment. Some in each group were very weak and anemic.

The lambs in all groups improved noticeably after the first treatment, and all gained weight throughout the trial.

Lambs treated with Ruelene made fastest gains, and those which received phenothiazine were slowest, with the Thiabenzole group intermeding between the two.

Since weather conditions were rather dry after the first four weeks and the lambs were thrifty and gaining, it appeared that all of the treatments were effective in controlling internal parasites. Comparison of gains and erythrocyte levels indicates that phenothiazine was less effective than Ruelene or Thiabenzole.

Experiment IV. Comparison of Anthelmintics When Treatment Groups Run Together and When They Are Separated.

Experiment IV was conducted during the summer of 1962 using 100 clipped Texas lambs.

The objectives of the experiment were:

a. To compare standard phenothiazine, fine particle phenothiazine, Thiabenzole and Ruelene as anthelmintics for grazing lambs.

b. To compare anthelmintic treatments in which lambs on all treatments grazed together with treatments where separate paddocks were provided for groups treated with each anthelmintic.

Treatments were as follows:

Treatments	Dosage	Treatment Interval	No. Lambs Grazed in Common	No. Lambs Grazed by Groups
Control-no Treatment	---	---	10	10
Standard Phenothiazine (Std PTZ)	1 oz/lamb	biweekly	10	10
Fine Particle Phenothiazine (Fine PTZ)	1 oz/lamb	biweekly	10	10
Thiabenzole (TBZ)	50 mg/kg body wt.	biweekly	10	10
Ruelene	125 mg/kg body wt.	biweekly	10	10

All lambs grazed sudan pasture during the experiment. An eight-acre field was divided into two four-acre fields. The lambs which were subjected to the five treatments and grazed together occupied one four-acre field. The other four-acre field was subdivided into 0.8 acre paddocks and treatment groups were assigned at random to them. The lambs were weighed at the start and at four-week intervals. Blood samples were taken for hematocrits biweekly. Fecal samples were taken, and helminth egg discharge levels were determined monthly.

Results are shown in Tables 4 and 5.

During the first three weeks of the experiment, it became evident from scoring of the lambs that the group grazed in common was infected with something

TABLE 4--COMPARISON OF ANTHELMINTIC TREATMENTS FOR LAMBS GRAZED IN COMMON
(Experiment IV)

Treatment	Control	Standard Phenothiazine	Fine Phenothiazine	Thiabenzole	Ruelene
No. of Lambs	10	10	10	10	10
Days on Test	56	56	56	56	56
Initial Data on Lambs					
Avg. wt. (lb)	60.7	62.2	61.2	61.1	61.6
Avg. hematocrits (%) PCV	37.1	37.2	34.3	38.7	34.5
Avg. worm eggs/gm feces	2910	1830	2650	1990	2580
Data at 2 Weeks					
Avg. hematocrits (%) PCV	26.6	32.8	29.0	33.1	31.8
Data at 4 Weeks					
Avg. da. gain (lb)	.26	.28	.10	.20	.17
Avg. hematocrits (%) PCV	28.0	27.9	25.9	29.6	28.5
Avg. worm eggs/ gm feces	10860	5120	4110	5150	3140
Data at 6 Weeks					
Avg. hematocrits (%) PCV	26.0	25.3	24.1	30.0	29.5
Data at 8 Weeks					
Avg. da. gain (lb)	.20	.16	.16	.18	.18
Avg. hematocrits (%) PCV	22.8	26.5	24.3	28.0	27.4
Final Avg. Worm Egg Count/gm feces	7360	3430	2820	1830	1600
No. Alive at End of Trial	8[1]	10	9[2]	10	10

[1]Death due to Hemonchus contortus infection but no evidence of coccidiosis.

[2]Death due to Hemonchus contortus infection.

TABLE 5--COMPARISON OF ANTHELMINTICS FOR LAMBS GRAZED IN SEPARATE TREATMENT GROUPS
(Experiment IV)

Treatment	Control	Standard Phenothiazine	Fine Phenothiazine	Thiabenzole	Ruelene
No. Lambs	10	10	10	10	10
Days on Test	56	56	56	56	56
Initial Data on Lambs					
Avg. wt. (lb)	60.1	61.2	61.1	61.5	60.8
Avg. hematocrits (%) PCV	37.4	37.4	39.6	37.6	35.8
Worm eggs/gm feces	1990	2260	1370	1520	2760
Data at 2 Weeks					
Avg. hematocrits (%) PCV	33.2	32.4	32.7	32.3	32.5
Data at 4 Weeks					
Avg. da. gain (lb)	.15	.07	.05	.27	.28
Avg. hematocrits (%) PCV	28.3	29.9	27.6	28.2	32.4
Worm eggs/gm feces	4830	3880	4000	2000	1260
Data for 6 Weeks					
Avg. hematocrits (%) PCV	25.3	24.0	25.4	26.9	32.5
Results at 8 Weeks					
Avg. da. gain (lb)	.19	.09	.11	.19	.15
Avg. hematocrits (%) PCV	26.6	24.9	26.0	27.4	31.2
Worm eggs/gm feces	4060	4200	3820	2450	1900
No. alive at end of trial	10	10	10	10	10

other than internal parasites. The difficulty was diagnosed as coccidiosis. The following numbers were treated in each group: controls, 7; standard phenothiazine, 6; fine phenothiazine, 6; Thiabenzole, 9; and Ruelene, 3.

The treatment was apparently effective since no lambs died solely from coccidiosis. Two died in the control group from hemonchosis and coccidiosis, and one died of stomach worm infection in the group given fine particle phenothiazine.

Rainfall was light during the test, and thus pasture conditions were poor at the end. Pastures grazed by lambs treated with Thiabenzole and Ruelene were much shorter at the conclusion of the trial than those grazed by lambs on the other treatments. All lambs lost weight during the last weeks of the trial.

Lambs treated with Thiabenzole and Ruelene were thriftier in appearance, had higher erythrocyte levels and lower worm egg counts than the other groups. Thus, it was concluded that internal parasites control was more complete in those groups.

During the dry weather, internal parasites appeared to be much less of a problem than reduced pasture yield.

There was little difference in performance of lambs grazed as one group from those grazed by treatments, but grazing by groups allowed a much more accurate appraisal of the effect of anthelmintic treatment on grazing habits of lambs.

Experiment V. Anthelmintics Treatment Tests With Lambs on Pasture and in Paddocks.

Experiment V was conducted during the summer of 1963 using 85 clipped Texas spring lambs. (Tables 6 and 7.)

Objectives of the experiment were:

a. To compare the effects of no treatment versus drenching with standard phenothiazine, fine particle phenothiazine, Thiabenzole and Ruelene on grazing lambs.

b. To compare the effect of grazing the treatment groups on a common pasture and separating them in paddocks by groups.

Treatments were as follows:

Treatments	Dosage	Times Treated	No. of Lambs Grazed in Common	No. of Lambs Grazed in Groups
Control	---	None	8	9
Standard Phenothiazine (Std PTZ)	1 oz. 40% conc./lamb	Initially & at 6 weeks	8	9
Fine Phenothiazine (Fine PTZ)	1 oz. 40% conc./lamb	Initially & at 6 weeks	8	9
Thiabenzole (TBZ)	50 mg/kg body wt.	Initially & at 6 weeks	8	9
Ruelene	125 mg/kg body wt.	Initially & at 6 weeks	8	9

TABLE 6--EFFECT OF ANTHELMINTIC TREATMENTS WHEN LAMBS ON ALL TREATMENTS WERE GRAZED ON A COMMON PASTURE[1] (Experiment V)

Treatments	Control	Standard Phenothiazine	Fine Phenothiazine	Thiabenzole	Ruelene
No. of Lambs	8[2]	8	8	8	8
Dosage	--	1 oz. 40% conc. per lamb	1 oz. 40% conc. per lamb	50 mg/kg wt.	125 mg/ kg wt.
Initial					
Avg. wt. (lbs)	61.4	60.1	59.5	58.1	58.1
Avg. hematocrit (%) PCV	20.4	28.4	27.6	24.5	24.5
Avg. no. worm eggs/gm. of feces	1800	4200	7600	5400	3600
Results at 2 Weeks					
Avg. wt (lbs)	64.9	65.4	60.9	65.3	61.4
Avg. daily gain (lb)	.27	.41	.11	.42	.25
Avg. hematocrit (%) PCV	22.0	29.0	30.5	28.2	30.1
Avg. worm eggs/ gm. feces	6200	2400	9500	2500	100
Results at 4 Weeks					
Avg. wt. (lbs)	71.6	72.1	66.2	71.9	69.5
Avg. daily gain to date (lbs)	.38	.44	.25	.44	.42
Avg. hematocrit (%) PCV	29.9	30.1	27.9	28.8	31.0
Results at 6 Weeks					
Avg. wt (lbs)	75.9	73.1	71.9	74.0	71.2
Avg. daily gain to date (lbs)	.35	.32	.30	.34	.32
Avg. hematocrit (%) PCV	30.3	26.6	28.8	28.8	28.4

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The treatment was apparently effective since no lambs died solely from coccidiosis. Two died in the control group from hemonchosis and coccidiosis, and one died of stomach worm infection in the group given fine particle phenothiazine.

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Treatments were as follows:

Treatments	Dosage	Times Treated	No. of Lambs Grazed in Common	No. of Lambs Grazed in Groups
Control	---	None	8	9
Standard Phenothiazine (Std PTZ)	1 oz. 40% conc./lamb	Initially & at 6 weeks	8	9
Fine Phenothiazine (Fine PTZ)	1 oz. 40% conc./lamb	Initially & at 6 weeks	8	9
Thiabenzole (TBZ)	50 mg/kg body wt.	Initially & at 6 weeks	8	9
Ruelene	125 mg/kg body wt.	Initially & at 6 weeks	8	9

TABLE 7--EFFECT OF ANTHELMINTIC TREATMENTS ON GRAZING LAMBS SEPARATE TREATMENTS GRAZED IN PADDOCKS[1] (Experiment V)

Treatments	Control	Standard Phenothiazine	Fine Phenothiazine	Thiabenzole	Ruelene
No. of Lambs	9[2]	9[3]	9	9[4]	9
Initial					
Avg. wt. (lbs)	59.3	59.1	60.1	58.7	58.8
Avg. Hematocrit (%) PCV	31.3	28.5	29.0	27.9	28.3
Avg. worm eggs/ gm. feces	1800	4200	7600	3600	5400
Results at 2 Weeks					
Avg. wt. (lbs)	64.8	63.5	62.2	58.7	65.1
Avg. daily gain (lbs)	.43	.34	.08	.00	.48
Avg. hematocrit (%) PCV	32.8	28.5	30.4	30.0	34.0
Avg. worm eggs/ gm. feces	7800	3100	2900	2200	200
Results at 4 Weeks					
Avg. wt. (lbs)	69.1	69.0	69.6	66.7	69.0
Avg. daily gain (lbs)	.36	.37	.35	.30	.38
Avg. hematocrit (%) PCV	30.0	28.0	28.9	29.9	32.2
Results at 6 Weeks					
Avg. wt. (lbs)	72.7	72.9	70.4	69.3	74.6
Avg. daily gain to date (lbs)	.33	.34	.25	.26	.39
Avg. worm eggs/ gm. feces	1100	000	400	200	000

Results at 8 Weeks					
Avg. wt. (lbs)	74.6	72.5	72.4	71.8	75.7
Avg. daily gain to date (lbs)	.28	.24	.22	.24	.31
Avg. hematocrit (%) PCV	31.0	21.6	31.3	29.8	35.0
Results at 11 Weeks					
Avg. Wt. (lbs)	71.1	73.2	73.2	73.9	75.0
Avg. daily gain to date (lbs)	.15	.13	.17	.20	.21
Avg. hematocrit (%) PCV	29.0	24.2	36.6	30.0	30.0
Avg. worm eggs/ gm. feces	3800	900	400	100	1000

[1] Each group grazed on .8 acre sudan paddocks.

[2] One lamb died July 8. Death due to internal parasites. A second lamb killed by predators July 12.

[3] One lamb died July 6. Death due to internal parasites. Four other lambs killed by predators on August 28, August 30, September 2 and September 3.

[4] One lamb killed by predators on July 12.

All of the lambs grazed sudan pasture. The 45 lambs which grazed in common had access to a 4-acre field. The lambs grazed in groups by anthelmintic treatment had access to .8-acre paddocks for each treatment group.

Rainfall was below normal during the period of the trial and pasture conditions were less than optimal; however, all lambs gained in weight and nearly all ended the test in at least fair condition.

The level of infestation on the pastures appeared to be low except during the last three weeks when worm egg counts and hematocrit levels indicated a buildup. After the initial few weeks, controls appeared to be very little affected by internal parasites.

Lambs grazed in common made faster gains and had less death loss than those grazed by treatment groups. This was understandable because of the difference in stocking rate per acre. Differences in stocking rate made a noticeable difference in the amount of feed available for the lambs. They also probably made a difference in infection levels due to the fact that pastures were quite short at the end of the test.

Lambs treated with Thiabenzole and Ruelene made somewhat faster daily gains than those on other treatments. Differences were greater in the groups pastured in paddocks than in those which ran together. Results in this experiment, as in others wherein the anthelmintics were compared, indicate that both the Thiabenzole and Ruelene were superior to either of the phenothiazines. Thiabenzole and Ruelene were approximately equal as drenches when infections were low.

Experiment VI. Ruelene and Thiabenzole Compared Under Three Management Systems.

Experiment VI was conducted during the summer of 1963 using 72 late spring lambs out of Western ewes and sired by Hampshire rams.

The objectives of the experiment were to compare Ruelene and Thiabenzole under three different management systems.

The treatments were as follows:

Pasture Management	Lambs Grazed at Night From 6 p.m. to 6 a.m.		Lambs Grazed During the Day From 6 a.m. to 6 p.m.		Lambs Grazed Continuously	
	Ruelene	Thiabenzole	Ruelene	Thiabenzole	Ruelene	Thiabenzole
No. of lambs	12	12	12	12	12	12
Days on test	78	78	78	78	78	78
Dosage						

The lambs were drenched initially and at the end of the sixth week.

All lambs in each pasture management group grazed together on seven-acre fields. The three groups were rotated on fields at weekly intervals to compensate for differences in fields.

Weights and blood samples were taken on each lamb biweekly. Composite fecal samples were also collected from each group at two-week intervals.

Table 8 gives results.

Table 9 gives results of the grazing treatments and Table 10 summarizes results of the anthelmintic comparison.

Rainfall during the experiment was unusually low and pasture conditions were not optimum. Thus, conditions were not conducive to heavy gains. Lambs pastured continuously gained somewhat faster than the other two groups. The lambs which were allowed to graze only during daylight hours made the poorest gains. When the lambs were grouped according to anthelmintic treatments, average daily gains were slightly in favor of those treated with Ruelene.

Hematocrit levels and worm egg counts both indicated that the worm infestation on pastures was low. These observations were in agreement with previous data obtained on lambs during dry weather.

Erythrocyte levels were slightly higher for lambs that were grazed only during daylight hours, but results were not consistent. They were consistently higher for lambs treated with Ruelene than for those which received Thiabenzole.

TABLE 8--RUELENE VERSUS THIABENZOLE FOR LAMBS UNDER THREE GRAZING TREATMENTS
(Experiment VI)

Time of Grazing	Night Only		Day Only		Continuous	
	Ruelene	TBZ	Ruelene	TBZ	Ruelene	TBZ
No. of Lambs	12	12	12	12	12	12
Avg. Initial Wt. (lbs)	63.1	60.3	63.7	62.0	62.4	60.4
Avg. Final Wt. (lbs)	79.2	74.7	77.5	74.0	79.6	76.6
Avg. Gain per Lamb (lbs)	16.1	14.4	13.8	12.0	17.2	16.2
No. Days on Test	78	78	78	78	78	78
Avg. Daily Gain	.20	.18	.17	.15	.22	.20
Hematocrits (%) PCV						
Initial	29.7	30.2	30.2	30.5	29.9	30.5
14 days	33.4	31.6	34.1	30.6	32.7	29.4
28 days	32.6	30.1	31.4	27.1	32.0	30.4
42 days	28.1	26.9	29.5	27.3	24.1	23.5
56 days	30.2	27.1	32.7	32.0	31.6	33.1
78 days	25.5	24.4	28.3	25.7	28.7	23.0
Worm Eggs per gm. of Feces[1]						
Initial	300	300	200	200	200	200
14 days	00	3700	100	13400	100	6000
28 days	600	1700	00	3600	00	1700
42 days	900	1500	500	2800	2100	1300
56 days	00	200	00	100	100	200
78 days	2000	100	800	2700	1900	4900
Mineral Consumption[2]						
Lbs. consumed	28		32		18	
No. of days consumption checked	50		50		50	
Avg. daily consumption per lamb (lb)	.023		.026		.015	

[1] Fecal samples were taken from at least six lambs in each group and composited.

[2] Mineral consumption was measured from the 28th day to the end of the experiment.

TABLE 9--SUMMARY OF EFFECT OF TIME ON PASTURE ON GRAZING LAMBS (Experiment VI)

Time of Grazing	Night Only	Day Only	Continuously
Days on test	78	78	78
No. of lambs	24	24	24
Av. initial wt. (lb)	61.7	62.8	61.4
Av. final wt. (lb)	76.9	75.7	78.1
Av. daily gain (lb)	.19	.19	.21
Av. initial hematocrit (%) PCV	30.0	30.3	30.2
Av. final hematocrit (%) PCV	25.0	27.0	25.9

TABLE 10--RUELENE VERSUS THIABENZOLE FOR GRAZING LAMBS (Experiment VI)

Treatment	Ruelene	Thiabenzole
Days on Test	78	78
No. of Lambs	36	36
Avg. Initial Wt. (lb)	63.1	60.9
Avg. Final Wt. (lb)	78.8	75.1
Avg. Daily Gain (lb)	.20	.18
Avg. Initial Hematocrits (%) PCV	29.9	30.4
Avg. Final Hematocrits (%) PCV	27.5	24.4
Change in Hematocrits PCV	-2.4	-6.0

Experiment VII. Comparison of Anthelmintics With and Without Protein Supplementation for Grazing Lambs.

The objectives of the experiment were:

a. To determine the effect of no treatment, drenches with fine particle phenothiazine, Thiabenzole, Maretin and Maretin fed in a mixture with protein supplement for grazing lambs.

b. To study the effect of feeding ¼ pound of soybean oilmeal daily on gains and thrift of grazing lambs and on their ability to withstand internal parasite infection.

One hundred twenty clipped black-faced Texas spring lambs were used in this experiment during the summer of 1964. They were assigned to treatments as shown in Table 11.

TABLE 11--TREATMENTS OF LAMBS (Experiment VII)

Anthelmintic Treatments	None		Phenothiazine		Thiabenzole		Maretin		Maretin	
Dosage	None		1 oz/lamb		50 mg/kg body wt.		50 mg/kg body wt.		20 mg/kg body wt./day for 3 days	
Method of Administering	None		Drench		Drench		Drench		Mixed with soybean oilmeal	
Frequency of Treatment	None		Biweekly		Biweekly		Biweekly		Biweekly	
Soybean Oilmeal per Lamb Daily	None	.25 lb	None	.25 lb	None	.25 lb	None	.25 lb	None	.25 lb
No. Lambs per Group	10	10	10	10	10	10	10	10	10	10

Each of the ten groups of lambs was assigned at random to an 0.8-acre paddock where they grazed sudan pasture for the first six weeks of the trial. During the last four weeks, an adjacent sudan pasture was subdivided into 0.8-acre paddocks and the lambs were given access to this as well as the orginal pasture. Thus, at the end, each group was grazing 1.6 acres of sudan. Prior to the trial, the sudan pasture was grazed heavily with dry ewes to assure infestation with parasites. All lambs were weighed, blood samples were drawn for hematocrits, and fecal samples were taken from at least six lambs. Lambs were treated with anthelmintics at biweekly intervals. Individual worm egg counts were made individually at the conclusion of the trial. Results are shown in Tables 12, 13, 14, and 15. Overall results are shown in Table 12.

During the first two weeks of the trial, some lambs were scouring. The cause was diagnosed as coccidiosis. They were treated with sulfa drugs by personnel of the University of Missouri Veterinary Clinic; most lambs made satisfactory recovery. Weighing tests were suspended during the time of treatment to avoid spread of coccidiosis.

Predators killed four lambs during the trials. These lambs were replaced by similar lambs when they were killed.

Grazing the pastures with ewes prior to the beginning of the trial was apparently a satisfactory method of obtaining a high degree of infestation with worm eggs. Erythrocyte levels of all lambs were reduced during the first two weeks of the experiment, and worm egg counts increased in most groups.

Death loss was highest in the control groups. Six out of 20 of the lambs which received no anthelmintics died from internal parasites. Many of the surviving lambs were critically anemic at the conclusion of the trial.

Death loss was also high in the groups treated with phenothiazine. Five of the 20 lambs were lost from internal parasites, and a high percentage of the survivors were very anemic.

Some difficulty was encountered in obtaining a uniform consumption of the Maretin fed in soybean oilmeal. Some of the lambs refused to eat the mixture, and thus were not protected from worms. Three lambs died during the experiment. Others in the group had low hematocrits. None of the group treated with Maretin died. They had the highest erythrocyte levels at the end of the trial of lambs on any of the treatments.

None of the lambs treated with Thiabenzole died during the trial, but some were very anemic at the end of the study. Average daily gains were not a true indication of the efficiency of the anthelmintics due to the number which died. It was only possible to obtain gain data on survivors of each group. It was interesting to observe that lambs in the control group which survived made daily gains comparable to those in any of the other treatments. This is another of the many indications of the difference in the ability of certain lambs to withstand parasite infection.

TABLE 12--EFFECT OF ANTHELMINTIC TREATMENTS AND PROTEIN SUPPLEMENTS ON GRAZING LAMBS
(Experiment VII)

Anthelmintic	None	None	Phenothiazine		Maretin Drench		Maretin Fed		Thiabenzole	
Dosage			1 oz. 40% conc./lamb		50 mg/kg. body wt.		20 mg/kg. wt. 3 days		50 mg/kg. body wt.	
Soybean Oilmeal/ Head/Day (lb)	None	.25	None	.25	None	.25	None	.25	None	.25
Group No.	1	2	3	4	5	6	7	8	9	10
No. of Lambs	12	12	12	12	12	12	12	12	12	12
Days on Test	70	70	70	70	70	70	70	70	70	70
Avg. init. Wt. (lb)	57.3	59.4	58.6	56.4	58.0	58.6	58.5	57.5	56.5	58.5
Avg. hematocrit (%) PCV	33.8	35.5	34.6	36.2	33.4	33.9	35.1	36.7	36.0	34.7
Worm eggs/gm. Feces	283	208	217	967	408	267	275	2825	475	300
Avg. Final Wt. (lb)	64.3	69.5	58.0	64.5	62.5	69.3	67.4	66.8	60.0	67.5
Avg. Daily Gain (lb)	.10	.14	-.01	.11	.06	.15	.12	.12	.05	.13
Avg. Final hematocrit (%) PCV	20.5	21.9	17.8	25.5	26.4	30.0	26.8	25.9	24.4	23.1
Avg. Change in Hematocrits										
Final Worm Egg Count/gm. Feces	0	177	156	0	0	17	22	133	35	175
Change in Worm Egg Count	-283	-31	-61	-967	-408	-250	-253	-2692	-440	-125
Death Loss From Parasites	3	3	3	2	0	0	3	0	0	0

TABLE 13--SUMMARY OF THE EFFECT OF ANTHELMINTICS ON GRAZING LAMBS
(Experiment VII)

Anthelmintic	Control	Phenothiazine	Thiabenzole	Maretin	Maretin
Method of Administering	--	drench	drench	drench	fed
Treatment Groups	1-2	3-4	5-6	7-8	9-10
No. of Lambs	24	24	24	24	24
Avg. init. Wt. (lb)	58.4	57.5	57.5	58.3	58.0
Avg. init. Hematocrit (%) PCV	34.5	35.4	35.4	33.7	35.9
Avg. Worm Eggs/gm. Feces	246	592	388	338	1550
Avg. Final Wt. (lb)	66.9	61.3	63.8	65.9	67.1
Avg. Daily Gain	.12	.05	.09	.11	.13
Avg. Final Hematocrits (%) PCV	21.2	21.7	23.8	28.2	26.4
Change in Hematocrits					
Avg. Final Worm Eggs/ gm. Feces	89	78	105	9	78
Avg. Change in Worm Eggs/gm. Feces	-157	-514	-283	-227	-1472
Dead From Internal Parasites	6	5	0	0	3

TABLE 14--SUMMARY OF THE EFFECT OF PROTEIN SUPPLEMENTATION ON GRAZING LAMBS (Experiment VII)

Protein Supplement	None	Soybean Oilmeal
Amount Fed/Lamb/Day (lb)	None	.25
Treatment Groups	1-3-5-7-9	2-4-6-8-10
No. of Lambs	60	60
Avg. Initial Wt. (lb)	57.8	58.1
Avg. Initial Hematocrits (%) PCV	34.6	35.4
Avg. Worm Eggs/gm. Feces	332	913
Avg. Final Wt. (lb)	62.4	67.5
Avg. daily Gain (lb)	.06	.13
Avg. Final Hematocrits (%) PCV	23.2	25.3
Change in Hematocrits PCV	-11.4	-10.1
Avg. Worm Eggs/gm. Feces	43	101
Change in Worm Eggs/gm. Feces	-289	-812
No. Dead of Parasites	9	5
Avg. USDA Live Grade at 10 Weeks[1]	3.4	4.3

[1]USDA grades were assigned values as follows: medium utility, 5; low utility, 4; high cull, 3; medium cull, 2.

Feeding a low level of protein supplement apparently resulted in increased ability of lambs to withstand parasite infection (Table 14).

Red blood cell levels were slightly higher at the end of each period for lambs that did not receive protein supplement. Death losses were nine for those which received no protein supplement, compared with five for those which received the soybean oilmeal. Daily gains of lambs receiving the oilmeal were slightly more than double gains of those which received none. The lambs fed the low level of soybean oilmeal also appeared more thrifty and graded slightly higher.

There was a great difference in amount of forage left in paddocks of controls and the amount left by the groups treated with Thiabenzole and Maretin. Plenty of forage was left for controls to graze while very little was left in the other paddocks.

Experiment VIII was a follow-up of Experiment VII to again compare anthelmintics and effects of protein supplement, but on a more nutritious pasture.

TABLE 15--TREATMENTS OF LAMBS (Experiment VIII)

Anthelmintic Treatments	None		Thiabenzole		Maretin		CoRal	CoRal
Dosage	None		50 mg/kg body wt.		50 mg/kg body wt.		1 mg/kg body wt./da. for 6 days	1 mg/kg body wt. for 6 days
Method of Administering	None		drench		drench		capsule	feed
Frequency of Treatment	None		biweekly		biweekly		biweekly	biweekly
Group No.	1	2	3	4	5	6	7	8
No. of Lambs	15	15	15	15	15	15	15	15
Soybean Oilmeal Daily	None	.25 lb	None	.25 lb	None	.25 lb	None	.25 lb

Experiment VIII. A Comparison of Anthelmintics With and Without Protein Supplement for Grazing Lambs.

The objectives of the experiment were:

a. To compare Thiabenzole, Maretin administered as drenches, and CoRal administered in feed and by capsule as anthelmintics for lambs.

b. To determine the effects of feeding ¼ pound of soybean oilmeal per head daily on performance and ability of lambs to withstand parasite infection.

The experiment was conducted from August 3 to September 28, 1965, with 120 Texas black-faced spring lambs.

The lambs were divided into eight groups of 15 lambs (Table 15). Each group grazed a 2.4-acre paddock which contained good Korean lespedeza pasture.

Table 16 shows results, and pooled data for anthelmintics is in Table 17.

Pasture quality was excellent until the last two weeks of the experiment; after that lambs still had adequate grazing, but the quality was reduced.

Parasites were a problem, as can be seen by the death loss of four lambs during the first two weeks of the trial. Many other lambs were anemic.

Even though erythrocyte levels of controls were low and the lambs appeared unthrifty, only one lamb was lost from the untreated group. Greatest loss was in the group treated with CoRal by capsule with no protein supplementation. Four lambs died in the group. Two lambs were also lost from the groups fed CoRal and supplemented with soybean oilmeal. There was also a loss of two lambs in the group treated with Thiabenzole, and a loss of one in the control group which was fed soybean oilmeal.

The groups treated with Maretin made the best record. They had significantly ($P<.05$) higher daily gains than any other treatment group. Their erythrocyte levels were also the highest, but differences were not significant. Thiabenzole was the second most effective anthelmintic, with lambs given this treatment yielding significantly ($P<.05$) higher gains than those treated with CoRal. Differences approached significance over controls.

Lambs which were treated with CoRal made the poorest gains of any group not fed supplement. Gains also were lower than all but those of controls in the groups which were fed soybean oilmeal. Death loss was highest in the groups treated with CoRal.

The effect of feeding low levels of soybean oilmeal daily to lambs can be seen in Table 17.

Lambs which were fed the protein supplement gained three times as fast as their counterparts which received no soybean oilmeal. The differences were highly significant ($P<.01$). Hematocrit readings were too variable for significance, but they were 13.4 percent higher than those which received no protein supplement. It should also be noted that death loss from internal parasites accounted for seven lambs that received no protein supplement versus three which did.

TABLE 16--COMPARISON OF ANTHELMINTICS FOR GRAZING LAMBS WITH AND WITHOUT SOYBEAN OILMEAL
(Experiment VIII)

Group no.	1	2	3	4	5	6	7	8
Protein supplement fed	None	SBOM	None	SBOM	None	SBOM	None	SBOM
Treatment	Control	Control	TBZ	TBZ	Maretin	Maretin	CoRal	CoRal
How administered	--	--	Drench	Drench	Drench	Drench	Capsule	Feed
Dosage	--	--	50 mg./ kg. Body Weight	50 mg./ kg. Body Weight	50 mg./ kg. Body Weight	50 mg./ kg. Body Weight	1 mg./kg. Body Wt. for 6 Days	1 mg./kg. Body Wt. for 6 Days
No. of Lambs	15	15	15	15	15	15	15	15
Initial - Aug. 3								
Avg. Wt. (lb)	63.0	63.7	63.9	63.9	62.1	61.9	63.0	63.3
Avg. Hematocrit (%) PCV	30.7	31.3	32.4	31.5	30.9	30.1	31.6	32.5
Avg. Worm Eggs/gm. Feces[1]	3133	5473	2540	8353	6400	2820	7580	4933
Results at 2 Weeks - Aug. 17								
Avg. Wt. (lb)	66.9	65.5	67.9	67.2	66.7	67.9	64.8	66.1
Avg. Hematocrit (%) PCV	31.4	24.9	28.3	26.0	35.2	21.2	26.5	32.5
Worm Eggs/gm. Feces	3000	9200	5700	9300	1000	2100	600	5000
No. Dead of Parasites[2]	1	--	1	--	--	--	2	--
Results at 4 Weeks - Aug. 31								
Avg. Wt. (lb)	67.6	66.3	68.6	69.5	69.3	72.1	63.0	67.2
Avg. Hematocrit (%) PCV	29.4	27.9	34.2	33.2	40.7	38.9	26.4	28.5
Worm Eggs/gm. Feces	100	1200	1100	2800	900	1600	2400	1000
No. Dead of Parasites	--	--	--	--	--	--	--	1
Results at 6 Weeks - Sept. 14								
Avg. Wt. (lb)	68.2	66.7	70.2	73.2	70.7	76.1	64.6	71.0
Avg. Hematocrit (%) PCV	30.4	33.2	32.8	39.7	38.3	38.5	30.5	34.5
Worm Eggs/gm. Feces	2900	1600	300	300	700	300	800	300
No. Dead of Parasites	--	--	--	--	--	--	2	1

TABLE 16 (Continued)

Group no.	1	2	3	4	5	6	7	8
Protein supplement fed	None	SBOM	None	SBOM	None	SBOM	None	SBOM
Treatment	Control	Control	TBZ	TBZ	Maretin	Maretin	CoRal	CoRal
How administered	--	--	Drench	Drench	Drench	Drench	Capsule	Feed
Dosage	--	--	50 mg./ kg. Body Weight	50 mg./ kg. Body Weight	50 mg./ kg. Body Weight	50 mg./ kg. Body Weight	1 mg./kg. Body Wt. for 6 Days	1 mg./kg. Body Wt. for 6 Days
Final Results at 8 Weeks[3] - Sept. 28								
Avg. Wt. (lb)	66.9	73.6	69.0	77.2	68.8	78.0	63.7	72.9
Avg. Hematocrit (%) PCV	28.4	36.1	35.4	35.1	39.3	39.0	26.5	38.6
Avg. Worm Eggs/gm. Feces	1421	3021	2038	2860	560	1340	3318	569
No. Dead of Parasites	--	1	1	--	--	--	--	--
Total avg daily gain (lb)[4]	0.06	0.17	0.08	0.24	0.12	0.27	0.01	0.17
Avg. Total Change in Hematocrit (%) PCV	-2.2	+4.7	+3.3	+3.5	+8.4	+8.9	-5.5	+6.2
Avg. Total Change in Worm eggs/gm. Feces	-1712	-2452	-502	-5493	-5840	-1480	-4262	-4364
Total Death Loss Due to Parasites all Periods	1	1	2	0	0	0	4	2

[1] Individual fecal samples were taken initially and at the end of the test. During the test composite samples were taken from at least six lambs from each lot.

[2] All death losses were due to internal parasites. Figures indicate the death losses for the specified two week interval.

[3] All figures are based on only those lambs which lived throug the entire test period.

[4] Adverse weather conditions and disappearance of good pasture contibuted to the poor rate of gain of almost all lambs during the last two weeks of test.

TABLE 17--SUMMARY OF COMPARISON OF THE EFFECTS OF FEEDING PROTEIN TO GRAZING LAMBS RECEIVING DIFFERENT ANTHELMINTICS

Protein	None	SBOM
Rate	--	0.25 lbs./hd./day
Groups	1, 3, 5, 7	2, 4, 6, 8
No. of Lambs	60	60
Initial - Aug. 3		
Avg. wt. (lb)	63.0	63.2
Avg. hematocrit (%) PCV	31.4	31.4
Avg. worm Eggs/gm. feces[1]	4913.3	5394.8
Results at 2 Weeks - Aug. 17		
Avg. wt. (lb)	66.6	66.7
Avg. daily Gain (lb)	0.24	0.25
Avg. hematocrit (%) PCV	30.4	26.2
Worm eggs/gm. feces	2575.0	6400.0
No. dead of parasites[2]	4	0
Results at 4 Weeks - Aug. 31		
Avg. wt. (lb)	67.1	68.8
Avg. daily gain (lb)	0.11	0.21
Avg. hematocrit (%) PCV	32.7	32.1
Worm eggs/gm. feces	1125.0	1650.0
No. dead of parasites	0	1
Results at 6 Weeks - Sept. 14		
Avg. wt. (lb)	68.4	71.8
Avg. daily gain (lb)	0.13	0.21
Avg. hematocrit (%) PCV	33.0	36.5
Worm eggs/gm. feces	1175.0	625.0
No. dead of parasites	2	1
Final Results at 8 Weeks[3] - Sept. 28		
Avg. wt. (lb)	67.3	75.4
Total avg. da. gain (lb)[4]	0.07	0.22
Avg. hematocrit (%) PCV	32.8	37.2
Avg. total change in hematocrit (%) PCV	+1.4	+5.8
Avg. worm eggs/gm. feces	1834.3	1947.5
Avg. Total Change in Worm Eggs/gm. Feces	-3079.0	-3447.3
No. Dead of Parasites Fourth Period	1	1
Total Death Loss Due to Parasites	7	3

[1]Individual fecal samples were taken initially and at the end of the test. During the test composite samples were taken from at least six lambs from each lot.

[2]All death losses were due to internal parasites. Figures indicate the death losses for the specified two week interval.

[3]All figures are based on only those lambs which lived through the entire test period.

[4]Adverse weather conditions and disappearance of good pasture contributed to the poor rate of gain of almost all lambs during the last two weeks of test.

Lambs fed the soybean oilmeal appeared thriftier and more alert than those which did not receive it.

Experiment IX. Effects of Changing Energy and Protein Intake of Lambs Treated With Anthelmintics.

Experiments VII and VIII indicated that soybean oilmeal supplementation resulted in faster daily gains and higher hematocrits for lambs pastured on sudan and on good lespedeza. Since the effect was apparent when lambs were grazed on a lower as well as a higher protein pasture, the next experiment was designed to determine whether the effect was caused by increased energy in the ration or by increased protein.

Experiment IX was conducted from July 16 to September 24, 1966.

Objectives of the experiment were:

a. To compare Thiabenzole and Maretin as anthelmintics for grazing lambs.

b. To determine the effect of supplementing lambs on pasture by feeding protein daily and by self-feeding it in combination with salt to limit intake.

Ninety Texas spring ewe lambs were used in modified 4 x 3 factorially arranged experiments. Each treatment group grazed a 1.3-acre sudan paddock.

Treatments are shown in Table 18.

TABLE 18--TREATMENTS COMPARED FOR LAMBS GRAZED ON SUDAN PASTURE (Experiment IX)

Group	No. Lambs	Anthelmintic	Dosage	Supplement	Method of Feeding
1	10	None	--	None	--
2	10	Maretin	50 mg/kg body wt.	None	--
3	10	Maretin	50 mg/kg body wt.	SBOM[1]	Self fed
4	10	Maretin	50 mg/kg body wt.	SBOM[2]	Hand fed
5	10	Maretin	50 mg/kg body wt.	Corn[2]	Hand fed
6	10	Thiabenzole	50 mg/kg body wt.	None	--
7	10	Thiabenzole	50 mg/kg body wt.	SBOM[1]	Self fed
8	10	Thiabenzole	50 mg/kg body wt.	SBOM[2]	Hand fed
9	10	Thiabenzole	50 mg/kg body wt.	Corn[2]	Hand fed

[1]Salt was mixed with the soybean oilmeal at a level sufficient to control intake to 0.25 pound per lamb daily.

[2]Hand fed at a levelof 0.25 pound per lamb daily.

Height of pasture was equalized by clipping the forage when an area was higher than 8 inches. Three clippings were required during the trial. The lambs were treated with anthelmintics initially and at the end of the second, fourth, sixth and eighth weeks. Over-all results are shown in Table 19. Results of the anthelmintic comparison are shown in Table 20 and effects of the supplementation in Table 21.

Parasite infection in lambs was apparently low during the first six weeks of the trial as indicated by low death losses and normal erythrocyte levels in lambs. Later, lambs in the control group (Group 1) became anemic and two lambs died. At the end of the trial, their erythrocyte levels were low, and their worm egg counts were the highest of those for any group. There was a noticeable lack of thrift among the lambs.

One interesting observation which was true in this as well as other experiments was the apparent individual difference in the ability of lambs to resist parasites. Some lambs were little affected by parasites, as indicated by appearance of thrift, normal hematocrit readings, worm egg counts and gains. There has never been any obvious reason to explain the differences between individual lambs.

Lambs treated with Maretin made significantly ($P < .05$) faster gains than controls. They also gained slightly faster than those treated with Thiabenzole, but differences were not significant. Average red cell levels as determined by hematocrit readings were also higher in Maretin-treated lambs but the difference was not significant.

Death losses from parasites occurred in the control and Thiabenzole-treated groups but none occurred in the groups treated with Maretin.

Lambs which were hand-fed a daily allowance of soybean oilmeal had the same daily gains and somewhat higher hematocrit values than those hand-fed corn, but differences were not significant. They did make somewhat higher daily gains than the group that was self-fed soybean oilmeal and the controls which received no supplement, but the differences were variable and not significant.

Lambs which were hand-fed soybean oilmeal had higher final erythrocyte levels than those which were self-fed soybean oilmeal and those which received no supplement.

In this, as well as other experiments in which a low level of soybean oilmeal was fed daily, there were superior gains and livability. Lambs which received the supplement also had less anemia, and thus, apparently, had greater resistance to internal parasites.

TABLE 19--MARETIN VERSUS THIABENZOLE AS ANTHELMINTICS AND EFFECT OF SUPPLEMENTARY FEEDING CORN OR SOYBEAN OILMEAL ON PERFORMANCE OF GRAZING LAMBS
(Experiment IX)

Anthelmintic	None	Maretin				Thiabenzole			
Supplement	None	None	SBOM	SBOM	Corn	None	SBOM	SBOM	Corn
Method of Feeding Supplement	--	--	Self	Hand	Hand	--	Self	Hand	Hand
Group no.	1	2	3	4	5	6	7	8	9
No. of Lambs	10	10	10	10	10	10	10	10	10
Days on Test	70	70	70	70	70	70	70	70	70
Av. Initial Wt. (lb)	57.3	57.1	57.8	56.7	58.0	57.6	58.0	57.6	57.6
Avg. Hematocrit (%) PCV	31.6	31.4	33.0	32.0	33.4	33.4	31.8	31.5	31.6
Worm Eggs/gm. Feces	300	380	220	240	190	340	20	390	60
Avg. final Wt. (lb)	69.4	70.2	77.7	77.3	81.6	72.9	73.7	77.1	72.9
Avg. daily Gain (lb)	.18	.19	.28	.29	.34	.22	.22	.27	.22
Avg. Final Hematocrit (%) PCV	25.4	35.4	33.0	35.6	34.3	26.6	27.8	30.5	29.4
Avg. Change in Hematocrit PCV	-6.2	+4.0	-.05	+3.6	-0.9	-6.80	-4.0	-1.0	-2.2
Final Worm Eggs/gm. Feces	2200	680	420	480	490	1115	340	800	820
Change in Worm Egg Count	+1900	+300	+200	+240	+300	+775	+320	+410	+760
Deaths From Internal Parasites	2	None	None	None	None	1	None	None	None

TABLE 20--COMPARISON OF ANTHELMINTICS FOR GRAZING LAMBS
(Experiment IX)

Anthelmintic		Maretin	Thiabenzole
Group Numbers	1	2-3-4-5	6-7-8-9
Number of Lambs	10	40	40
Avg. Initial Wt. (lb)	57.3	57.4	57.7
Avg. Hematocrits (%) PCV	31.6	32.4	32.0
Avg. Worm eggs/gm. Feces	300	257	202
Results at 70 Days			
Avg. Final Wt. (lb)	71.6	76.7	74.2
Avg. Daily Gains (lb)	.21	.27*	.23
Avg. Hematocrits (%) PCV	31.0	34.6	28.6
Change in Hematocrits PCV	-.6	+2.2	-3.4
Worm Eggs/gm. Feces	897	517	769
Change in Worm Egg Count	+597	+260	+567
Deaths From Internal Parasites	3	0	1

*Significantly greater than controls ($P < .05$).

TABLE 21--EFFECT OF SUPPLEMENTING GRAZING LAMBS BY HAND FEEDING CORN OR SOYBEAN OILMEAL OR SELF FEEDING SOYBEAN OILMEAL PLUS SALT
(Experiment IX)

Supplement	None	Corn	SBOM	SBOM
Method of Feeding	--	Hand	Hand	Self
Daily Allowance (lb)	--	.25	.25	.25
Group Numbers	2-6	5-9	4-8	3-7
No. of Lambs	20	20	20	20
Avg. Initial Wt. (lb)	57.4	57.8	57.2	57.9
Avg. Hematocrists (%) PCV	32.4	32.5	31.8	32.4
Avg. Worm eggs/gm. Feces	360	125	315	120
Results at 70 days				
Avg. final wt. (lb)	71.6	77.3	77.2	75.7
Avg. daily gain (lb)	.21	.28	.28	.25
Avg. hematocrits (%) PCV	31.0	31.8	33.1	28.9
Change in hematocrits	-1.4*	-.7	+1.3	-3.5*
Worm eggs/gm. feces	897	655	640	380
Change in worm egg count	+537	+530	+325	+260
Deaths from Interal parasites	3	None	None	None

*Significantly ($P < .05$) lower than groups hand fed SBOM.

SUMMARY

In nine experiments between 1960 and 1967, a total of 1953 lambs were used to compare anthelmintics and test the combined effects of concentrate supplementation and anthelmintics on grazing lambs.

Anthelmintics compared in the experiments were standard phenothiazine with no guarantee of particle size, micronized phenothiazine guaranteed to pass through a 3 micron screen, Ruelene, Thiabenzole, CoRal, and Maretin.

Micronized phenothiazine was superior to standard phenothiazine for the control of internal parasites.

Both Thiabenzole and Ruelene were superior to phenothiazine in a large-scale field trial. Ruelene appeared somewhat superior to Thiabenzole in the field trial, but both were satisfactory as sheep anthelmintics.

Experiments were conducted in which anthelmintic treatments were compared when lambs grazed together and when they grazed in treatment groups. More precision was obtained where the lambs grazed in treatment groups.

Ruelene was superior to Thiabenzole in a test in which one group of lambs were grazed continuously and compared with groups grazed day or night. Lambs that grazed continuously made faster gains but had slightly lower (not significant) erythrocyte levels at the end of the trial than the lambs that grazed during the day only. Although the lambs grazed during the day only had slightly higher erythrocyte levels, the differences were not significant.

Maretin as a drench appeared superior to Thiabenzole, CoRal, or Maretin furnished in a supplement to lambs. Maretin proved nontoxic and appeared to have much potential as a sheep anthelmintic.

Feeding a supplement to lambs on pasture, either 0.25 pound of soybean oilmeal or 0.25 pound ground corn, resulted in faster gains and higher erythrocyte levels. Lambs that were hand-fed soybean oilmeal at the rate of 0.25 pound daily made faster gains, and had higher red cell levels and lower death losses than lambs that were not fed a supplement when grazing sudan or lespedeza pastures.

This work indicates that Ruelene, Thiabenzole, and Maretin drenches are all excellent anthelmintics for grazing lambs.

In these, as in experiments reported in Missouri Experiment Station Research Bulletin 773, there appeared to be a great difference in resistance of individual lambs to parasitism. This may indicate an inherent ability and suggests that sheep could be selected for the trait. Further work is needed on the subject.