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1965 Area Sheep Days: Research Reports and Sheep Management Programs

Cooperative Extension Service
South Dakota State University

Agricultural Experiment Station
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Feb

1965 AREA SHEEP DAYS

Research Reports and Sheep Management Programs

SOUTH DAKOTA STATE UNIVERSITY, BROOKINGS

South Dakota State University
Brookings, South Dakota

Extension Service | Livestock Specialist Section

RESEARCH REVIEW

Systems of Managing Ewes and Lambs
Dixon Springs Experiment Station, Simpson, Ill.
Sheep Day Report 1963

Almost everyone will agree that the most profitable lamb is the one reaching market weight and grade on pasture rapidly enough to be sold on the June market. However, if one or a combination of such conditions as (1) limited pasture, (2) declining pasture quality, (3) numerous multiple births, (4) relatively late lambs, and (5) increased internal parasite infestation, resulting in slower gains and increased death loss, is a problem, then some other system of management should be considered.

For the past six years, investigations at this Station have been directed toward finding methods of managing ewes and lambs to produce a high-quality market lamb in a minimum time and at reasonable cost. The objective was to produce a lamb of desirable market weight and quality before the first of July. To do this in the area of the Dixon Springs Station, it is necessary to provide conditions that will permit twin lambs to perform as well as single lambs and to reduce losses from internal parasites, increasing heat, humidity, and declining pasture quality.

It was evident, despite two drenchings of the ewes before the pasture season, that the ewes were the principal reservoir of the parasite build-up on pastures. Thus it seemed necessary to study systems of management that did not allow the lambs to pasture with the ewes and to compare the gains of lambs grazed on nitrated orchardgrass or legume-grass pastures with those of lambs weaned and fed in dry lot. The data reported here are principally from work conducted in 1960 and 1961 and covered in more detail in the Dixon Springs Sheep Day Reports of 1961 and 1962.

Study of the systems outlined in Table 1 involved 392 lambs and 305 ewes. The work was started when the ewes went to pasture on April 25, 1960. Lambs varied in age from 47 to 100 days, the average age between lots varying from 74 to 84 days. Individual weights of lambs at the beginning of the study ranged from 27 to 77 pounds.

The ewes were drenched with fine-particle phenothiazine containing lead arsenate before going on pasture. Both ewes and lambs were individually weighed onto the experiment and at approximately 28-day intervals thereafter until the lambs were marketed or the study was terminated. The lambs were sold at a local pool and were assigned live grades by a competent grader. Thus the marketing data represent live grade or buyer acceptance.

AREA SHEEP DAYS

Program

10:00 a.m.	--	Sheep Research (Summary from all research stations), L. J. Kortan, Extension Livestock Specialist
10:40 a.m.	--	Improved Production Through Selection and Cross Breeding, Delwyn Dearborn, Extension Livestock Specialist (West River)
11:20 a.m.	--	"Where Are We in the Control of Sheep Breeding?" (Estrus Synchronization), Dr. Leon Bush, Animal Science Department
12:00 - 1:00 p.m.	--	Lunch
1:00 p.m.	--	Farm and Ranch Cost and Income Estimates, Dr. Wally Aanderud, Extension Farm Management Specialist
1:30 p.m.	--	Producer View on Sheep Production, Hugh R. Barnett, Sheep Producer, Brookings, South Dakota
2:00 p.m.	--	SDSU Sheep Nutrition Research, Dr. L. Embry (East River) and Prof. Joe Minyard (West River)
2:30 p.m.	--	Management to Consider in Parasite Control, J. J. O'Connell, Extension Livestock Specialist
3:00 p.m.	--	Questions
3:30 p.m.	--	Adjourn

SHEEP FIELD DAYS

Introduction

The Sheep Industry in South Dakota is one of the three most important meat animal industries in our state.

The January 1, 1965, Livestock Inventory, South Dakota, showed that sheep and lambs including those on feed total $1\frac{1}{2}$ million. This is 7% below a year earlier and 12% below 1959-63 average. Forty-seven per cent of the stock sheep were east of the river while 53% were in West River counties. The sheep and lambs were valued at $25.5 million.

The South Dakota wool clip during 1964 totaled nearly 13.9 million pounds, slightly more than a year earlier. Wool production was about equally distributed between the East River and West River counties.

South Dakota is one of the top five sheep producing states both in "all sheep and lambs" and "lambs on feed". Texas, Wyoming, Colorado, and Clifornia are the only states leading South Dakota in "all sheep and lamb" numbers.

For a number of years, sheep producers have been faced with increasing flock production cost. This is partly due to the constantly rising level of the general economy. As the production cost increases the producers must then direct their attention toward ways and means of increasing the lamb raising potential of sheep. It is with this in mind that the area sheep field days were planned. Efforts toward increasing the earning capacity of the farm and ranch flocks could very well be the theme.

The sheep industry in South Dakota will thrive and grow only when the income will carry the burden of production costs and also leave a satisfactory margin of profit. Increase in quantity and quality of lambs and wool and practices which lower production and marketing costs both can have a significant effect on earning capacity and profit.

Flocks of 200 to 500 ewes on many farm flocks and ranch operations will be the general trend in the future. Operators with units this size will become more specialized in all phases of production. This level of production will enable producers to develop more efficient units which in turn will emphasize the real potential of sheep production in South Dakota.

The Area Sheep Days held this year are sponsored by the South Dakota State University Extension Service, The Department of Animal Science, South Dakota Agricultural Experiment Station, in cooperation with the many sheep producers throughout South Dakota.

The objective is to bring sheep producers up-to-date on the most recent sheep production information. Research from the SDSU Experiment Station as well as from other stations will be presented. You will have an opportunity to ask questions and exchange ideas. We appreciate your interest and hope your day with us has been worthwhile.

Table of Contents

Table 1. Systems of Managing Ewes and Lambs (1960)

Lot	System
1	Lambs weaned, self-fed on legume pasture
2	Lambs self-fed in dry lot, ewes on legume pasture during the night, returned to lambs during the day (in and out)
3	Lambs weaned and self-fed in dry lot
4	Ewes and lambs on legume-grass pasture, lambs creep-fed
5	Ewes and lambs on legume-grass pasture, no creep
6	Ewes and lambs on nitrated orchardgrass pasture, no creep
7	Ewes and lambs on nitrated orchardgrass pasture, lambs creep-fed
8	Lambs weaned, self-fed on grass pasture
9	Lambs self-fed in dry lot, ewes on nitrated orchardgrass during the night and returned to lambs during the day (in and out)
10a/	Approximately half of lambs in Lots 4, 5, 6, and 7 weaned and self-fed in dry lot after 28 days on pasture with their dams

a/ A variation of this system in 1961 involved weaning lambs after five weeks on pasture with the ewes and after eight weeks on pasture with the ewes.

All lambs that had access to feed other than pasture were self-fed the ration shown in Table 2.

Table 2. Lamb Creep Ration

	Pounds
Corn, ground shelled	600
Hay, ground mixed	250
Soybean meal (44% CP)	150
Bone meal	10
Limestone, feeding grade	10
Salt	5
Premix per pound of rationa/	

a/ Sufficient to furnish vitamins A and D, B_{12}, and Terramycin.

Results in Table 3 show that little if any difference in rate of gain could be attributed to the type of pasture that was used.

Table 3. Ewe and Lamb Gain Data (1960)

Lot	Management	Average initial weight	Average daily gain	Feed per lb gain	Average ewe gain
		lb.	lb.	lb.	lb.
1	Weaned on legume pasture	54.0	0.44	2.28	--
2	In and out of legume	52.7	0.55	4.25	11.0
3	Weaned on dry lot	50.3	0.51	4.70	--
4	Ewes and lambs on legume, creep	51.5	0.51	1.50	14.6
5	Ewes and lambs on legume, no creep	51.8	0.38	--	-0.7
6	Ewes and lambs on grass, no creep	50.6	0.53	--	11.3
7	Ewes and lambs on grass, creep	48.4	0.52	0.60	10.7
8	Weaned on grass pasture	46.2	0.41	3.01	--
9	In and out of grass	49.4	0.57	4.34	7.0
10	Late-weaned	48.2	0.55	3.16[a]	--

a/ Feed required per pound of gain, post-weaning only.

The slowest gaining lambs were those on legume-grass pastures (Lot 5) without creep. A heavy parasite infestation contributed dominantly to this disappointing performance. Comparison of the gains of ewes in Lots 4 and 5 (Table 3) provides additional evidence of the effect of a heavy infestation of internal parasites in Lot 5. The fastest gaining lots in each group were the in-and-out lots (2 and 9). This system of management has consistently produced the most rapid gains over the past six years. It does require more handling of the ewes and limits their grazing time. However, evaluation of the ewe gains shown in Table 3 indicates that this system does not place an unreasonable stress on the ewes.

LAMB AND EWE MANAGEMENT
Dixon Springs Agriculture Center, University of Illinois

The goal of research in ewe and lamb management is the production of a high-quality market lamb in a minimum of time at a reasonable cost.

When ewes are turned out to pasture, should their lambs go with them? This is a question that breeders are faced with each Spring. Young lambs are highly susceptible to parasites. On pasture with their mothers, their gain too often slows up. They may actually lose weight and start scouring if they get loaded with parasites which are not controlled by a regular, effective worming program.

In 1963 and 1964, variations of the in-and-out system were studied in an attempt to reduce feed costs without affecting rate of gain or quality of lamb produced.

The study involving Lots 1 and 2 was made during the early part of the grazing season in 1963 and 1964. Lot 3 was added in 1964.

TABLE 1. VARIATIONS OF IN-AND-OUT MANAGEMENT SYSTEMS

Lot	Management
1	Ewes separated from lambs, grazed on grass pasture, and returned to lambs at night. Lambs confined to shelter with self-feeder.
2	Ewes separated from lambs daily, grazed on grass pasture, and returned to lambs at night. Lambs given access to high-quality legume pasture in addition to self-feeders.
3	Ewes separated from lambs daily, grazed on legume pasture, and returned to lambs at night. Lambs given access to high-quality legume pasture in addition to self-feeders.

TABLE 2. HIGH-ENERGY, HIGH-PROTEIN RATION, SELF-FED

Ingredient	Pound
Mixed hay, ground	250
Corn, ground shelled	590
Soybean meal (50% C.P.)	160
Bone meal	10
Limestone	10
Salt	5

Vitamin A to equal 1,000 IU per pound of ration
Vitamin D to equal 400 IU per pound of ration
Terramycin (TM-10) at 10 milligrams per pound of ration

TABLE 3. LAMB GAIN AND FEED DATA (April 24 - July 25, 1963, 92 days)

	Lot 1	Lot 2
Average initial weight	45.9	42.1
Average daily gain		
4/24 - 5/22	0.659	0.783
5/22 - 6/20	0.510	0.470
6/20 - 7/25	0.400	0.520
Total	0.495	0.591
Feed per pound gain	4.11	2.84

TABLE 4. LAMB GAIN AND FEED DATA (April 24 - July 9, 1964, 76 days)

	Lot 1	Lot 2	Lot 3
	lb.	lb.	lb.
Average initial weight	54.4	52.8	50.8
Average daily gain			
4/24 - 5/21	0.831	0.717	0.807
5/21 - 6/10	0.700	0.530	0.691
6/10 - 7/9	0.561	0.464	a
Test period	0.710b	0.624b	0.628c
Feed per pound gain	3.63b	3.02b	2.89c

a Dry conditions reduced pasture, and this lot was terminated at the end of 47 days.
b For 76 days on test.
c For 47 days on test.

Conclusions

1. All variations of the in-and-out system of management in these studies produced a rapid-gaining, high-quality lamb.

2. The data suggest that access to a high-quality legume pasture (not grazed by the ewes) may reduce the feed required per pound of gain.

3. Providing ewes with legume pasture (Lot 3, 1964) did not appreciably improve lamb gains.

THREE-YEAR STUDY OF LAMB PRODUCTION
BY WESTERN EWES
1965 Sheep Days, Iowa State University

The age at which lambs can be readied for market is economically important. This is shown as the average daily gain from birth to market weight for both the early and late lambs in Table 3.

Table 3. AVERAGE DAILY GAIN IN POUNDS -- BIRTH WEIGHT TO MARKET WEIGHT*

Season	1960-61	1961-62	1962-63	3-year average
Early	0.71	0.57	0.65	0.65**
Late	0.60	0.46	0.56	0.54

* Market weight was approximately 100 pounds live weight.
** Statistically significant at the 1 percent level weight.

It was observed that in each of the 3 years, the early lambs had an advantage in average daily gain. The 3-year average gain for early lambs was significantly greater than that for late lambs (.65 vs. .54 pounds).

The rate of gain of lambs may also be affected by breed of sire. This comparison is shown in Table 4.

Table 4. AVERAGE DAILY GAIN IN POUNDS -- BY BREED OF SIRE.[1]

Sire	1960-61	1961-62	1962-63	3-year average
White Face[1]	0.64	0.52	0.57[1]	0.57
Black Face[1]	0.68*	0.51	0.62**	0.61

* Significant at the 5 percent level of probability.
** Significant at the 1 percent level of probability.
1 White Face = Columbia; Black Face = Hampshire.

In 2 of the 3 years (first and third), the Black face sired lambs gained significantly faster than did the White faced sired lambs. The 3-year average daily gain was .61 pound for the Black face sired lambs versus .57 pound for the White faced sired lambs.

A study was also made for the average daily gain of single versus multiple birth (Table 5).

Table 5. AVERAGE DAILY GAIN IN POUNDS -- BY TYPE OF BIRTH.

Type of Birth	1960-61	1961-62	1962-63	3-year average
Single	0.68	0.53	0.63	0.61
Multiple	0.63	0.50	0.59	0.58**

** Significant at the 1 percent level of probability.

These data show that lambs born as singles outgained the multiple birth lambs in all 3 years with an average daily gain of .61 pound for all single births and .58 pound for lambs of multiple birth. This average is small, and does not overcome the desirability of multiple births.

Another factor studied was average daily gain of lambs when fed the ration in either pellet or meal form. Pelleted creep produced gains significantly greater than when lambs received the ration in meal form (.61 vs. .57 pound, Table 6).

Table 6. AVERAGE DAILY GAIN IN POUNDS -- BY TYPE OF CREEP

Type of Creep	1960-61	1961-62	1962-63	3-year average
Meal	0.69	0.50	0.57	0.57
Pellet	0.72	0.53	0.64	0.61**

** Significant at the 1 percent level of probability.

A study was also made of the cost of producing a lamb to market age based on a 3-year total of 506 lambs marketed from 490 ewes originally placed in the breeding flock with the rams. The dry lot feed cost per ewe for all ewes over the 3-year period was $8.64. The cost per lamb marketed from all ewes was $8.39 in dry lot feed costs. When an additional $2.00 was charged per ewe for pasture cost, the average feed cost per ewe per lamb marketed was $10.33. The total cost of the feed fed to the lambs was $6.60 per lamb marketed. Therefore, the total feed cost for producing a lamb to market weight was $16.93.

This 3-year study indicates that Western ewes bred to Black face rams produced lambs that gained significantly faster than lambs from comparable ewes bred to White face rams. Furthermore, lambs born in late January and early February rather than in late March and early April resulted in the lambs reaching market at 3 weeks younger age.

In addition to the faster growth rate of early lambs, there is usually a more favorable market at the time the early lambs are ready to sell. This would indicate that in a normal year the early lambs will realize an economic advantage over late born lambs. All factors considered, it appears that the overall return from lambs born early in the season will be $3.00 to $5.00 per lamb greater than for lambs born 1 month to 6 weeks later in the season.

WOOL TYPE OR MEAT TYPE
West Virginia Experiment Station

Advantages of western or wool type ewes over the native or meat type are that they can be purchased in uniformly large numbers, are excellent wool producers and mothers, and are long-lived. These ewes should be mated to meat-type, black-faced rams for top quality and rapid growing lambs.

A recent report from the West Virginia Experiment Station shows that white-faced Montana ewes averaged $6.82 more per ewe yearly than did native (Hampshire) ewes. This was a ten year study, and 65 yearling ewes of each kind were started on experiment. They were kept in the flock as long as they were productive. There were 12 native ewes and 17 western ewes left at the end of 10 years. The same meat rams were used on all ewes. The ten year summary is shown in the accompanying Table No. 1.

The conclusions drawn from this trial are as follows:

1. Western ewes were heavier by an average of 13 lbs. at the start of the breeding season.

2. The longevity of the western ewes was superior. There was a much heavier loss of native ewes as they reached seven to eight years of age.

3. The lambs from the native ewes graded slightly higher.

4. The value of lambs sold per ewe in the flock, however, was greater nine years out of ten for western ewes.

5. The western ewes were more prolific--they had 50.5% twin births over these years and 45.2% single births compared to 43% and 54% respectively, for the native ewes.

6. The weight of the fleece, per ewe clipped, was approximately 100% heavier in the case of the western ewes.

The below figures should also give a good idea of how many total dollars can be expected from a group of yearling ewes over their lifetimes.

TABLE NO. 1	Native (meat type)	WESTERN (wool type)
Number of ewes started................	65	65
Number of live lambs born.............	450	620
Number of lambs marketed..............	395	561
Percentage of lambs born marketed.....	87.8	90.5
Pounds of lamb marketed...............	30,913.6	45,088.8
Receipts from lambs...................	$5,990.71	$8,950.14
Total pounds of wool..................	1,801.7	4,121.9
Receipts from wool....................	$1,009.60	$2,341.52
Receipts from wool and lambs..........	$7,000.30	$11,291.66

CHEAP RAMS ARE EXPENSIVE
U.S. Department of Agriculture

How much influence does the ram contribute to the progress of your flock? The statement one often hears is that the ram is half the flock. This is apparently based on the fact that the ram sires all the lambs in a one-sire flock.

But let's look at the selection pressure that is put on good purebred rams compared to the average grade ewe. Approximately one-third of the ewe lambs must be kept for replacements in order to maintain a constant number of ewes. If a 100-ewe flock produces 125 lambs, one-half of which would be ewes, about one-third of these or 21 ewe lambs would be kept for flock replacement. This means that if you are selecting for a characteristic such as gain ability, you cannot make as much progress by selecting 33 percent of the top animals as you can if you selected the top 3 percent.

On the other hand, only three or four rams are needed to mate a 100 ewe flock. If you were selecting your own replacement rams in the same sized flock, you would need to keep only about two each year out of 63 male lambs. This would equal 3 percent of the group, and so you would be practicing much more selection pressure on rams than on ewes. As a result, the ram would be contributing more than 50 percent of your progress.

Dr. Clair E. Terrill, U. S. Department of Agriculture, makes these statements: "We need to emphasize the selection of rams because hereditary gains are largely made from these selections. The statement that the sire is half the flock is wrong. In terms of the gains that can be made through selection, the sire is much more than half the flock. In fact, our work shows that 89-90 percent of the gains made in improving a trait like fleece weight came from the selection of rams and only 10-20 percent came from the selection of the ewes."

Performance records in 1961 between sire groups at the S.D.S.U. station indicated an average daily gain variation of .13 pounds. Within sire groups, an increase of .14 pounds average daily gain was shown.

A cheap ram can be an expensive ram if the .14 pounds average daily gain is taken off instead of putting on the lambs he sires. Lambs having 8 to 12 pounds less weight at market will mean a loss of approximately $2.00 at present day prices, or if these lambs are kept on the farm until they are 8 to 12 pounds heavier, it will require a 20 or 30 day longer feeding period. Another 60 to 100 pounds of feed will be needed and at present day prices will amount to $1.20 to $2.00 additional feed cost.

A ram is generally used for at least two years. He should sire a total of 100 lambs during this period. At present prices, this means he will be siring over $2000 worth of offspring. If a ram can put 800 to 1000 more pounds on the lambs he sires, it is easy to figure his value on increased weight alone.

A ram that has an outstanding weight-for-age record, good conformation and scale, fertile and free from disease, will contribute more than half of all improvement in your flock. With his lamb crop returning over $2000, it would appear that he is one of the biggest bargains in the livestock business.

SHADE VERSUS NO SHADE FOR GRAZING LAMBS
University of Missouri 8th Annual Sheep Day Report

Ninety-six purebred and crossbred lambs which had been raised on the sheep farm were placed in outcome groups according to breed, sex and weight and then assigned at random to the experiment. One group was provided shade and the other was furnished no shelter.

The lambs grazed for 60 days on two grass-lespedeza pastures and later were moved to orchard grass pasture for 31 days. The pastures were rotated bi-weekly during the test. Results are shown in the following table:

Treatments	Lot I No Shade	Lot II Shade
No. lambs starting experiment	48	48
Death loss	2[1]	2[2]
Av. days on test	91	91
Av. initial wt. (lbs.)	53.8	54.0
Av. final wt. (lbs.)	62.0	69.0
Av. total gain (lbs.)	8.2	15.0
Av. daily gain (lbs.)	.09	.16**

** Highly significant ($P < .01$)
1 One died of pneumonia, the other stomach worms.
2 Both starved to death; one got hung in fence, the other hurt its mouth.

Observations:

1. Considering the dry weather, all lambs made good gains on pasture.

2. It was observed that lambs which had no shade would lie near the fence posts and in tall weeds and grass to escape the direct rays of the sun at midday.

3. Neither group grazed during the heat of the day.

4. Although the death loss during the experiment was the same, the causes were different. The lambs with no shade died of pneumonia or stomach worms whereas both shade lambs died of starvation - one got hung in fence, the other hurt its mouth and couldn't eat.

5. Lambs without shade seemed to be more susceptible to stomach worm infestation because they appeared unthrifty the last two months of the experiment even though they were wormed with Thiabendazole at approximately two-week intervals.

6. Several lambs in the "no shade" lot were extremely weak and a few died immediately following the experiment due to stomach worms.

7. Lambs having shade available made significantly larger gains than those without shade ($P < .01$).

FLUSHING OF EWES
U. S. D. A. Workers At University of Idaho

Research workers at this station wanted to know why "flushing" sometimes helped and sometimes did not help. The preliminary results of their studies indicate that the value of the flushing is influenced by (1) age of the ewe (flushing increased the lamb production of most ewes, except the two-year olds), (2) the timing and duration of the flushing period and (3) the kind of supplement used.

In regard to timing, the 17-day period which precedes turning the ram in proved best. The ewes average 1.43 lambs per head.

As to duration of flushing, an additional 17 days of flushing produced no further increase in lamb crop, while the cost of supplement feeding was obviously doubled. When the flushing was continued for a third 17-day period, production decreased to 1.35 lambs per ewe. The "no flushing" treatment group average 1.27 lambs per ewe.

These workers found that .70 lb. of oats daily accounted for the increases in lamb production. Using alfalfa pellets at a rate of 1 lb. per head per day produced slight increases, but was insignificant.

These workers' theory on how flushing affected lamb production is that when ewes have not been getting an ideal ration, increasing their energy intake or supplying them with specific nutrients somehow stimulated the development of the follicles in the ovaries that release egg cells. The ewe seemed to need this stimulation for only a short period early in the estrus, or heat cycle when follicles are actually developing. Later, stimulation is inaffective, probably for the reason that number of eggs to be released by the ovary has already been determined.

KEEP EWES COOL AT MATING TIME

Kentucky Animal Science Research Reports, July, 1964

60 western ewes were divided at random into three groups of 20 each. One group was held for comparison, the second group placed in a heated room (90° F, relative humidity 60-65%) at the time of mating. The third group was placed in the heated room one day after breeding.

Three days after they were bred, both groups were removed from elevated temperature and placed with the comparison group. Thus, the test groups had been exposed to the heat for three days and two days, respectively.

Three days after breeding, one-half of the ewes in each group were slaughtered for data on ovulation and fertility. The remaining ewes were kept for lambing data. Estimated embryo loss was significantly higher for ewes exposed to the high temperature. Earlier studies had shown that ewes kept at high temperature at similar times for 20 days suffered material embryo loss, but present work has pinned it down to first few days after fertilization.

Reproductive Performance of Ewes Exposed to Short Periods of Heat Stress

			Ewes Exposed To Heat	
		Control Ewes	At Breeding	1 day after breeding
(a)	Abnormal ova, %	9.1	50.0	41.7
	Fertilized ova, %	100.0	85.7	92.3
	Ewes lambing, %	70.0	40.0	50.0
(b)	Embryo loss, %	9.1	58.3	41.6
	Lambing rate	1.43	1.25	1.40

South Dakota State University
Brookings, South Dakota

Extension Service — Livestock Specialist Section

Management Practices for Increasing Lamb Raising Potential of Sheep

L. J. Kortan[1]

Ram Management Practices for Increased Lamb Numbers

Selection of purebred ram - The ram influences the characteristics of every lamb he sires, hence, he should be a good one. The most rapid and cheapest improvement in a flock can come via careful selection of the ram.

Select for:

(1) Superior meat type characteristics
(2) Breeding performance of his dam
(3) Ram Qualities
(4) Weight for age
(5) Early finishing qualities
(6) If possible give preference to rams from a performance tested flock (100 pounds or more of adjusted weight at 120 days of age.)
(7) Body conformation, scale, substance, and constitution.
(8) Fleece should be dense, uniform in length and diameter.

Daughters of rams that are born twins, everything else being equal, are more likely to be prolific. Ewes sired by rams that were born early in the season are usually better ewes than those sired by rams that were lambed late.

Price - A ram is more than half the flock because his genetic contribution is to the performance of all lambs born and not just to one or two as in the case of a particular ewe.

The chances of purchasing an outstanding ram for a low price seems most unlikely. Just how much you can afford to pay for a ram is not easy to determine but pay the price to get a good one. A formula or practice followed by many successful producers is to be willing to pay 3 or 4 times the value of a good market lamb for a ram for commercial lamb production.

Time of Selection - It is advisable always to select rams well in advance of the breeding season. The early buyer has a much larger selection to choose from and has ample time to shear the ram. (Six to eight weeks prior to use and again at breeding time.)

Shearing ram - Effects of exposing rams to 90° F. temperature for one week, Kentucky Experiment Station.

		Five Weeks Later	
	Rectal temperature on last day	Sperm Motility	Abnormality
	°F	%	%
Controls (unheated)	102.2	85	10.0
Sheared (heated)	102.4	80	8.1
Unsheared (heated)	105.0	10	71.0

Marking Harness - Either a marking harness or other device should be used on the ram with color changed every 17 days to make sure he is settling the ewes. Most growers keep rams with ewes from 6 weeks to 2 months or longer. Do not allow ram to run with ewes except during breeding season.

Number of Mating - A ram one year or older should be able to take care of 35 to 50 ewes. It is generally more satisfactory to keep ram penned during day, feed him hay or grain, and turn him with ewes at night. If several groups of rams are used, alternate each group of rams every 24 hours.

A safety factor is usually provided by using more rams than are absolutely essential in serving all the ewes.

Edgar (1961, New Zealand) placed individual rams with flocks of 300 ewes each. Of 40 rams so tested only three settled less than 100 ewes in the first 18 days. One ram settled 250 and the average was 160 per ram.

As we learn to check fertility of rams we probably can increase numbers of ewes per ram.

How to "Hand Breed" - If hand bred, one ram can serve as many as 100 ewes. Tie a piece of heavy cloth, an "apron", to cover the belly of a "teaser" ram. Color his chest. Turn this teaser with ewe flock during day. He will paint ewes in heat. Place only painted ewes with real breeder at night.

Trim Feet - Feet are important to a ram. Trim when necessary and help correct lameness if possible. Avoid all possibilities of a ram going lame.

Feed for Ram - Ten days before breeding, feed 3/4 to 1 1/2 pounds of corn-oat mixture and 1/10 pound protein supplement per day. Allow to run on grass where there is plenty of shade and water.

Ewe Management Practices for Increased Lamb Numbers

Flushing the ewe - before breeding season will stimulate an increased ovulation rate under some conditions.

Hulet (Dubois Laboratory, 1962) and Wallace (New Zealand). In both cases increased number of twins were born from ewes that received additional feed just prior to breeding. California work. When bred on dry range about 20% of ewes gave birth to twins while those fed on green feed produced at least 50% twins. Other tests show that 15 to 20 more lambs may be had per 100 ewes if ewes are flushed.

How to flush - Ewes should be fairly thin and gaining in weight. Feed ½ to 1 pound of grain per ewe daily while flushing for 2 weeks before breeding. Continue while ewes are being bred. Oats is a suitable grain for flushing. The grain may be fed in addition to sudden fresh green grazing. Or it may be fed alone while sheep are still on dry roughage. Fresh green grazing alone makes good flushing feed and in several reports results are generally as good or better than when using other feeding programs.

The general consensus seems to be that flushing:

(1) If properly accomplished, will result in a noticeable increase in the proportion of twin birth.

(2) May not be advantageous when applied to either very young or very old ewes, or to poor milking ewes
(3) Is not likely to result in the desired response when applied to ewes already in fat condition
(4) May result in an increase in the number of non-pregnant ewes in the flock
(5) May result in an increase in the incidence of lambing paralysis unless proper feeding precautions for ewes in advanced pregnancy are taken
(6) May prolong the lambing season
(7) Is not consistent under all conditions or with all breeds

Age to breed ewe - Before they are a year old or at around 18 months. In favorable environment ewe lambs may be bred before they are a year of age.

Scotland studies (1962) indicate that by breeding ewe lambs and culling all which do not conceive as lambs, the ewes of low fertility can be eliminated. New Zealand study be Wallace (1958) on selecting for twins found that lambs reared as twins were more likely to be dry as two-year-old ewes. If twin ewe-lambs are to be saved for replacement ewes, they merit special feeding where growing out replacement ewes is a problem.

Age of ewes - Within a breed or type, a flock of ewes will usually increase their lambing percentages rather steadily from their first lambing through the fourth or fifth. After the fifth or sixth lambing the rate of twinning may start to decline.

Temperature - Exposing ewes to high ambient temperature (90° F) before breeding results in a lower fertilization rate and increased early embryonic death. Several studies have been carried out to determine which period of high temperatures are most detrimental to the developing sheep embryo.

Critical period for early embryo mortality in ewes exposed to high temperatures. Dutt (Kentucky Experiment Station).

The effect on embryo mortality in ewes exposed to high ambient temperature (90° F) at time of breeding (0-day) and on 1, 3, and 5 days was determined in two experiments. Fertility rate (69.2%) in ewes exposed to a high ambient temperature at time of breeding was non-significantly lower than it was in control ewes.

Exposure to heat results in an increase in morphologically abnormal ova. Only 3.7% of ova from control ewes, examined 3 days after breeding, were classified as morphologically abnormal. In the 0-day ewes 46.2% and in the 1-day ewes 30.8% of the ova were classified abnormal.

Embryo loss, estimated as the percent of fertilized ova that failed to survive, was significantly higher in all treated groups and ranged from 61.5% to 100%. Embryo loss for the combined 0- and 1-day groups was significantly higher than in the 3- and the 5-day ewes. The sheep zygote is most sensitive to the harmful effect of high ambient temperature during the initial stage of cleavage while in the oviduct.

Eighty-five percent of the control ewes lambed, compared with 10% of the ewes in the 0- and the 1-day groups. Thirty-five percent of the ewes in the 3-day group lambed, and 40% in the 5-day group lambed.

Other data from this same station indicates that summer temperatures are partly responsible for poor conception rate of ewes bred to Southdown rams early in the breeding season. This same data also pointed out the possibility of improving conception rate early in the breeding season by keeping rams at lower environmental temperatures during the summer months. Reproduction in the yearling ewe as affected by breed. (Foot & Pope, Wisconsin).

Those animals that were better grown out as indicated by greater body weight shed the greater number of ova in each of three years.

Nutrition - Normal reproduction is dependent on a highly complex and very delicate balance on many physiological processes of the ewe. Proper nutrition is essential for all of these processes and therefore can be associated with not only possibility of pregnancy occurring, but also very likely with a possible effect on multiple births.

Early lambing ewes - Some studies have shown that the first half of the ewe flock will drop a higher percentage of twins than the half of the flock that lambs last. This observation may be a direct result of the effect of flushing it still deserves some consideration and is still another characteristic for which we can select.

Genetic background - Some breeds, Merino, as an example, are noted for their inability regularly to produce a high rate of twins. However, one can find individual ewes that never miss twins. Selecting replacement animals of multiple birth can be utilized in an attempt to increase twinning. (Heritability estimates within a flock 10% - 15%).

At birth - This is a critical time in the life of a little lamb. If he needs help to breathe, provide artificial respiration at this time. An apparatus (tube, paper sack, plastic bag, etc.) can be used which will fit over the lamb's mouth and nose. Breathing in and out of the apparatus by mouth will provide needed respiration. See that the membranes and scum is taken away from the mouth and nose and, during cold weather, make sure that he is dried off and heat is provided, if necessary. It is important that this little fellow receives some milk the first few hours of his life in order to give him the proper start. If too long a time lapses before nourishment is given, the possibility of survival is greatly decreased. A lamb that is completely chilled soon after birth has little chance of survival. Consequently, it is important that a system of heating, brooder, or some protection be provided.
A simple brooder with a heat lamp up on the top will generally provide sufficient heat. When lambs are born on the range under favorable climatic conditions, supplemental protection must be provided. The most important management practice for the producer to follow is to be available during lambing and give considerable attention to the lambs for the first week or ten days following birth.

(Montana Data) When do lamb losses occur and what is the reason for this loss? Lamb losses at Montana Experiment Station range flock - 23.5% died between birth and weaning (7191 lambs used). Of this group 72.1% were placed in five categories. Pneumonia, 16%; starvation, 13.8%; no visible lesion, 15.8%; stillbirths, 14.3%; and dysentery, 11.8%. Fifty-six percent of lambs died within three days of life and 73% within first five days. To sum up the story on lamb losses, the producer should pay real close attention during the first five days of the lamb's life and if he gets the lamb past this period his chances for weaning this lamb are quite good.

(Ohio Data) The infant mortality in a total lamb crop of 491 was 18.5% of all fetuses born. The rate among purebred lambs was 19.06% and among crossbred lambs was 17.8%. Autopsy of all lambs dying from birth to weaning, including aborted and stillborn, revealed that 24.47% were stillborn, 30.48% died from constitutional weakness and starvation; 18.08% died from pneumonia; 7.45% from physical injury and 5.30% from infection (navel and intestinal). Minor causes leading to death included anomaly, 2.12%; drowning, 1.06%; orphaned, 1.06%; and 6.36% from undetermined cause. Fifty-five percent of the total mortality occurred at birth and during the first three days. A total of 70 percent occurred at birth and during the first ten days thereafter.

Hormones - The use of hormones to increase multiple birth is still in experimental stage.

Production of twins - The importance of twins and triplets in profitable flock operation has been characteristic of high income earning flocks.

One set of data involving two breeds of sheep shows that after deducting infant mortality, the group of ewes of each breed which gave birth to single lambs reared 83.5 and 86.3 percent lamb crop to weaning at 90 days. The ewes that gave birth to twin pairs or triplets in each breed reared 163 and 172 percent lamb crop. The twin-bearing groups in each case were approximately double the number raised by the ewes giving birth to single lambs. The influence of this multiple birth factor numberwise in flock economics is plain.

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Lamb Losses 1965

Ohio Puts Finger On Unsuspected Cause Of Major Death Losses In Baby Lambs

A. H. Hamdy[1]

The research and development center in Wooster, Ohio, studied 779 births occurring during the 1965 season. Here are the facts:

The overall death loss from birth to 90 days of age or weaning was a whopping 26 per cent (203 lambs).

How did these 203 lambs die? The causes were:

pneumonia	56.6%
stillborn	21.6%
starvation and/or constitutional weakness	7.3%
white muscle disease (stiff lamb)	3.9%
other causes*	8.3%

At what age did these lambs die? Taking those that died of pneumonia, it was observed that almost two-third died within the first 10 days of life. The figures were:

First 10 days	66.4%
11-20 days	16.0%
21-30 days	8.0%
31-40 days	2.5%
41-50 days	3.5%
51-60 days	1.8%
61-90 days	1.8%

The 115 lambs that succumbed to pneumonia comprised 15 per cent of the total lamb crop studied by the Ohio station (as well as being almost 57 per cent of the death losses from all causes). The Ohioans wanted to know why. This is what they found:

The pneumonia observed in young lambs was intimately associated with their mother's. Bacteria isolated from the throats of these mothers appeared to be associated with the occurrence of pneumonia in their lambs. The dam may carry these organisms in her throat and then transmit them to her lamb by mechanical means such as licking, by airborne infection, or by other physical contact. Once in the throat of the lamb, they may invade the tissues of the respiratory tract under conditions of stress, and this may contribute to bringing on the pneumonia.

It is evident that this and other conditions affecting the health of the breeding flock must be investigated and brought under control if we are to raise large, profitable crops of healthy lambs.

The Ohio studies may have pointed a finger at the real villain - the health status of the ewe.

1 Sheep Disease, Sheep Research & Development, July, 1965.
* Injury, navel infection, enterotoxemia (overeating disease), or undetermined.

I.S.U. tests show how fast Dec./Jan. lambs gained to reach top-dollar June market.[1]

No. ewes	74	72	71	69
No. lambs	90	95	103	96
Avg. 8 wk. lamb wt./lbs.	44.8(est)	44.8	51.0	52.6
Avg. 100 day lamb wt./lbs.	83.4	78.4	88.8	88.1
Avg. lamb mkt. wt. (farm), lbs.	97.3	98.9	103.8	103.1
Avg. mkt. ag, days	117.3	125.6	130.8	128.5
Avg. da. gain - 8 wks. to 100 da., lb.	.88	.76	.86	.81
Avg. da. gain - 100 da. to mket. lb.	.80	.63	.47	.52
Avg. da. gain - 8 wks. to mkt., lb.	.86	.73	.70	.70
Pounds lamb per day age, lb.	.83	.79	.79	.80
Single	49	48	32	32
Twins	40	44	66	54
Twins raised as singles	1	3	5	10
Marketing dates	May 26 June 10 June 23		June 1* June 28**	

* Price $28.76/cwt.
** Price $26.60/cwt.
[1] The Shepherd, November, 1965.

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Extension Service — Livestock Specialist Section

Improving Sheep Production Through Selection and Crossbreeding

D. D. Dearborn [1]

Background

A meeting sponsored by the Center for Agricultural and Economic Development and entitled "The National Sheep Industry Conference" was held on the campus of Iowa State University in September of 1964. This meeting included presentations by representatives from all segments of the sheep industry and was preceded by a pre-conference seminar on lamb carcass evaluation. Therefore, a thorough investigation of all the problems facing the sheep industry in the 1960's was one of the purposes for this meeting. All of the presentations were condensed with their main points being abstracted into one presentation entitled "Summary" prepared by Dr. Clair E. Terrill, Chief, Sheep and Fur Animal Research Branch, A.R.S., U.S.D.A. Beltsville, Maryland.

Problem

One of the production problems included in this summary was stated as follows: "The lamb producer has difficulty in selecting rams which will sire growthy, heavily muscled lambs." Therefore, the purpose of this presentation is to review, consolidate and interpret research results to aid the lamb producer in improving his accuracy for selecting rams that will sire growthy, heavily muscled lambs.

The principles suggested apply to both ram and ewe selection. However, since the selection pressure that may be applied on the sire side is much greater than on the ewe side, emphasis will be placed on ram selection.

Present Production Goals

Present production potential at this same conference was outlined by Dr. A. L. Pope, Professor of Animal Science at the University of Wisconsin. He indicated it was now possible to obtain a 200 percent lamb crop; to have lambs reach 100 pounds in 90 days; to produce one pound of lamb on less than three pounds of feed; to have three lamb crops in 13½ months and to produce three square inches of loin eye on a 50 pound carcass. His production goals did not include any concerning wool production but an average production of 6 pounds of clean wool per individual would be less difficult to obtain than some of the production traits he did mention. Table 1 presents these production goals and compares them with some average estimates.

[1] Extension Livestock Specialist - West River

Table 1. Comparison of Average and Potential Production

	Average	Potential
Percent lamb crop	105	200
Growth rate	1.3# per day	1.0# per day
Feed efficiency	9# of feed per 1# of gain	3# of feed per 1# of gain
Ribeye on 50# carcass	2.3 square inches	3.0 square inches
Wool production, annual (clean wool basis)	4.0 pounds	6.0 pounds

The large difference between average and potential production if obtained would do much to improve the sheep man's economic status. Animal breeding is a basic science and of utmost importance for it deals with establishing the genetic potential of an individual animal and determines his response to optimum nutrition and management.

Genetic Principals Related to Sheep Breeding

Difference between sheep or the variation that may be seen or measured is caused by two major forces, Heredity and Environment. An individuals's genetic potential is determined at conception when the sperm, containing a sample half of the sire's genetic makeup, fertilizes the egg containing a sample half of the ewe's genetic makeup.

The basic unit of inheritance is called a gene. There are thousands of pairs of genes, submicroscopic in size, determined only by responses that are measurable in the live sheep. The genes are carried on threadlike material present in the cell nucleus, called chromosomes. There are twenty-seven pairs of chromosomes in sheep. Both the chromosomes and genes occur in pairs. As cells divide to provide growth or replacement tissue, each new cell in the animal body contains essentially the same makeup of chromosomes and genes.

However, the formation of sperm cells in the testes and the egg cells in the ovaries involves a reduction process thereby allowing each sperm and egg to contain only one of each of the twenty-seven chromosome pairs. The splitting as to which chromosome from each pair is present in the newly formed reproductive cells is determined only by chance and as yet in uncontrollable by man. The combination of the egg and sperm at conception provides a new living cell that again contains twenty-seven pairs of chromosomes, one of each pair having originated from each parent. Division of this newly formed cell and further division of cells formed through previous division provide for fetal growth and later in the lamb following birth.

At this point you have been introduced to two conditions where chance enters into sheep breeding: first, the reduction of chromosome pairs in the ewe and thus the genetic makeup of the egg; and second, the reduction of chromosome pairs in the ram and thus the genetic makeup of the sperm. There is also a third condition that should be recognized. It is known that many thousand sperms are produced and are present in each ejaculate. However, only one of these many thousands will fertilize the egg. The decision as to which sperm will fertilize the egg may not be determined by man at the present time and therefore may be considered due to chance.

The potential for thousands of various genetic makeups in both the egg and the sperm as well as the chance of which sperm will fertilize the egg provides the basis for a different genetic capability of each new individual except in the case of identical twins, and thus the basis for the genetic variation that is present in our total sheep population.

The identical twin exception is caused by a split of the fertilized egg following conception. Each of the identical twin pairs have the same sperm and the same egg as parents and therefore would have the same genetic makeup. The chance of any other two individuals having exactly the same genetic makeup is extremely remote.

Genetic variation is often condemned by the sheep producer. However, it is this genetic variation that provides the producer the opportunity for applying selection pressure and determining which animals will be allowed to reproduce and thereby providing the potential for improving the performance of future generations.

The genetic merit of a large number of offspring will average that of their parents. However, there will be noticeable variation among the offspring with some being genetically superior and others being gentically inferior.

The challenge therefore, is to recognize among the variation in our sheep flocks that which has a genetic basis. Earlier it was mentioned that there are two major sources of variations. This may best be understood by interpreting the following formula:

$$H + E = \text{trait expression}$$

H - heridity
E - environment

Using this formula it may be said that all the variation present in one particular trait is due to a combination of heridity and environmental forces. Also, if the effects of environment could be held constant for two or more sheep then the difference in the way they express a certain trait would be due to heridity. This would then allow the sheep producer to select animals having the superior genetic makeup and thus would be expected to produce offspring superior to those produced by the other sheep which displayed inferior performance on the same environment.

The problem of common environment for different individuals is extremely difficult. It has been said that the environment on one farm or ranch is never the same as the environment on another farm or ranch. This is probably true therefore the differences between sheep raised on two different operations should never be identified as only genetic differences. In fact, genetic inferiority may often be hidden by superior environment. Therefore, genetic differences may best be identified on a within-flock basis where all sheep receive a common environment. Even here it is necessary to adjust for differences in type of birth (twin or single), date of lambing, sex of lamb, and age of ewe.

Traits That Should Be Considered in Sheep Selection

The decision as to which traits should be considered and their relative value is difficult. First, it should be realized that as the number of traits to be considered increase the amount of potential improvement possible for any one trait decreases. Therefore, it would seem best to include only the most important traits. Importance in this case refers to their effect on net economic returns.

In addition to the economic value it is important to consider the influence of heredity on the traits in question. Heritability is the proportion of the variation between animals that is transmitted from parent to offspring. The higher the heritability for a particular trait, greater the opportunity for improving the trait through selection. Some of the important traits and their heritability estimates are reported in table 2.

Table 2. Heritability of Important Traits in Sheep

Prolificacy	12-15%
Birth weight	30
Weaning weight	25-30
Type of weaning	10
Finish or condition at weaning	12
Rate of gain	30-40
Fleece:	
Face covering	50
Yearling grease fleece weight	40
Staple length, weaning	40

Traits with heritabilities between 0 and 20 are termed lowly heritable; those with heritabilities between 20 - 40 moderately heritable; and those with heritabilities above 40 high heritable.

The four traits included in table 2 having the greatest economic value to commericial sheep producers are prolificacy, weaning weight, rate of gain and grease fleece weight. All of these are in the moderate heritability range except prolificacy. Selection will improve twinning very slowly while improvement in the other traits if properly measured and utilized in a selection program would occur more rapidly.

Ram Selection is Most Important

The effect of the sire and the dam on each offspring is approximately equal. However, one sire may transmit his influence to 50 lambs while the dam only influences one or two each year.

In addition it is necessary to keep from one-third to one-half of the ewe lambs to maintain your flock size. Selection requirements for rams are much less as far as numbers are concerned. Therefore, possible selection pressure on the male side is much greater than that available on the female side. This fact is the basis for the estimate that more than 80 percent of the genetic improvement in sheep will come from the sire side. Importance of sire selection is seldom overstressed.

The use of performance records on a within flock comparison can be helpful in improving the accuracy of sire selection. It behooves all sheep producers to not only choose a good source of rams but also to select a ram whose performance is as far above the flock average as possible. In order for your ram producer to provide you with the records that will aid you with the accuracy for your selection, it is a must that he follows a well designed performance testing program.

Recommended Methods for Obtaining Performance Information

A detailed record of performance program is a most helpful aid in selecting animals with superior genetic potential. Recognizing this fact there is still a question as to its advisability for large commercial sheep producers. Therefore, two possible alternatives are being suggested:

1. Performance Record Program for Purebred Flock.

Basic to any record of performance program is some means of animal identification. Ear tags or tattoos are two of the more common methods. This should be done at birth or shortly thereafter.

The following information should be recorded at this time: birthdate, type of birth (single or twin), sex and identification of dam. At a later time from your breeding records, it will also be possible for you to add sire identification.

Weigh all lambs at weaning time and adjust the lamb weights for difference in age, sex, type of birth and age of ewe. Formulas and nomographs for completing this adjustment may be obtained for you by your county agent from the State Extension Livestock Specialist.

Wool production should be measured also. This can best be done in the ewes at shearing time by weighing the fleeces. In unshorn lambs a measurement of staple length by using a small ruler will prove helpful. All staple length measurements should be made in the same area on each lamb.

Accuracy of these records may be further refined by the calculation of an index which takes in to account the traits you desire to include in a selection program, their economic importance, how heritable they are, and their genetic relationship with each other. For the purpose of brevity a discussion of indexes is not included however if sufficient interest develops, additional work may be continued for the purpose of developing sheep selection indexes.

2. Performance Program for Large Commercial Flocks.

The thought of keeping an individual record on each sheep in a large commercial flock seems insurmountable to many sheepmen. Their selection at the present time is based on eye evaluation. Therefore this program is designed to compare only animals that have experienced the same or similar environment thereby assuming the variation that is detected by eye to represent genetic differences. In this case it is recommended that you identify the "very early" and the "very late" lambs. Twin lambs may best be compared if kept separate.

At shearing time it would be well to employ one man that would mark all ewes having exceptionally light or poor quality fleeces.

At weaning time select some of the largest ewe lambs from each of the three groups, early, late and twins. This can best be done by keeping the twins separate and having some identifying mark that designates which lambs are early and which are late. Ewes mothering the lightest lambs should be cut out and culling should take place from this group.

Progress from this system will not be as rapid as from the first system explained. However, it should provide a basis for some genetic improvement. Therefore, a record of performance program and its use as a basis of selection is recommended to all sheepmen producing either rams for sale or for their own use. All sheep producers are encouraged to ask the breeder for performance information when they are selecting rams.

Selection is the determination of animals that will be allowed to reproduce. It is the basis for all permanent genetic improvement and is the method by which gene frequency for the desired gene(s) may be increased. The progress received from selection is due to additive gene effects.

The Potential of Crossbreeding for Commercial Sheep Production

Heterosis (hybrid vigor) is the result of non-additive gene effects and has been detected in some sheep breeding projects and by numerous commercial sheep operations. Heterosis is determined by comparing the average of a particular cross with the average of the parental breeds or groups used in the cross. Utilization of heterosis necessitates a form of outbreeding, the mating of animals less related than average. This may be accomplished by crossing two families within a breed or more often accomplished by crossing two breeds.

A sheep crossbreeding project was initiated at Beltsville, Maryland about forty years ago. Two-way crosses of the three parent breeds, Hampshire, Shropshire, and Southdown were initiated in 1947. Three-way crosses have since been studied using a two-way cross ewe and a ram from a third breed either of mutton or wool types.

In all production comparisons the two-way and three-way crosses out performed the averages of the purebred parents. This was especially true for lamb livability. A trait for which you will recall has a low heritability. Lamb production for the three-way cross (crossbred ewe) was also higher than that of the two-way cross.

Additional research is needed to further evaluate sheep mating systems however on the basis of experimental evidence available with other species (swine and poultry) it may be expected that the effect of heterosis is inversely proportional to the heritability of the trait. In other words the greatest heterosis will be observed by traits showing low heritabilities. Therefore, it would seem that the heterosis effects from a well designed crossbreeding program could compliment potential progress achieved by selection.

If optimum heterosis is to be achieved certain problems must be recognized and solved. These include an overlap of generations among females in the flock. The percentage of different breeds among the females will vary since only about one-fourth of the flock is replaced each year. Therefore, more than one breed and source of rams are necessary, separate breeding pastures will be needed and the ewes may need to be identified for knowing ancestry of each.

A sheep producer must balance these problems with the added potential in deciding whether or not crossbreeding will work for him. A decision to crossbreed does not belittle the importance of sire selection. The use of inferior sires could more than counterbalance the positive effects of heterosis.

Choice of breeds as well as individuals to incorporate in a crossbreeding program is important. It would be well to select breeds strong in certain important characteristics that would tend to compliment the other breeds (ex: breed a wool production, breed b growth rate and muscling, breed c prolificacy.)

Sheep improvement is important and rather difficult. It requires purebred breeders using well designed techniques for selecting breeding stock having superior genetic potential for the desired traits. In addition, the rate of improvement in commercial flocks will depend on whether or not the rams selected are above average in performance. Additional production may be achieved by developing a well designed crossbreeding program.

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Animal Science Department
Agricultural Experiment Station

A. S. Mimeo Series 65-23

Synchronization of Estrus and Fertility in Sheep

Leon F. Bush[1]

Sheep must be produced economically to meet the competition from other farm enterprises. One way in which this can be done is to increase the productivity of the ewe. The length of gestation is approximately five months; lambs are weaned when from three to five months of age, thus for three or four months of the year, the ewe is neither producing or nursing a lamb. Research has shown that the reproductive cycle of the ewe can be altered so that a flock of ewes could possibly produce a lamb crop every eight months. Modification of the seasonal pattern of reproduction would permit a much greater return on the investment with little increase in feed costs, labor and equipment. It would also provide a more uniform supply of lamb throughout the year and permit sales to be made in seasons when lambs are scarce and prices are usually higher. Availability of lamb throughout the year could result in increased demand for lamb.

There are available several methods of overcoming seasonal production of sheep - selection of individuals or breeds which exhibit estrous periods throughout the year, artificially modifying environmental factors such as light and temperature or use of hormones to induce estrus and fertility during the non-breeding season. The use of hormones, when perfected, has the advantage of immediate application and at the same time synchronize breeding and lambing dates. Hormones can also be used to synchronize estrus in the normally cycling ewe.

With the development of orally active hormones, the approach to induce estrus and synchronization has become more practical. Research has been conducted with the anestrous ewe, the lactating ewe and the cycling ewe.

Ewes in Anestrous

Numerous workers have attempted to induce estrus and fertility in the anestrous ewe. The use of a gonadotrophin such as pregnant mare serum (PMS) will induce ovulation although not usually accompanied by estrus. Only when the PMS injection is preceded by the administration of progesterone does ovulation and estrus occur. Fertility at the induced heat period have been quite low, about 33%, especially during the middle of the anestrous period.

To induce estrus during the anestrous period, orally active progestin is fed to the ewes for 10 to 16 days followed in 24 to 36 hours with a single injection of from 500 to 1000 international units of PMS. From 70% to 90% of the treated ewes will exhibit estrus within two to three days, approximately three days after the progestin feeding period. Repeating the above treatment or a double progesterone - PMS treatment will increase conception rate.

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[1] Associate Professor in Animal Science

Fertility may be greater than 50% when natural service is used, however, the results from artificial insemination has been disappointing. Treatment of ewes during the anestrous period seldom initiates estrus cycling. The ewes which shows estrus during the induced estrus period, if conception fails to occur, usually will not return to estrus until the normal breeding season.

Lactating Ewe

If two lambings per year are accomplished, breeding the ewe while lactating would be helpful if not necessary. Synchronization of estrus in the lactating ewe during the anestrous period has been achieved, however, fertility has been poor. From 60% to 90% of the lactating ewes may be synchronized and exhibit estrus within four days after progestin feeding, however, in many trials, none of the ewes conceive and in others, the conception rate is only 28%. Two series of progestin - PMS treatments gave improved results but still not satisfactory. Ewes which lamb in the fall during the normal breeding season may be bred while lactating. Most of these ewes may be expected to conceive within 30-45 days after lambing.

Ewes in Breeding Season

During the normal breeding season, synchronization of estrus with normal fertility is very promising. The daily feeding of progestins for a period of 16 days will result in 85% to 100% of the ewes synchronized and exhibiting estrus within a two or three day period. An injection of PMS is not necessary to produce estrus and fertility in the cycling ewe. PMS injection could be used to increase ovulation thus an increased lamb crop. Conception rate is about normal - 60% to 70%. Ewes not showing estrus or conceiving will return to a synchronized estrus in 16 to 18 days. Some work reports better than 85% conception for the two estrus periods. Lambing will be bunched to a certain extent. Length of gestation may vary a week or more. Although ewes are bred in a 2 or 3 day period, lambing may vary a week or 10 days with most of them lambing in a four or five day period.

Low conception rate when artificial insemination (A.I.) is used during synchronized estrus is a problem of much concern. Cornell workers reported only 16% of the ewes artificially inseminated lambed compared to 61% of the ewes served naturally. One of the benefits of synchronization is the use of A.I. to increase production through the tested or proven rams. If A.I. could be used satisfactorily, synchronized ewes may be inseminated at a selected time after treatment. Perhaps two inseminations at 24-hour intervals without regard to detection of estrus would simplify management.

New materials and methods are being investigated. The orally active progestins mostly used are CAP and MAP. Both are synthetic progesterones. A new material called Cronolone (syncro-mate), also a synthetic progesterone, has been developed by the makers of the "pill". A plastic sponge is impregnated with the material. The sponge is inserted into the vagina for the required time, then removed with a string which is attached to the sponge. The progesterone is absorbed slowly. According to Australian researchers, syncro-mate is more precise in regulating the dose and costs less than the orally-active progestin. Most of the research with this material has been conducted in Australia.

The synthetic progesterones used to induce estrus and fertility in sheep are available only for experimental purposes. Considerable time and research is needed in order to meet regulations and put a product on the market for public use.

MANAGING COSTS AND RETURNS FOR PROFITABLE SHEEP PRODUCTION

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Economics Department, SDSU, December 1965

Management ability in sheep production must be present with special efforts made to constantly improve management in all its aspects if the sheep enterprise is to succeed. Sheep require a high level of management skill in feeding, breeding, and disease control. Compared with other livestock enterprises average ability is required in buying and selling. Variability of income is relatively low when compared with other livestock enterprises. The table below compares management abilities required for sheep and other selected livestock enterprises.

MANAGERIAL ABILITY NEEDED IN SELECTED MANAGEMENT AREAS

Enterprise	Buying & Selling	Feeding & Breeding	Disease Control	Variation in Income
Sheep flock	average	high	high	low
Beef herd	average	average	average	average
Dairy cows	average	high	high	low
Lamb feeding	high	high	average	high
Beef feeding	high	average	average	high
Hogs	average	average	high	high
Egg production	average	high	high	average

Management must be balanced in all areas of sheep production to make use of the resources that you have available on your ranch or farm to produce profitable returns to your labor and management. Our discussion on costs and returns will be based on two budgets. Table 1 is a budget for a 200 ewe farm flock and Table 2 is a budget for 200 ewes in a range flock for comparison of the two systems.

The level of management assumed in both budgets is average to high average. For real profits from sheep production higher levels of management must be reached.

These budgets are based on specified production levels as a guide for you in looking at your own operation--120% lamb crop saved to market age for the farm flock and 110% lamb crop saved for the range flock.

Seasonal price patterns are a factor in planning your sheep operation for profit. The seasonal pattern shows that lowest monthly prices are received on the average in December. Prices normally rise from December until a peak monthly average price is reached in June - fully $2.25 higher than December's average price. August-September prices average about $1.00 lower than the high monthly average price in June and about $1.25 higher than December's average.

If you are producing lambs that reach market in the lower price period, are your costs of production lower than they would be if you produced lambs for the higher priced market? Are these costs low enough to leave you as high a return for your labor and management? Forward planning, through the use of budgets, will estimate for you the best plan for your ranch or farm.

In Part I of Table 1 and Table 2 gross incomes are estimated. June lamb sales for the farm flock and early September lamb sales for the range flock were assumed.

Part II in both budgets is an estimate of feed value and cash operating costs. Values used for grain and forage are estimated average market prices. It is assumed that these prices pay cash costs of production depreciation, return on capital, interest on land investment, land taxes, and returns to labor and management for crop and forage production. By charging the costs this way we can see what part of the net ranch or farm income is produced by the sheep. For an estimate of all income you would need to work out a whole ranch or farm plan that will show you how much income comes from each enterprise. Extension Circular 632, "Ten Steps in Planning Your Farm or Ranch Business", available from your county agent is designed for forward planning of your whole farm or ranch business.

Part III shows the returns that remain after charging off market value of feed and paying cash costs. This is the income that can be used to pay interest on investment, fixed costs, labor and a return to management.

Part IV estimates average annual operating capital requirements. It includes an average value for the ewe flock and an average value for the rams. Part of the value of grain and forage is tied up for a year, so the sheep flock is charged with this capital. Since part of the other cash costs are made at the first of the year and part at the end, the sheep flock is charged with half of this amount for the whole year.

Part V is a labor charge and operating capital charge to be deducted from returns. Part VI is the income that remains to pay for buildings, equipment, and management.

Two estimates are made for buildings and equipment investment in Part VII. The higher estimate leaves no return to management.

In Part VIII gross income is allocated to all of the costs of production. How much income you receive yourself depends on which of the factors you provide yourself and which ones others provide. Work this out for your own farm or ranch.

Part IX is an estimate of the change in income and costs if your lamb crop differs from the base budgets. Note that a 10% increase in lamb crop for the farm budget increases net returns by $310 after subtracting $70 added feed costs. This means that you are actually earning $310 more per year for management from a 200 ewe flock as a result of the 10% higher lamb crop. The same analysis for the range flock budget shows that management returns for each 200 ewes increases by $292 when the lamb crop saved is 10% higher.

Table 1.

200 EWE FARM FLOCK, 120% LAMB CROP SAVED,
20% FOR REPLACEMENT (18% CULLED AND 2% DEATH LOSS)
95 POUND SLAUGHTER LAMBS SOLD, JUNE

I.	Receipts		
	Slaughter lambs	200 x 95 lbs. x 100% x $.21	$3,990.00
	Wool incentive	200 x .95 cwt x 90% x $.55	94.05
	Cull ewes	200 x 140 lbs. x 18% x $.05	252.00
	Wool	200 x 10 lbs. x .62	1,240.00
		Gross Sales	$5,576.05
II.	Operating Costs		
	Corn	200 x 2.3 bus. x $ 1.05	$ 483.00
	Oats	200 x 2.9 bus. x $ .55	319.00
	Alfalfa hay	200 x 0.3 ton x $17.00	1,020.00
	Grass hay	200 x 0.2 ton x $14.00	560.00
	Pasture	200 x 1.0 AUM x $ 3.00	600.00
	Aftermath	200 x 0.4 AUM x $ 3.00	240.00
	Supplement	200 x 0.2 cwt x $ 4.50	180.00
	Mineral and salt	200 x 0.2 cwt x $ 3.00	120.00
	Ram depreciation and death loss	(.50 per ewe)	100.00
	Veterinary and drugs		120.00
	Shearing		100.00
	Taxes and Insurance (breeding flock)	(1½% of $3,450)	51.75
	Marketing and farm overhead		225.00
		Total Direct Costs	$4,118.75
III.	Income Over Operating Costs		$1,457.30

IV.	Operating Capital Requirements		
	Ewes and replacements		$3,000.00
	Rams		450.00
	Grain and forage	(.3 x $3,222)	967.00
	Other cash costs	(.5 x $896)	448.00
		Total	$4,865.00

V.	Labor Charge and Interest on Average Operating Capital		
	Labor charge	(200 x 3 hours x $0.80)	$ 480.00
	Operating capital charge	(6% of $4,865)	291.90
		Total	$ 771.90
VI.	Return to Buildings, Equipment, and Management (III minus V) ($1,457.30 - $771.90)		$ 685.40

VII. Estimated Profitable Investment in Buildings and Equipment

Assume that the following rates of charge on new cost are needed to cover investment costs: Depreciation - 6%, Interest - 3%, Repairs - 1.7%, Taxes - 1%, and Insurance - 0.3%. These are commonly referred to as the DIRTI five costs of ownership. In this case they total 12% of the new cost of the investment. Anyone making an investment also wants some return for his management or for assuming the risk of ownership. If the return desired for risk of ownership is between 3 and 6%, then we can estimate the investment that can profitably be made by capitalizing returns to buildings, equipment, and management of $685.40 shown in item VI above.

17% Capitalization rate (5% for risk)	Total	Per Ewe
Estimated Investment ($685.40 ÷ .17)	$4,032	$20.16

12% Capitalization rate (0% for risk)	Total	Per Ewe
Estimated Investment ($685.40 ÷ .12)	$5,712	$28.56

VIII. Allocation of Gross Income

Grouping of costs or charges	Level of Building and Equipment Investment $4,032	$5,712
Grain	$ 802	$ 802
Hay	1,580	1,580
Grazing	840	840
Other feed	300	300
Other cash costs	597	597
Interest on operating capital	292	292
Labor charge	480	480
Buildings and equipment	483	685
Management	202	0
GROSS INCOME	$5,576	$5,576

IX. Estimated Change in Returns to Buildings, Equipment, and Management for Other Levels of Management of a 200 Ewe Flock, Using a 120 Percent Lamb Crop Saved to Market Age as a Base.

Percent Lamb Crop	100	110	130	140
Change in Gross	-$760	-$380	+$380	+$760
Reduced or Added Costs	$140	$ 70	$ 70	$140
Change in Net Returns	-$620	-$310	+$310	+$620

Table 2

200 EWE RANGE FLOCK, 110% LAMB CROP SAVED,
20% FOR REPLACEMENT (18% CULL, AND 2% DEATH LOSS)
HALF FEEDERS-HALF FATS SOLD, SEPTEMBER

I. Receipts

Fat lambs	200 x 90 lbs. x .45 x $.20	$1,620.00
Feeders	200 x 70 lbs. x .45 x $.19	1,197.00
Wool incentive	200 x .8 cwt x .9 x $.55	79.20
Cull ewes	200 x 130 lbs. x .18 x $.04	187.20
Wool	200 x 10 lbs. x .62	1,240.00
	Gross Sales	$4,323.40

II. Operating Expenses

Corn	200 x .75 bu. x $ 1.10	$ 165.00
Alfalfa hay	200 x .19 ton x $18.00	684.00
Prairie hay	200 x .08 ton x $15.00	240.00
Range	200 x 2.2 AUM x $ 3.00	1,320.00
Supplement	200 x .3 cwt x $ 4.50	270.00
Mineral and salt	200 x .2 cwt x $ 3.00	120.00
Ram depreciation and death loss	(.50 per ewe)	100.00
Veterinary and drugs		120.00
Shearing		100.00
Taxes and Insurance (breeding flock)	(1½% of $3,450)	51.75
Marketing and ranch overhead		200.00
	Total Direct Costs	$3,370.75

III. Income Over Operating Costs $ 952.65

IV. Operating Capital Requirements

Ewes and replacements		$3,000.00
Rams		450.00
Grain and forage	(.3 x $2,409)	723.00
Other cash costs	(.5 x $962)	481.00
	Total	$4,654.00

V. Labor Charge and Interest on Average Operating Capital

Labor charge	(200 x 2.5 x $0.80)	$ 400.00
Operating capital charge	(6% of $4,654)	279.24
	Total	$ 679.24

VI. Return to Buildings, Equipment, and Management $ 273.41
(III minus V) ($952.65 - $679.24)

VII. Estimated Profitable Investment in Buildings and Equipment

Assume that the following rates of charge on a new cost are needed to cover investment costs: Depreciation - 6%, Interest - 3%, Repairs - 1.7%, Taxes - 1%, and Insurance - 0.3%. These are commonly referred to as the DIRTI five costs of ownership. In this case they total 12% of the new cost of the investment. Anyone making an investment also wants some return for his management or for assuming the risk of ownership. If the return desired for risk of ownership is between 3 and 6%, then we can estimate the investment that can be profitably made by capitalizing returns to buildings, equipment, and management of $273.41 shown in item VI above.

17% Capitalization Rate (5% for risk)	Total	Per Ewe
Estimated Investment ($273.41 ÷ .16)	$1,608	$ 8.04

12% Capitalization Rate (0% for risk)	Total	Per Ewe
Estimated Investment ($273.41 ÷ .12)	$2,278	$11.39

VIII. Allocation of Gross Income

Grouping of costs or charges	Level of Building and Equipment Investment $1,608	$2,278
Grain	$ 165	$ 165
Hay	924	924
Grazing	1,320	1,320
Other feed	390	390
Other cash costs	572	572
Interest on operating capital	279	279
Labor charge	400	400
Buildings and equipment	193	273
Management return	80	0
GROSS INCOME	$4,323	$4,323

IX. Estimated Change in Returns to Buildings, Equipment, and Management for Other Levels of Management of a 200 Ewe Flock, Using a 110 Percent Lamb Crop Saved to Market Age as a Base.

Percent Lamb Crop	90	100	120	130
Change in Gross	-$624	-$312	+$312	+$624
Reduced or Added Costs	$ 40	$ 20	$ 20	$ 40
Change in Net Returns	-$584	-$292	+$292	+$584

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A.S. Series 65-25

Effects of Urea and Nitrate on Feedlot Performance and Blood Methemoglobin of Lambs

D. W. Hoar, L. B. Embry and R. J. Emerick[1]

Nitrates can accumulate in plants under certain conditions and may reach levels high enough to cause feeding problems from nitrate toxicity. Recently there has been an increased interest in the use of relatively high levels of urea in rations for ruminants. This in turn has given rise to the question of the effects urea might have when added at high levels to rations which also contain relatively high levels of nitrate.

The purpose of this experiment was to compare soybean meal and urea as protein supplements to a low-protein ration of rolled shelled corn and corn silage fed to lambs and to determine the effects of nitrate added as sodium nitrate with each source of protein.

Trial 1

Procedure

Eighty ewe and wether lambs, previously drenched with thiabendazole and vaccinated against overeating disease, were allotted on the basis of sex, weight and source into 8 lots of 10 lambs each for four replicated treatments. They were implanted with 3 mg. diethylstilbestrol at the beginning of the treatments.

The rations fed were composed of 3 parts of corn silage on a wet basis to 1 part of rolled shelled corn and supplements. This combination resulted in rations in which the ratio of concentrates to air-dry roughage was about 1:1.

The protein supplements and sodium nitrate were administered in the concentrate portion of the rations. Feed grade urea (262% protein equivalent) was added at a level of 2% to the concentrate mixtures resulting in about 1% of urea in the total air-dry ration. This gave a ration with about 10.8% protein on a 12% moisture basis. Soybean meal was used to furnish an equivalent amount of protein in control rations. Concentrates to which nitrate was added contained 5% of sodium nitrate thus resulting in a level of about 2.5% of sodium nitrate in the total air-dry ration. Sodium nitrate was replaced by common salt in the control rations. Combinations of these treatments resulted in rations supplemented with soybean meal and with urea, each fed with and without sodium nitrate, giving a total of four treatments. All concentrate mixtures contained 20 mg. of chlortetracycline and 2,000 I.U. of vitamin A per pound.

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Prepared for Area Sheep Field Days, December 6-20, 1965.

The rations were fed once daily. The lambs were started on feed at 2 lb. per head daily of the appropriate ration. This was increased 0.4 lb. per head daily while maintaining the ratio of 3 parts of corn silage to 1 part of concentrates in the ration. This rate of increase in feed was maintained until the lambs were on full feed after about 2 weeks. Thereafter, they were fed in amounts that would be about completely consumed by the next feeding.

Blood samples were obtained from all lambs 21 days after the beginning of the experiment and analyzed for total hemoglobin and methemoglobin. One lot of lambs from each treatment group was bled for these analyses at the termination of the experiment.

Some losses occurred and the weight gain data were calculated only for lambs completing the trial. Feed consumption was adjusted by subtracting an average feed intake during the time these lambs were on trial.

Table 1. Effects of Urea and Nitrate on Lambs
(Trial 1 - 82 days)

Item	Soybean Meal		Urea	
	Control	Nitrate	Control	Nitrate
Number of lambs	19	18	20	19
Initial weight, lb.	75.9	74.4	75.0	76.6
Final weight, lb.	103.0	99.4	96.8	96.5
Average daily gain, lb.	0.328	0.306	0.264	0.255
Average daily feed consumed, as fed, lb.				
Corn silage	4.11	4.33	3.82	3.97
Concentrate mix	1.43	1.52	1.32	1.39
Total	5.54	5.85	5.14	5.36
Feed per pound of gain, as fed, lb.				
Corn silage	12.5	14.0	14.4	15.6
Concentrate mix	4.4	4.9	5.0	5.5
Total	16.9	18.9	19.4	21.1
Average hemoglobin, g/100 ml. blood				
21 days	14.1	13.5	14.0	13.7
81 days	13.3	13.9	13.6	13.8
Average methemoglobin, g/100 ml. blood				
21 days	0.11	0.16	0.15	0.21
81 days	0.50	0.40	0.43	0.48

Results

The results of trial 1 are presented in table 1. The lambs fed corn-corn silage rations with 1% urea, air-dry basis, gained at a lower rate than those fed rations with an equivalent amount of protein from soybean meal. When sodium nitrate was included in the rations (2.5% air-dry basis), the rate of gain appeared to be reduced slightly for lambs fed soybean meal but not for those fed urea. However, gains of lambs fed rations with soybean meal and sodium nitrate exceeded the gains of those fed urea at the level used in the experiment.

During the first 2 weeks of the experiment when the lambs were being brought to full feed, the lambs fed rations with sodium nitrate gained faster than those fed rations without the nitrate with either the soybean meal or urea. After this 2-week period, the gains were higher than the overall averages shown in table 1, and differences between rations with and without sodium nitrate were slightly greater. During the first 2 weeks when getting the lambs on full feed, the average daily feed consumption was low. Total protein intake was less than the recommended requirements. The rations with added nitrate supplied an average of about 21 grams more calculated crude protein per lamb daily during this time. This may have been a factor in the higher rates of gain during the initial phase of the trial for lambs fed rations with added sodium nitrate.

Feed consumption was slightly greater with rations which contained soybean meal. Since rate of gain was also greater, these lambs had lower feed requirements than those fed urea. The level of urea fed appeared to reduce feed consumption and rate of gain resulting in higher feed requirements.

The lambs fed rations with sodium nitrate consumed as much or slightly more feed than those which did not receive the added nitrate. Feed requirements were also higher with the added nitrate.

Methemoglobin values were low and with no important differences between treatments at 21 and 81 days on the trial. Apparently the level of sodium nitrate did not result in any change in methemoglobin values at these times or result in any visible signs of nitrate toxicity.

Trial 2

Procedure

Ninety-six ewe lambs, previously drenched with thiabendazole and vaccinated against overeating disease, were allotted on basis of weight into 8 lots of 12 lambs each. Four replicated treatments the same as for trial 1 were used for this trial.

The same general procedures were followed as for trial 1 with a few exceptions. The lambs did not receive diethylstilbestrol. The urea source was 281% protein equivalent instead of 262% as in trial 1. It was included at 1.86% of the concentrate mixture to furnish an equivalent amount of protein from urea as in the previous trial. The average protein content of the ration was 10.6% on a 12% moisture basis. Soybean meal was used to furnish an equivalent amount of protein in rations without urea.

In this trial, the lambs were fed the rations without added sodium nitrate for a period of 2 weeks while bringing to approximately a full feed. This procedure was followed to overcome differences in crude protein content of rations when getting the lambs on full feed because of nitrate addition to the rations. At the end of this 2-week period, the number of lambs per lot were adjusted to 11, and sodium nitrate was added at a level of 5% to the concentrate portion of the rations (2.5% of the air-dry ration). The feeding level at this time was 4 lb. per head daily, being 3 parts of corn silage (wet basis) and 1 part concentrates.

Blood samples were obtained for hemoglobin and methemoglobin determinations at days 1, 2, 3, 4, 7, 23 and 53 of the trial. The lambs not fed sodium nitrate were also bled on all occasions except on the second day. However, the analyses were performed on the blood from these lambs only on days 1, 7, 23 and 53.

Results

This trial is still in progress, but the results after 71 days are shown in table 2. The weight gain data to date are similar to trial 1 in that lambs fed urea gained at a lower rate than those fed soybean meal. Sodium nitrate again reduced rate of gain with soybean meal but had only a slight effect in rations with urea.

The levels of urea and sodium nitrate fed appeared to reduce feed consumption. The combination of urea and sodium nitrate did not reduce feed consumption over either one alone. This reduction in feed consumption with lower rates of gain resulted in higher feed requirements.

Only on the second day after sodium nitrate was added at 2.5% of the air-dry ration (22.7 gm per head daily initially) was any appreciable amount of methemoglobin found in the blood. Those fed urea had a smaller total increase. Methemoglobin values had declined to low levels by the third day following nitrate supplementation and remained at low levels at all other bleedings. No visible signs of nitrate toxicity were observed from the level of sodium nitrate fed.

Summary

Lambs fed rations composed of corn silage and corn grain (3:1 ratio on wet basis) gained at a lower rate when supplemented with urea to give 10.6 - 10.8% protein, air-dry basis, than when the rations contained an equivalent amount of protein from soybean meal. This level of urea caused a reduction in feed consumption and higher feed requirements.

Feeding sodium nitrate at 2.5% of the air-dry ration reduced rate of gain with soybean meal as the protein supplement, but it had only a slight effect in rations with urea. However, gains of lambs fed rations with soybean meal and sodium nitrate were greater than those of lambs fed urea, with or without sodium nitrate.

The level of sodium nitrate fed resulted only in a temporary rise in methemoglobin values. The values had declined to relatively low levels by the third day following administration. The rise was less pronounced in the presence of urea. No visible signs of nitrate toxicity were evident in either trial.

It would appear from the results of these two trials that relatively high levels of urea do not result in lambs being more susceptible to nitrate toxicity.

Table 2. Effects of Urea and Nitrate on Lambs
(Trial 2 - Preliminary results after 71 days)

Item	Soybean Meal		Urea	
	Control	Nitrate	Control	Nitrate
Number of lambs	20	21	21	21
Initial weight, lb.	65.9	62.9	65.2	65.2
Final weight, lb.	93.8	87.0	87.7	86.8
Average daily gain, lb.	0.393	0.341	0.318	0.304
Average daily feed consumed, as fed, lb.				
Corn silage	4.33	3.82	3.84	3.88
Concentrate mix	1.49	1.32	1.34	1.32
Total	5.82	5.14	5.18	5.20
Feed per pound of gain, as fed, lb.				
Corn silage	11.0	11.2	12.2	12.9
Concentrate mix	3.8	3.9	4.2	4.4
Total	14.8	15.1	16.4	17.3
Average hemoglobin, g/100 ml. blood				
1 day	11.4	11.6	11.7	10.5
2 days		11.2		10.5
3 days		11.3		10.1
4 days		11.3		10.0
7 days	11.0	11.1	11.1	10.4
Average methemoglobin, g/100 ml. blood				
1 day	0.02	0.25	0.16	0.50
2 days		3.03		1.33
3 days		0.52		0.73
4 days		0.34		0.21
7 days	0.10	0.27	0.12	0.15

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A.S. Series 65-28

Low-Moisture Alfalfa-Bromegrass Silage, Ground Hay and Pelleted Rations Fed at Two Grain Levels to Lambs

L. B. Embry, J. V. Woster and L. J. Nygaard[1]

Different methods of roughage preparation have undergone much research during past years. Many questions are still raised regarding the relative merits of feeding roughages in various forms. Not only the performance of the animals must be considered, but the economic aspects must be taken into account. The type of roughage, quality of roughage, ratio of concentrates to roughages, level of feeding, the livestock to which fed and market prices of the products obtained are factors which may affect the comparative value of roughages fed in various forms.

In a previous trial with lambs, weight gains, feed consumption and feed efficiency were improved by feeding rations composed of corn grain and alfalfa-bromegrass hay as pellets in comparison to feeding as rolled shelled corn and ground hay. The improvement in gain amounted to 59 and 30% and in feed efficiency to 21 and 11%, respectively, with 60 and 30% hay in the rations. The differences in feeding value between hay and low-moisture silage (haylage) stored in a concrete stave silo and an air-tight silo were much smaller, and the results varied at various times during the experiment.

The forage fed in the previous trial was not of very high quality (about 15% protein, air-dry basis) and it was stored in the silos at an average moisture content of about 30%. The quality of forage may have been an important factor in the rather large improvement in lamb performance from pelleting and the higher level of grain. Also, the rather dry form in which the haylage was stored may have resulted in a forage only slightly different from the hay.

The experiment was repeated using a forage which appeared to be of higher quality and at a higher moisture content when stored as haylage. The lower level of forage fed was 20% of the air-dry ration instead of 30% as in the first trial.

Procedure

One hundred sixty Texas ewe lambs averaging about 70 lb. were used in the experiment. Prior to the beginning of the experiment in July, the lambs were sheared, drenched with thiabendazole and vaccinated for control of overeating disease.

The lambs were allotted into 16 lots of 10 lambs each for 8 replicated treatments. The treatments consisted of alfalfa-bromegrass forage at 60 and 20% of the rations (air-dry basis) fed as ground hay, pellets, haylage stored in a concrete stave silo and haylage stored in an air-tight silo. One-half of the lambs in each lot were implanted with 3 mg. of diethylstilbestrol and the other one-half with Synovex-L.

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The silos were filled between June 15 and 18 with first-cutting alfalfa-bromegrass which contained about 55% bromegrass. The alfalfa was in an early bloom stage, and the protein content was about 18% on a dry basis. The forage was distributed between the two silos during the filling operation to obtain uniformity between them. The average moisture content was 37.5 and 38.8%, respectively, for the concrete stave and air-tight silos. A representative portion of the forage was dried further and baled for that to be pelleted and fed as ground hay.

Each kind of forage was fed at 60 and 20% of the air-dry rations along with rolled shelled corn and supplements. The amount of haylage fed was adjusted to give the desired ratio in the rations on an air-dry basis. When fed as pellets, the entire ration was pelleted. Rations with 60% roughage were fed without a protein supplement. Soybean meal was added to the concentrate portion of the 20% roughage rations in amounts to equal 5% of the air-dry ration. Vitamin A was added to the low-roughage rations at 500 I.U. per pound, air-dry basis. Aureomycin was included in all rations at 10 mg. per pound.

The rations were full-fed once daily. A small amount of hay was fed with the pelleted rations during the first 2 weeks while getting the lambs on full feed.

The lambs fed pelleted rations were marketed after 70 days on trial and the others after 84 days.

Results

The results of this experiment are presented in table 1. Lambs implanted with diethylstilbestrol and with Synovex-L gained at essentially the same rate. The results are, therefore, presented as an average for these two treatments.

The average daily gain was improved from feeding the higher concentrate rations except with pelleted rations. Feed consumption was reduced and there was an improvement in feed efficiency. Except in the case of rations with ground hay, carcass grade and dressing percent were higher for rations with the higher level of concentrates.

Pelleted rations resulted in an increase in rate of gain over rations with ground hay at both levels of roughage, but greater at the higher level. The advantage for pelleted rations amounted to 44.7% at the 60% level of roughage and 15.8% at the 20% level.

The lambs fed pelleted rations consumed more feed but they had lower feed requirements than those fed rations with ground hay. Those fed pelleted rations required 15.9% less feed with the 60% roughage rations, but only 2.7% less when the rations contained 20% roughage.

Rate of gain and feed consumption determine the amount of gain and the animal days of feeding for a given quantity of ration. Difference in gain from an equal quantity of two rations multiplied by the estimated selling price of the gain is a means of estimating the difference in the value of two rations. Since animal days of feeding influence nonfeed costs between equal quantities of two rations, they must also be taken into account. Weight gain and lamb days per ton of ration have been calculated and presented in table 1. These may be used in estimating the amount of added cost one might afford for different types of forage preparation and storage and various amounts of concentrates.

Lambs fed the pelleted ration with 60% hay gained 43 lb. more per ton of ration than those fed the ration with 60% ground hay. Also, 112 less lamb days were involved in making this greater gain. One estimate of the cost which could be afforded for pelleting this ration would be the estimated selling price of the extra gain plus the reduction in nonfeed cost resulting from fewer animal days of feeding. Any difference in market price due to differences in carcass quality and time of marketing would be additional considerations. In this experiment, the lambs fed pelleted rations had slightly higher carcass grades.

The lambs fed the pelleted ration with 20% hay had a gain of only 9 lb. more per ton of ration and 57 less lamb days than those fed ground hay. The value of pelleting this low-roughage ration would be much less than for the one with 60% hay.

The lambs fed haylage stored in the concrete stave silo gained at about the same rate as those fed hay at both levels of roughage. There was a slight improvement in feed efficiency for haylage at the higher roughage level. Weight gains and lamb days per ton of ration, carcass grade, and dressing percent would indicate little difference between hay and haylage from the concrete stave silo in this experiment, except for the slight improvement in feed efficiency for haylage at the higher level of roughage.

The lambs fed haylage from the air-tight silo gained at a faster rate than those fed hay or haylage from the concrete stave silo with both levels of roughage. They consumed more feed but had lower feed requirements. With the 60% roughage ration, the gain per ton of ration was 25 lb. more for haylage from the air-tight silo than for hay, and there were 36 less lamb days involved. With the 20% roughage ration, the difference in rate of gain between this haylage and hay was only 8 lb. per ton of ration but with 47 less lamb days of feeding. The rations were composed of the same percentages of concentrates and air-dry roughage. If these differences were attributed to the roughage portion of the ration, they would represent 60% and 20% of the difference between a ton of the air-dry haylage and hay. On this basis, the value of haylage over hay would be fully as much at the 20% level as at the 60% level. Since performance was about the same between hay and haylage stored in the concrete stave silo, haylage from the air-tight silo would have about the same comparative value on an air-dry basis with the haylage from the concrete stave silo as with the hay, except with the difference in feed efficiency being some less at the higher level of roughage.

Lambs fed the haylage from the air-tight silo gained at a lower rate than those fed the pelleted ration at 60% roughage. They consumed less feed but had higher feed requirements. The gain per ton of ration was 18 lb. less for the haylage with 76 more lamb days. These values compare with 43 lb. of gain and 112 lamb days in favor of pellets over hay at 60% roughage. The return from pelleting in comparison to this haylage would be less than half that of pellets in comparison to hay. There were only small differences in rate of gain, feed consumption, feed efficiency and carcass quality between rations composed of haylage from sealed storage and pellets with 20% roughage.

Summary

Lambs were fed finishing rations composed of alfalfa-bromegrass forage at 60 and 20% of the air-dry ration as ground hay, pellets, haylage (37.5% moisture) stored in a concrete stave silo and haylage (38.8% moisture) stored in an air-tight silo. Data are presented for estimating cost which might be afforded for the various types of roughage preparation and storage at two levels of grain feeding.

Pelleted rations offered a much greater advantage at the higher level of roughage. The advantage over hay was about twice as great as over haylage from the air-tight silo. Haylage from the concrete stave silo was intermediate between the hay and haylage from sealed storage.

At the low level of roughage, performance was about the same between hay and haylage from the concrete stave silo. The improvement from pelleting was much less than at the high level of roughage. Results were about the same for the pelleted ration and haylage from the air-tight silo.

Table 1. Feedlot Performance of Lambs Fed Hay, Pellets and Haylage at Two Levels
(Av. of two lots - July 14-Oct. 6, 1964)

Item	Ground hay		Pelleted ration		Haylage C.S. silo[1]		Haylage air-tight silo[2]	
	60%	20%	60%	20%	60%	20%	60%	20%
Number of lambs	19	19	20	18	19	19	20	20
Days fed	84	84	70	70	84	84	84	84
Initial wt., lb.	66.3	67.1	65.9	66.9	67.3	65.5	66.1	66.7
Final wt., lb.	98.3	104.5	104.7	103.1	101.1	103.5	103.7	109.1
Av. daily gain, lb.	0.38	0.46	0.55	0.52	0.40	0.45	0.45	0.50
Av. daily ration, air dry, lb.[3]	3.33	2.89	4.09	3.15	3.32	2.88	3.54	3.10
Feed per 100 lb. gain, air dry, lb.[3]	879	629	739	612	829	636	792	614
Gain per ton of ration, lb.	228	318	271	327	241	314	253	326
Lamb days per ton of ration	601	692	489	635	602	694	565	645
Carcass grade[4]	10.6	10.9	11.7	12.4	10.6	11.1	10.5	12.1
Dressing percent	50.1	50.8	49.5	51.7	49.3	50.7	49.2	51.8

1 C.S. = concrete stave silo.
2 Harvestore, A. O. Smith Harvestore Products, Inc., Arlington Heights, Illinois.
3 Haylage adjusted to 12% moisture.
4 8 = good, 11 = choice, 14 = prime.

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A.S. Series 65-27

URINARY CALCULI IN WETHER LAMBS

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INTRODUCTION

Urinary calculi, urolithiasis, or "water-belly" as it is often referred to, is one of the most prevalent nutritional diseases among cattle and sheep occurring in the United States and large annual economic losses have been attributed to this disease. The term, urinary calculi, is employed to describe mineral deposits which occur in the urinary tract. The calculi may occur as large single stones or with a sand-like consistency, and are often named according to their location in the urinary tract; thus they may be commonly referred to as bladder stones or kidney stones.

Two distinct types of urinary calculi commonly occur in South Dakota. One is composed largely of calcium and magnesium phosphate and is referred to as phosphatic urinary calculi, while the other type of stone is composed chiefly of silica and is referred to as siliceous calculi. The phosphatic urinary calculi occurs more frequently in lambs in the feedlot and has received the bulk of attention in research at South Dakota State University.

The exact causes and methods of preventing urinary calculi have not been established. However, it appears that high levels of dietary phosphorus may be a primary causative factor in inducing phosphatic urinary calculi. In addition to studying causes of urinary calculi, several compounds (including ammonium chloride, high levels of dietary calcium and high levels of sodium chloride) have been tested as means of preventing this disease. In the three trials summarized here, studies were made on the influence of levels and sources of dietary phosphates on the production of urinary calculi and the effects of various compounds in preventing this condition.

EXPERIMENTS CONDUCTED

Trial 1

This experiment was conducted to determine the influence of variations in the chemical form of dietary phosphates on the incidence of urinary calculi in wether lambs.

One hundred eighty crossbred wether lambs averaging approximately 72 lbs. were used in this experiment conducted during an 84-day period in late summer and early fall. The lambs were given 3 mg. diethylstilbestrol implants and were allotted on the basis of weight.

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Treatments in the form of additions to the rations (table 1) consisted of the following: no added phosphorus (1 and 5), monosodium phosphate (2 and 6), disodium phosphate (3 and 7), sodium tripolyphosphate (4 and 8) and dicalcium phosphate (9). All phosphorus supplements provided the equivalent of 0.35% phosphorus in the complete air-dry ration. They were fed with two levels of calcium (0.31 and 0.58% of the air-dry ration), using ground limestone as the supplementary source, with the exception of dicalcium phosphate which was fed only with the higher calcium level due to the calcium content of this supplement.

Calcium and phosphorus supplements were supplied in the concentrate portion of the basal diet, consisting of 85% ground corn and 15% soybean oil meal, which was fed at the ratio of one part concentrate to two parts silage (63.1% moisture). Sorghum silage was fed during the first half of the experiment and corn silage the last half. Moisture content of the two were about the same. The rations were designed to contain 11% crude protein calculated on an air-dry basis. Water and trace-mineralized salt were available free choice.

Results

Results of this trial are reported in table 1. The lowest levels of calcium and phosphorus (0.31 and 0.25%, respectively) used in this experiment are higher than the National Research Council requirements for growing and finishing lambs. Although there appears to be a trend toward higher rates of gain with the higher calcium level, the differences were not significant.

The occurrence of urinary calculi was restricted to the groups receiving the higher (0.60%) level of dietary phosphorus in the forms of sodium phosphates. There was no significant difference in incidence of calculi among the sodium phosphate sources used when fed at either level of calcium. In contrast with results obtained from use of sodium phosphates, no urinary calculi occurred in the lambs receiving dicalcium phosphate as the supplementary source of phosphorus.

Increasing the calcium level from 0.31% to 0.58% gave partial protection, as evidenced by the lower incidence of urinary calculi with the higher level of dietary calcium. Urinary calculi incidence with 0.60% phosphorus for the 0.31 and 0.58% calcium levels, respectively, were 74 and 42% with disodium phosphate, 68 and 25% with monosodium phosphate, and 60 and 20% with sodium tripolyphosphate. The lower incidence of urinary calculi with the higher calcium level was statistically significant ($P < 0.05$) in all instances.

The absence of urinary calculi in the group of lambs fed dicalcium phosphate in this experiment cannot be explained on the basis of the calcium level alone, since lambs fed equal levels of calcium but other sources of phosphorus developed calculi.

Serum and urine phosphorus values appeared to be related to the level of phosphorus in the diet and to the incidence of urinary calculi. Lambs on treatments 1 and 5 (no added phosphorus) which had no calculi had significantly lower serum and urine phosphorus values than lambs in which urinary calculi occurred. Increasing the calcium level in the diet from 0.31 to 0.50% tended to lower serum and urine phosphorus values; however, the differences were not significant. An inverse relationship between average serum and urine calcium level and evidence of calculi was also noticed. Groups in which no calculi occurred tended to have higher average serum and urine calcium values.

The results of this experiment show that high levels of phosphorus increase the incidence of urinary calculi in lambs. This condition was partially alleviated by increasing the level of dietary calcium. Lambs appear to be less prone to urinary calculi formation when fed dicalcium phosphate than when fed ground limestone with either monosodium phosphate, disodium phosphate or sodium tripolyphosphate at equivalent levels of calcium and phosphorus.

Table 1. Effect of Various Dietary Phosphates in the Ration[a]

Treatment number	1	2	3	4	5	6	7	8	9
Supplement phosphorus source	None	NaH_2PO_4	Na_2HPO_4	$Na_5P_3O_{10}$	None	$Na_2H_2PO_4$	Na_2HPO_4	$Na_5P_3O_{10}$	$CaHPO_4$
Calcium, %[b]	0.31	0.31	0.31	0.31	0.58	0.58	0.58	0.58	0.58
Phosphorus, %[b]	0.25	0.60	0.60	0.60	0.25	0.60	0.60	0.60	0.60
Number of lambs[c]	19	19	19	20	20	20	19	20	20
Average daily gain, lb.[d]	0.36	0.33	0.36	0.37	0.41	0.38	0.37	0.37	0.35
Daily ration, lb.[d]									
Concentrate mix	1.60	1.75	1.85	1.68	1.67	1.70	1.63	1.66	1.61
Silage[e]	3.34	3.65	3.83	3.50	3.48	3.54	3.39	3.48	3.37
Feed per 100 lb. gain, lb.[d]									
Concentrate mix	438	525	512	452	410	449	442	451	462
Silage[e]	917	1093	1059	940	857	937	918	943	966
Urinary calculi incidence[f]	0	13	14	12	0	5	8	4	0

his data is published in more detail in the Journal of Animal Science 24:671 (1965).

ir-dry basis.

nitially 20 lambs per treatment, but some losses occurred due to causes unrelated to the experiment.

alculated only for the lambs surviving the entire experimental period.

et basis.

ncludes losses due to urine blockage and animals having urinary mineral deposits at the termination f the experiment.

urces of phosphorus: Monosodium phosphate (NaH_2PO_4); Disodium phosphate (Na_2HPO_4); Sodium tripolyphosphate ($Na_5P_3O_{10}$); Dicalcium phosphate ($CaHPO_4$)

Trial 2

This experiment was conducted to determine the influence of supplemental magnesium on urinary calculi formation in lambs fed diets varying widely in calcium and phosphorus contents, and to determine if complete protection from phosphatic urinary calculi could be obtained through calcium supplementation.

This experiment, conducted over a 96-day period during late summer and early fall, utilized 256 crossbred wether lambs. The lambs averaging approximately 64 lbs. were given 3 mg. diethylstilbestrol implants and allotted on the basis of weight.

The basal ration consisted of ground shelled corn, 77%; alfalfa hay, 20%; and soybean meal, 3%. The basal ration contained 0.37% calcium, 0.25% phosphorus and 0.18% magnesium on an air-dry basis. Additions to the basal diet consisting of various levels of ground limestone, dibasic sodium phosphate and magnesium oxide were used to obtain the levels of calcium, phosphorus and magnesium comprising the 16 treatments shown in table 2. The rations were designed to contain 11% crude protein (calculated) and were full-fed once daily. Water and trace-mineralized salt were provided free choice.

Results

Data from this experiment are presented in table 2. A significant ($P < 0.01$) decrease in rate of gain was observed with an increase in the level of either dietary phosphorus or magnesium. In addition, a significant ($P < 0.01$) interaction occurred between calcium and phosphorus. The data indicate that this interaction was due to the apparent beneficial effect afforded by increased calcium levels when used in conjunction with the higher phosphorus level.

A 41.8% incidence of urinary calculi occurred in lambs fed the higher level (0.55%) of phosphorus. This is significantly ($P < 0.01$) higher than the 1.6% incidence which occurred in lambs fed the rations containing 0.25% phosphorus. Increases in the level of dietary calcium in conjunction with the higher level of dietary phosphorus were accompanied by decreases in the incidence of calculi which were significant ($P < 0.05$) when calcium was increased from 0.37 to 0.77% or greater. However, complete protection was not provided by even the highest calcium level, a 12.5% (2 cases out of 16 lambs) incidence occurring in the group of lambs fed 1.27% calcium with no added magnesium. It would appear from these data that a calcium to phosphorus ratio exceeding 2:1 is required for optimum protection from calculi in lambs fed high phosphorus rations. However, this ratio may vary for calcium and phosphorus sources differing in availability from those used in this experiment.

Addition of 0.20% magnesium to the diet in the form of magnesium oxide resulted in a nonsignificant decrease in the incidence of calculi. However, with all levels of calcium used in this experiment, the added magnesium appeared to reduce the incidence of calculi to an extent comparable to the reduction afforded by a similar amount of calcium. This is presented graphically in figure 1.

The feeding of supplemental phosphorus, calcium or magnesium resulted in significantly ($P < 0.01$) higher levels of these respective minerals in both serum and urine. On the other hand, phosphorus significantly ($P < 0.01$) lowered serum and urinary calcium.

The relationship between average urinary phosphorus levels and incidence of calculi in groups of lambs with and without supplemental dietary magnesium is shown graphically in figure 1. While 0.20% supplemental dietary magnesium, when fed with the lower levels of calcium, reduced urinary phosphorus to a larger degree than an equal amount of calcium, it did not exert a correspondingly greater reduction in urinary calculi.

These data, like those obtained in trial 1, indicate that high levels of dietary phosphorus increase the incidence of urinary calculi, and that although a high urinary phosphorus level is probably the most important measurable factor associated with phosphatic urinary calculi, other factors may be involved. Further, increasing the level of dietary calcium tends to lower, but does not completely prevent, the occurrence of urinary calculi resulting from high levels of phosphorus. A ratio of calcium to phosphorus of at least 2:1 appeared to be necessary to obtain protection from calculi induced by high-phosphorus diets and for optimum weight gains. While magnesium appeared to aid in reducing the incidence of calculi, it was no more effective than an equal amount of calcium.

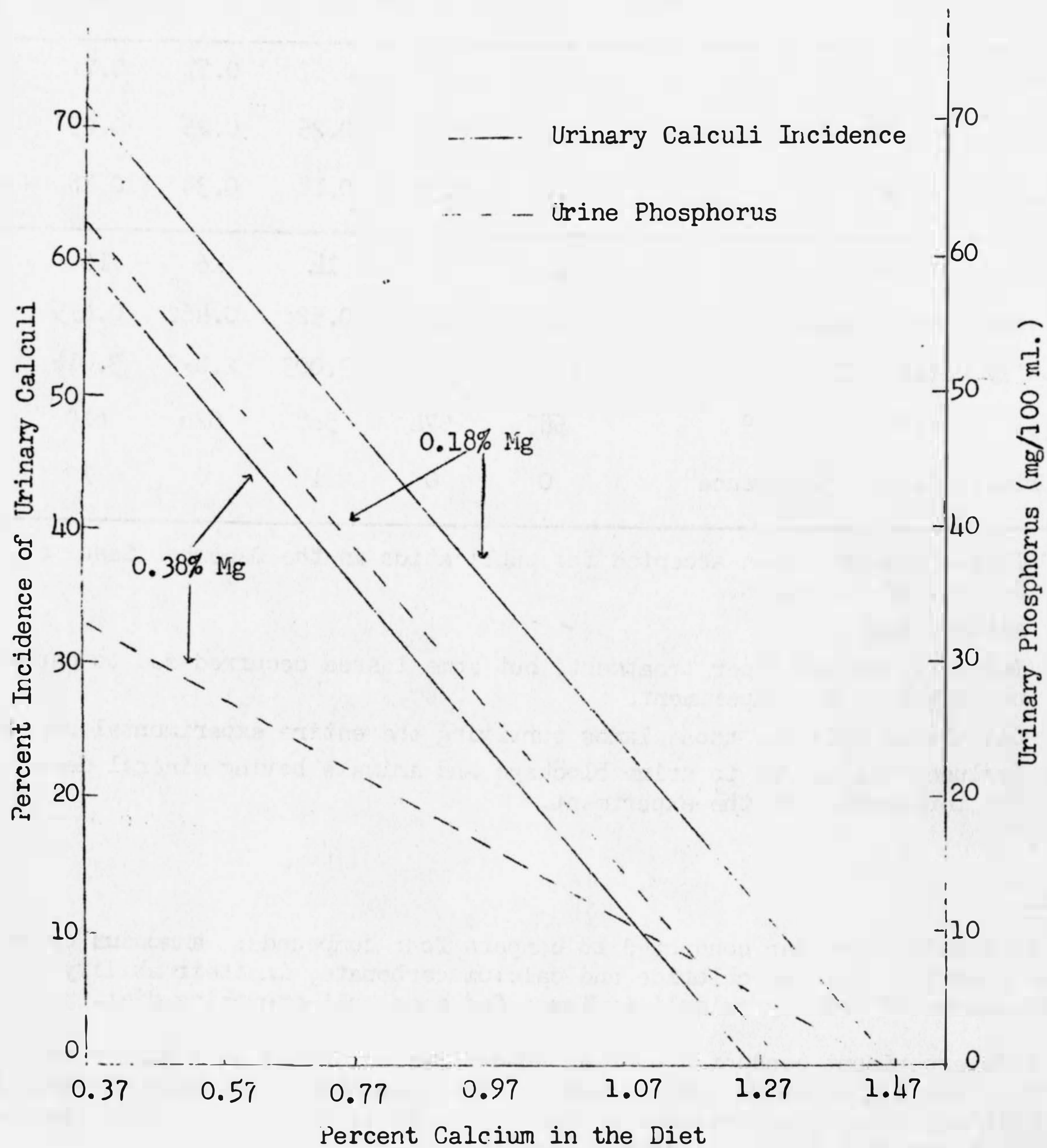

Figure 1. Incidence of Urinary Calculi and Urinary Phosphorus in Lambs fed 0.55% Phosphorus.

Table 2. Effect of Various Dietary Calcium, Phosphorus

Calcium, %[b]	0.37	0.37	0.57	0.57	0.77	0.77
Phosphorus, %[b]	0.25	0.25	0.25	0.25	0.25	0.25
Magnesium, %[b]	0.18	0.38	0.18	0.38	0.18	0.38
Number of lambs[c]	14	16	14	16	16	15
Average daily gain, lb.[d]	0.471	0.519	0.528	0.462	0.495	0.455
Daily ration, lb.[d]	2.774	2.983	3.003	2.893	3.014	2.873
Feed per 100 lb. gain[d]	587	574	568	626	610	632
Urinary calculi incidence[e]	0	0	1	0	1	0

[a] These data have been accepted for publication in the December issue of the Journal of Nutrition.

[b] Air-dry basis.

[c] Initially 16 lambs per treatment, but some losses occurred due to causes unrelated to the experiment.

[d] Calculated only for those lambs surviving the entire experimental period.

[e] Includes losses due to urine blockage and animals having mineral deposits at the termination of the experiment.

Trial 3

This experiment was conducted to compare four compounds: ammonium chloride, sodium chloride, calcium chloride and calcium carbonate, in their ability to reduce the incidence of urinary calculi in lambs fed a calculi-provoking diet.

This experiment conducted over an 88-day period during late summer and early fall utilized 234 crossbred wether lambs. The lambs averaging approximately 64 lbs. were allotted into nine treatment groups on the basis of weight. Each treatment was replicated with 13 lambs per replication.

The treatments (table 3) consisted of the following additions to the rations: no added supplement (1), calcium chloride (2 and 3), ammonium chloride (4 and 5), sodium chloride (6 and 7), and calcium carbonate (8 and 9). Calcium carbonate was supplied as feed grade ground limestone, ammonium chloride as the pure anhydrous form and sodium chloride as the iodine-free food grade. Each of the supplements was added at the rate of 0.5 and 1.5% of the ration on an air-dry basis. The basal ration consisted of ground shelled corn, 74.4%; ground alfalfa hay, 20%; soybean meal, 3.2%; trace-mineralized salt, 0.5% and dibasic sodium phosphate, 1.6%. The basal diet was shown by chemical analysis to contain 0.62% phosphorus and 0.37% calcium. This level of phosphorus was previously shown to be calculogenic in nature and Magnesium Levels in Sheep Rations[a]

1.27	1.27	0.37	0.37	0.57	0.57	0.77	0.77	1.27	1.27
0.25	0.25	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
0.18	0.38	0.18	0.38	0.18	0.38	0.18	0.38	0.18	0.38
16	16	15	16	13	16	16	16	16	14
0.482	0.466	0.451	0.345	0.482	0.425	0.451	0.429	0.532	0.504
2.873	2.794	2.834	2.845	2.845	2.515	2.814	2.763	3.054	2.955
595	598	629	822	591	592	624	643	574	587
0	0	11	10	9	8	6	5	2	0

(trials 1 and 2). The rations were designed to contain 11% crude protein (calculated) and were full-fed once daily. Mineral supplements were not provided free choice but the lambs were given free access to water.

Results

Results of this experiment are reported in table 3. No significant difference was observed for rate of gain or carcass grade. The rate of gain was low in all groups; this was the result of a very heavy infestation of worms when the lambs were placed on trial. During the latter part of the trial, however, gains were somewhat improved with all groups gaining in exesss of 0.39 lbs. per day with the exception of the control group which continued to gain at a slower rate. No treatment affect was noted with regard to carcass grade and lambs in all groups produced carcasses averaging in the choice to prime range.

All groups consumed an adequate amount of feed indicating that calcium chloride or ammonium chloride at 1.5% in a complete ration had no detrimental affect on feed consumption.

The occurrence of urinary calculi was less when the lambs were fed rations with 0.5 and 1.5% sodium chloride or 1.5% calcium carbonate, resulting in a 38, 33 and 24% incidence of calculi respectively compared to a 50% incidence occurring in the control group. However, this reduction was not statistically significant. The level of calcium in the ration with 1.5% calcium carbonate was approximately 1.6 times the level of phosphorus. The protective effect in this instance appeared to be less than obtained in previous trials with a calcium to phosphorus ratio of at least 2:1.

Feeding calcium chloride or ammonium chloride at 1.5% of the ration resulted in a significant (P 0.01) reduction in ruolithiasis, with only one lamb in each of these two treatments having calculi when slaughtered. No clinical cases were noted with either of these two treatments.

In addition to lowering the incidence of urinary calculi, 1.5% ammonium chloride or calcium chloride significantly ($P < 0.01$) increased the urinary excretion of calcium and the chloride ion. The increased calcium excretion was nearly three fold and five fold respectively for ammonium chloride and calcium chloride compared to lambs receiving a similar level of calcium as calcium carbonate. No important changes were noted with regard to serum and urine magnesium or serum calcium and phosphorus.

The data obtained in this experiment shows that a high incidence of urinary calculi occurs in lambs receiving a high-phosphorus ration. The incidence of urinary calculi was reduced by increasing the level of dietary calcium (1.5% calcium carbonate) or by adding sodium chloride (0.5% or 1.5%), Feeding rations with 1.5% ammonium chloride resulted in almost complete protection, with only one nonclinical case occurring with each of these treatments. Further, when fed in a complete ration this level (1.5%) of ammonium chloride or calcium chloride did not appear to affect feed consumption, rate of gain or carcass composition.

Table 3. Effect of various compounds on incidence of urinary calculi and feedlot performance

Treatment number	1	2	3	4	5	6	7	8	9
Supplement[a]		0.5% $CaCl_2$	1.5% $CaCl_2$	0.5% NH_4Cl	1.5% NH_4Cl	0.5% N_2Cl	1.5% N_2Cl	0.5% $CaCO_3$	1.5% $CaCO_3$
Number of lambs[b]	24	24	22	24	24	21	24	25	25
Average daily gain, lbs.	0.24	0.29	0.37	0.31	0.34	0.33	0.30	0.30	0.33
Daily ration, lbs.	2.39	2.62	2.77	2.56	2.58	2.55	2.82	2.66	2.74
lb. feed/lb. gain	9.41	8.81	7.38	8.83	7.58	8.28	10.33	8.76	8.40
Carcass grade[c]	1.72	1.48	1.95	1.85	1.80	1.86	1.75	1.78	1.77
Urinary Calculi incidence[d]	12	11	1	10	1	8	8	11	6

[a] Air-dry basis

[b] Initially 26 lambs per treatment, but some losses occurred due to causes unrelated to the experiment

[c] 1= prime, 2= choice

[d] Includes losses due to urine blockage and lambs having mineral deposits in bladder or kidneys at termination of the experiment.

Supplement: Calcium chloride ($CaCl_2$); Ammonium chloride (NH_4Cl); Sodium chloride (NaCl); Calcium Carbonate ($CaCO_3$)

SUMMARY

The results of these three trials show that high levels of dietary phosphorus to be a major causative factor in the formation of phosphatic urinary calculi. Since rations containing large amounts of concentrates in relation to roughage are relatively high in phosphorus as compared to calcium, one should be careful in selecting mineral supplements to be fed or offered free choice with these rations. Increased levels of dietary calcium, as ground limestone, appears to reduce the incidence of phosphatic urolithiasis and improve weight gains, but complete protection was not obtained by added calcium with the high levels of phosphorus employed in these experiments. Added magnesium appeared to be no more effective than an equal amount of calcium.

Ammonium chloride or calcium chloride when fed at 1.5% of the complete ration appeared to be highly protective with only one nonclinical case of calculi being observed with each compound. Further, when fed in the complete ration this level, neither compound appeared to affect rate of gain, feed consumption or carcass grade.

Sodium as much as 1.5% of the ration, was of limited value in preventing urinary calculi. However, other workers have reported sodium chloride to be effective when fed at much higher levels, 4 to 10% of ration.

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Parasite Control

James J. O'Connell[1]

Internal parasites of sheep are the largest single health hazard of this species of livestock. These parasites are a constant threat to sheep and are responsible for many of the failures for profits from large or small flocks. In the United States alone, loss of weight gains is estimated to be at 22 million dollars and loss of the wool clip at about 4 million dollars. The troublesome worms are stomach, nodular and common tape. As with most animal health problems, prevention is the best cure.

How to Control Worms in Sheep

On research conducted, several observations have been made and based on these, recommendations can be made regarding the time that the administration of treatment to sheep for removal of worms would be most effective. Since parasite infestations are at a very low level during the winter, treatment of ewes during this period can be expected to accomplish little towards a year-round control program.

Because of the increased infestation in spring months, individual treatment of ewes just prior to turning to summer range should greatly reduce pasture contamination. If the flock has been kept off summer range during winter and spring, pastures should then be relatively clean for the start of grazing. With sufficient summer range so that it is not overgrazed, infestations in lambs would generally not develop to a degree requiring treatment.

Should factors such as limitation of range, failure to treat the ewes, or spring contamination of range occur, it may become necessary to treat the flock during the summer. The time of that treatment should be during the rapid rise in the infestation of the lambs in early July.

There are two chief general principles necessary for the basic understanding of the disease caused by the worm parasites of grazing animals. (1) Every animal in the flock is infected. (2) Contamination of the pastures is continuous.

When one considers the tremendous rate of egg laying by the parasites, it is difficult to understand why there are not more outbreaks of parasitic disease and more severe mortalities. Even a lightly infested sheep may deposit many hundreds of thousands of eggs on the pastures every day for weeks on end. For example, the female stomach worm lays from 5,000 to 10,000 eggs every 24 hours. If all the eggs from one female in one day developed into larvae and were swallowed by grazing lambs and developed into worms, there would be enough to kill five lambs in a few weeks. It is obvious the number of eggs that may pass from a heavily infested ewe will not develop. The chief factors which control the numbers of worms are climate, which restricts the development of the eggs and larvae on pastures, and the occurrence of resistance and immunity which restricts the number of worms in the sheep.

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[1] Extension Livestock Specialist - Beef

It is clear that there are two sources of infestations for the grazing sheep. First, the larvae already on the pasture and, second, the daily addition of more larvae which develop from the eggs passed by the sheep. These two aspects of the problem have led to two sayings relating to the control of parasitic diseases. (1) "Permanent Pastures Perpetuate Parasites". (2) "Parents Perpetuate Parasites". In permanent pastures it means those that are continuously stocked and the statement stresses the pasture as the reservoir of infective material and a source of reinfestation. The second statement stresses the infested sheep as the reservoir and source of infective material. Both statements are correct and they are complementary not alternatives. The high degree of efficiency of modern worm killing drugs may tend to throw the stress chiefly on the contaminated pasture as the danger. However, even the best drenches are rarely 100 percent effective in every sheep. There is always a residue of worms after treatment. And, as explained above, even one female can quickly deposit a large number of eggs on the pasture. The known longevity of the eggs and larvae on pastures tends to stress the importance of the contaminated area as the source of reinfestation. However, it is the mortality of the majority and not the longevity of the few that is important from the point of view of parasitic disease. If they are given shaded situations and moisture, eggs and larvae may live for many months, but under the normal changes of conditions in a pasture, the vast majority are dead in 3 or 4 weeks. If a pasture is rested for 3 weeks most of the eggs and larvae will have died, but an infested sheep will continue to contaminate the pasture for weeks or even months.

Now that some of the general principles have been considered, one must decide what approach must be taken to put into operation a sound control program. The operator may ask himself two questions. (1) What am I doing to prevent the perpetuation of the parasite now by reducing the adult worm? (2) What changes can be made in my operation so a more effective control can be accomplished?

A full understanding of the life history and habits of the parasite will be helpful, if not necessary, in conducting a successful control program. The life cycle and control measures for internal sheep parasites are outlined in the leaflet F.S. 135, "Common Sheep Parasites".

Sheep Ticks

New developments with the use of insecticides in the last 15 years have greatly facilitated tick control. With good management, this pest can be controlled almost 100 percent. Spraying has been adopted by many producers because of available equipment. When spraying for the control of sheep ticks, the fleece should be wetted thoroughly. For this purpose, it is recommended that a household detergent washing powder be added to the spray mixture, especially if pressures under 100 pounds are used. Sheep should be sprayed just after shearing. When ewes are shorn while still nursing lambs, the ticks will move to the lambs, hence, it is important to treat the lambs also.

The following insecticides are approved for use as a spray:

	(for 100 gallons of spray)
Lindane	2 lbs. of 25% wettable powder
Co-Ral (Bayer 21-199)	8 lbs. of 25% wettable powder
Methoxychlor	8 lbs. of 50% wettable powder
Toxaphene	8 lbs. of 50% wettable powder

Be sure and check instructions on label of insecticide container.