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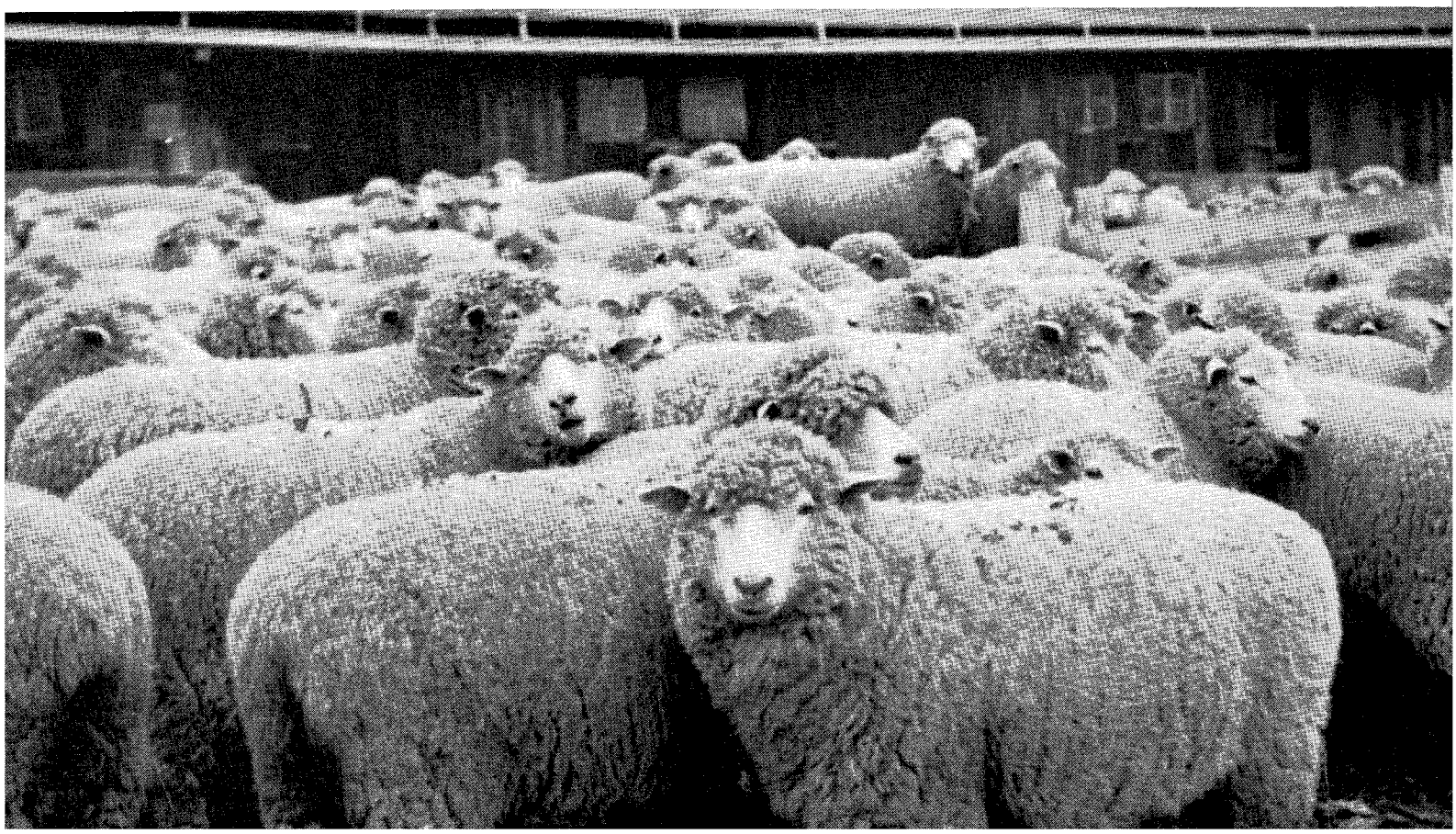

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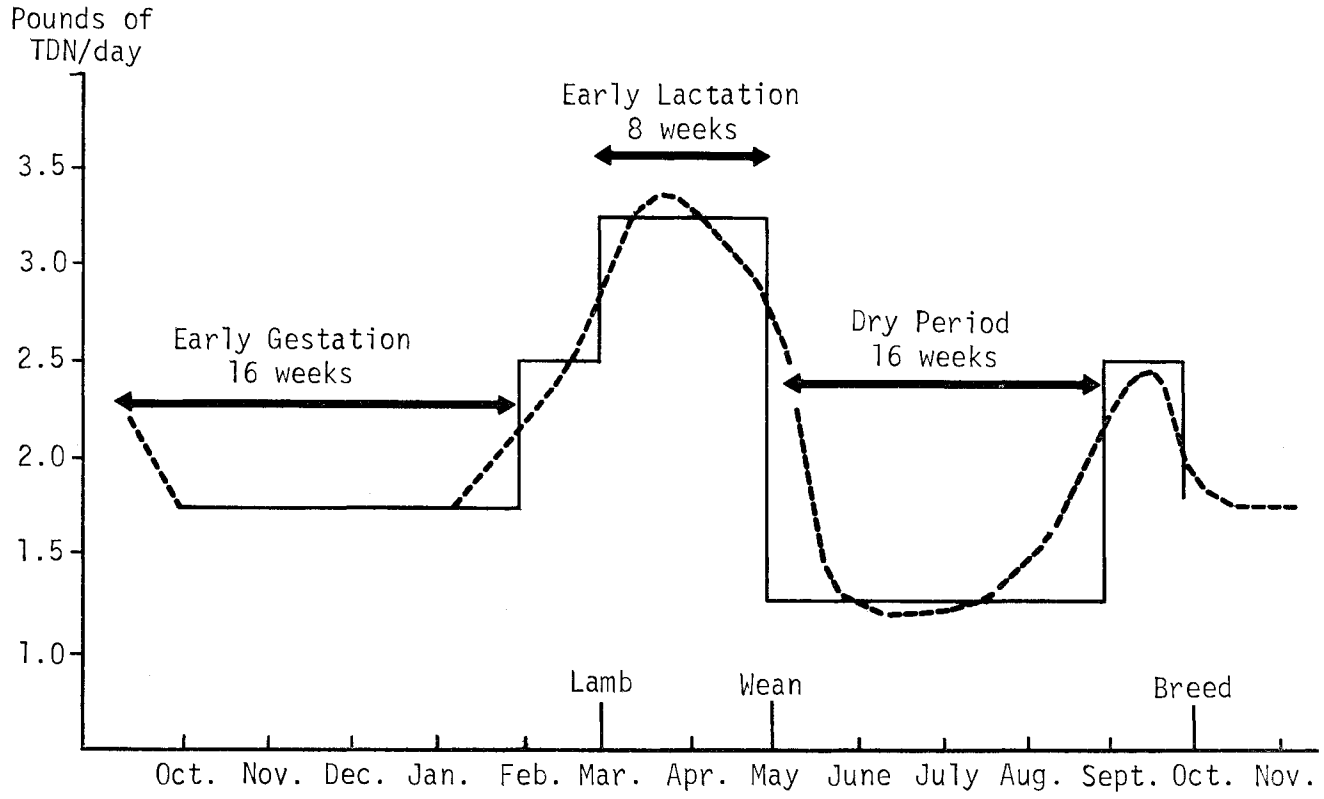


YEAR-ROUND SHEEP NUTRITION AND FEEDING PROGRAMS

R. M. Jordan, H. E. Hanke, G. C. Marten, and J. W. Rust

Total yearly feed costs per ewe and lamb amount to $25 to $26, according to a 1965 Idaho Station Report. Labor costs including shearing, worming, spraying, feeding, etc. total about $5 to $6 per ewe. While feed constitutes 70 to 80 percent of the cost, both feed and labor costs must be commensurate with production for maximum profits in the sheep enterprise.

With the adoption of the practice of early weaning of lambs (at 6 to 12 weeks of age), the nutritional needs of the ewe during the various periods of the year are considerably different than when the ewe nursed her lamb for 18 to 24 weeks. Although it is generally conceded that early-weaned lambs eat more grain and hay, economies of feeding the ewe during the nonlactating period can be of sufficient magnitude to result in early-weaned lambs being the most economical to produce. Conversely, unless some changes are adopted resulting in lower costs in ewe feeding and management, early weaning of lambs may be a costly and unwarranted practice.

The first consideration for successful feeding of the ewe is to realize that her nutritional needs are not static and depend largely on what stage of production she is in. This is illustrated by the figure on page 2. There are only about 16 to 20 weeks of the year when the ewe's energy needs are very critical (primarily during lactation, breeding, and prelambing). During early gestation (12 to 16 weeks) and the nonlactating period (12 to 16 weeks depending on when the lambs are weaned), energy levels may be lowered and thus provide an excellent opportunity to reduce costs.

Net profit is dependent on two factors: 1) high production resulting in an income in excess of production costs, and 2) low production costs. Every sheepman must decide how he can most easily attain maximum net income. For some, increased production levels should receive priority; others should economize on production costs. Production costs are either overlooked entirely by too many sheepmen or are approached in a haphazard manner by cutting feed levels at the very time when additional feed should be given. You should realize that saving $1 per ewe yearly by judicious feeding and management is equal to: 1) 5 pounds of lamb production per ewe when valued at 20 cents a pound, or 2) equivalent to increasing the lambing percentage 5 percent.

At the University of Minnesota several methods of feeding ewes have been studied over a period of years. The results demonstrate several procedures that may be used to increase efficiency of lamb production. Particular attention was given to developing systems of feeding and management that would entail a minimum of labor, reduce feed costs, and be especially applicable by sheep producers who are producing lambs on an intensive basis. This publication outlines the results of the research on sheep's nutritional needs.

REDUCTION OF LABOR

Choring time (daily feeding of the flock) constitutes the major labor expenditure in keeping a farm flock. The conventional practice of 9 out of 10 Minnesota sheepmen is a twice-a-day, 7-days-a-week choring program. A series of experiments were conducted to determine whether feed given in equal amounts 7 days a week to gestating ewes was superior to feeding the same amount of feed per week less frequently, such as three times a week.

The basic procedure employed was to feed the control group of ewes once daily an alfalfa-brome hay ration at a level to provide the amount of energy, protein, and minerals estimated by the National Research Council as requirements for gestating ewes. The second group of ewes was fed three times weekly (Monday, Wednesday, and Friday). This group received the same feed and the same amount on a weekly basis.. Therefore on Mondays and Wednesdays it received twice the amount of hay and on Fridays three times the amount of hay that was fed daily. Table 1 presents the results of this study.

Table 1. Effect of frequency of feeding on productivity of gestating ewes (average of two experiments).

Treatment	Fed daily	Fed 3 times per week
Number ewes	34	34
Initial wt., lb.	132.00	131.00
Average gain, lb.	18.10	18.30
Average daily feed consumed, lb.		
Alfalfa-brome hay	3.30	3.30
Shelled corn	.26	.26
Ewe production		
Fleece wt., lb.	8.40	8.50
Lambing percentage	117.00	129.00
Lamb birth wt., lb.	10.70	11.10
Average daily gain of lambs first 30 days, lb.	.28	.26

CONCLUSIONS

1. Weight gains of ewes fed three times per week were nearly identical to those fed daily.
2. Fleece weights, lambing percentage, lamb birth weight, and milk production, as measured by lamb gains during the first 30 days did not differ significantly between the two groups.
3. Less frequent feeding but larger amounts per feeding permitted the more timid sheep a greater chance to eat and decreased labor.

HIGH GRAIN RATIONS FOR EWES

The market value of alfalfa-brome hay and shelled corn, as dictated by supply and demand, has averaged about $20 per ton for hay and $40 per ton for shelled corn during the last 10 years. Occasionally hay is appreciably higher. Feeding large quantities of hay involves considerable labor, and the feeding of hay is also more difficult to mechanize.

Must sheep be fed an all-hay ration or can corn or other grains replace a large part of the ration? To answer that question three experiments conducted during 3 years involved the feeding of three basic rations:

1. **Hay ration**—Alfalfa-brome hay, (15 percent protein) fed at 4.0 pounds per ewe daily, which provided ample protein and total digestible nutrients (TDN) according to recommendations of the National Research Council. During the last 3 to 4 weeks of the gestation period .5 pound shelled corn was added to the ration to prevent pregnancy disease and assure ample milk flow.
2. **Medium grain**—Equal parts by weight of alfalfa-brome hay and shelled corn were fed at a level equal to 50 percent by weight of the control ration. During the last 3 to 4 weeks of gestation, 1 pound of hay per ewe daily was added to this ration.
3. **High grain**—One part hay and three parts of corn by weight were fed at a level equal to 50 percent by weight of the amount fed as hay in the control ration. During the last 3 to 4 weeks, 1 pound of hay per ewe daily was added to the ration.

Each of these "high grain" rations, when fed at 50 percent by weight of the hay ration, provided considerably less TDN than the standard hay ration. The results of these experiments are summarized and are presented in table 2.

CONCLUSIONS

1. Rations consisting of equal parts of hay and grain resulted in: a) equal weight gains during the test period, b) as great a lambing percentage, c) comparable lamb birth weights, and d) comparable lamb gains during the first 40 days, as those produced by ewes fed the conventional hay ration.
2. The rations consisting of 1 part hay and 3 parts of corn, while providing less TDN than the hay ration, resulted in: a) significantly greater weight gains during the test period, b) a greater lambing percentage, c) comparable lamb birth weights, and d) comparable lamb gains during the first 40 days. Fleece weights of the ewes fed the conventional hay ration were somewhat greater.

The fact that the ewes fed the "high grain" ration (at levels providing less TDN) made equal or significantly greater weight gains than those fed only hay suggests that the high grain rations were more digestible or that the published TDN values of hay are too high. The data indicate that from a TDN standpoint 1 pound of shelled corn can replace 2 pounds of good quality alfalfa-brome hay in a ewe gestation ration. Substitution of corn for hay should be dictated by price of the two feeds.

Table 2. High grain rations for gestating ewes (average 3 experiments).

Type of ration	Hay	Equal parts* hay and corn	1 part hay* 3 parts corn
Number ewes	31	31	31
Initial wt., gain, lb.	133.00	131.00	131.00
Average gain, lb.	18.10	17.90	28.60
Average daily feed consumed, lb.			
Alfalfa-brome hay	3.40	1.10	.76
Shelled corn	.14	1.04	1.47
TDN	1.81	1.36	1.55
Ewe production			
Average fleece wt., lb.	9.20	8.60	8.50
Lambing percentage	127.00	132.00	144.00
Lamb birth wt., lb.	9.60	9.50	9.80
Average daily gain of lambs first 40 days	.48	.48	.47

* Parts by weight

SUMMER DRYLOT RATIONS

Normally ewes are pastured during the summer. However, under systems of intensive sheep production, drylot feeding has considerable merit. How much should nonlactating ewes be fed? Or how little can they be fed without adversely affecting subsequent production? Three experiments were conducted during three summer periods to provide the answer. All of the ewes were fed a daily hay ration. The difference in the four treatments was the amount fed per ewe. The following treatments were employed:

1. Ewes were fed hay at a level to result in approximately a 10 percent body weight loss.
2. Ewes were fed hay at a level to result in approximately a 5 percent body weight loss.
3. Ewes were fed hay at a level to maintain their body weight.
4. Ewes were fed hay to result in approximately a 5 percent body weight gain.

Table 3. Summer drylot feeding of the nonlactating ewe and its effects on production (average of three experiments).

Feeding Level	To lose 10 percent body weight	To lose 5 percent body weight	To maintain body weight	To gain 5 percent body weight
Item:				
Number ewes	47	47	47	47
Initial wt., lb.	149.00	150.00	145.00	146.00
Average gain, lb.	−14.30	−6.90	+1.20	+7.10
Average daily feed consumed, lb.				
Alfalfa-brome hay	1.90	2.50	3.00	3.30
Shelled corn	..	..	..	.24
TDN	.97	1.24	1.58	1.86
Ewe production				
Fleece wt., lb.	8.40	8.90	9.00	8.70
Lambing percentage	149.00	144.00	143.00	131.00
Lamb birth wt., lb.	10.20	10.40	10.30	10.60

After a short period in the first study, it was found that a small amount of shelled corn had to be added to the ration in treatment 4

in order for the ewes to gain weight and result in no hay wastage. The results of these three experiments are summarized and presented in table 3.

CONCLUSIONS

1. Ewes that lost 5 to 10 percent body weight did not differ in wool production, lambing percentage, or lamb birth weights from ewes that were fed to maintain weight or to gain 5 percent of their body weight.
2. Two to 2.5 pounds of alfalfa-brome hay per ewe daily provided about 1 to 1.2 pounds of TDN, which was ample energy to support nonlactating ewes in "strong" condition.
3. The key to the system is the stage of production the ewe is in when she loses the weight. Losing weight during the nonlactating period and then being fed adequately during gestation resulted in no adverse effects but did reduce feed costs 25 to 35 percent.

YEAR-ROUND LEAST COST DRYLOT RATIONS

From the results of the previously presented experiments it is apparent that:

1. Feeding gestating ewes three times per week resulted in comparable production to that resulting when the ewes were fed daily.
2. Feeding ewes high-grain rations, while providing less calculated TDN, resulted in as high a production level with less labor in feeding than the conventional hay rations.
3. Ewes can lose 5 to 10 percent of their body weight during the nonlactating period during the summer, and if fed adequately during the gestation period no reduction in subsequent production results.

The question was: Could these various treatments be combined into a single feeding program for satisfactory year-round least-cost rations?

Table 4. Average apparent digestibility of a hay and a hay-grain ration.

Item	Ration	
	Hay	Hay-grain
Number animals	5	4
Dry matter, percent	52.2	66.1*
Crude protein, percent	61.7	70.9**
Energy, percent	52.2	64.5**
Digestible energy per pound of ration, kcal.	1,026	1,258

* $P < .05$.
** $P < .01$.

Could we feed ewes three times per week, feed high-grain rations, feed at low levels during the summer months, then follow that feeding regime with higher feeding levels during the gestation period without adversely affecting production?

To test this combined program, two experiments were conducted for 2 years. The following treatments were employed:

Summer nonlactating period. 1) Alfalfa-brome hay (15 percent protein) was fed daily at a level (2.6 pounds per ewe daily) to result in about a 5 percent loss in body weight. 2) Equal parts by weight of alfalfa-brome hay and grain (soybean meal added to provide protein) were fed daily at 50 percent by weight of the amount of that fed in treatment 1. This ration, fed at this level, provided about 40 percent less energy than in treatment 1. In treatments 3 and 4 the above two rations were employed; however the rations were fed the ewes three times weekly rather than daily.

Gestation period. The same basic diets and the same methods of feeding the ewes during the summer nonlactating period were employed during the gestation period. However, the amounts of feed fed daily were greater to accommodate the greater nutritional requirements during the gestation period.

The amount of hay fed (3.5 pounds) in treatment 1 provided the amount of TDN and protein as suggested by the National Research Council. As in previous experiments, during the last 30 days of gestation the ewes in treatment 1 were fed an additional 0.5 pound of shelled corn. The ewes fed the high-grain rations received an additional 1 pound of alfalfa-brome hay during the last 30 days of gestation.

In addition to the basic feeding experiment, a digestion trial was conducted to determine the amount of digestible energy that each ration provided. The results of the digestion trial and the feeding trials are presented in tables 4 and 5 respectively.

CONCLUSIONS

Digestion trial. Digestibility of dry matter, protein, and energy were significantly higher in the high-grain rations. Thus the high-grain ration contained 1,258 Kcal. and the hay ration contained 1,026 Kcal. of digestible energy per pound (table 4).

Summer nonlactating period. 1) All of the ewes, irrespective of the ration or feeding method, lost weight. However, those fed the high grain rations at a level providing considerably less energy lost the most weight. 2) There was no significant difference in weight change whether the hay or hay-grain ration was fed daily or three times per week.

Gestation period. 1) All ewes gained weight, irrespective of treatment. 2) The high-grain rations resulted in weight gains comparable to those made by the ewes fed the hay rations (30 to 37 pounds per ewe). 3) When the summer and gestating periods are combined (bottom of table 5), gains made during the entire year are not significantly different between treatments. On a year-round basis, when the effects of a feeding system during one period are carried into the next period, the conventional ration (the daily feeding of hay plus corn during the last 30 days of gestation) resulted in no advantage in production over a high-grain ration fed daily or a conventional hay ration fed three times per week. 4) Differences in lambing percentage, lamb birth weight, and lamb gains to 30 days are not significantly different between treatments.

These data suggest that feeding ewes according to their nutritional needs with the lowest cost ration that involves the least amount of labor has considerable merit and application.

PASTURING THE EWE

The first step toward maximizing returns from sheep is using your land wisely. The agronomist and soil scientist have provided plant materials and fertilizer programs that literally make two blades of grass grow where only one grew before. The task of the livestock man is to feed two sheep on land resources where only one could be fed before without sacrificing production.

The nonlactating ewe, whose production at that stage is confined to wool, provides the sheepman with the animal unit ideally suited for grazing at high stocking rates per acre, thereby reducing feed costs.

A series of grazing trials with nonlactating ewes have been conducted during the last 8 years to increase carrying capacity per acre, primarily by management of the ewe rather than through management of the forage crop. It is known that nonlactating ewes grazing good forage actually eat far more than they need, resulting in fat ewes with greater maintenance costs. If the carrying capacity of pastures is to be in-

Table 5. Effect of energy level as supplied by hay or high grain rations and frequency of feeding on ewes (average of two experiments).

Treatment	Hay daily	High grain daily	Hay 3 times weekly	High grain 3 times weekly
Nonlactation Period (Summer)				
Number ewes	20	20	20	20
Average initial wt., lb.	153.00	154.00	156.00	154.00
Average gain, lb.	—9.00	—16.00	—4.00	—15.00
Average daily feed, lb.				
Alfalfa-brome hay	2.60	.66	2.70	.66
Shelled corn	...	.55	...	.55
Soybean meal	...	.09	...	.09
Digestible energy, Kcal*	2,714.00	1,654.00	2,744.00	1,654.00
Breeding and Gestation Period				
Number ewes	20	20	20	20
Average initial wt., lb.	144.00	138.00	152.00	139.00
Average gain, lb.	30.40	37.40	35.20	29.90
Average daily feed, lb.				
Alfalfa-brome hay	3.40	1.30	3.40	1.30
Shelled corn	.15	.73	.15	.73
Soybean meal	...	.13	...	.13
Digestible energy, Kcal*	3,698.00	2,684.00	3,709.00	2,684.00
Summer and Gestation Period				
Number ewes	20	20	20	20
Initial wt., lb.	153.00	154.00	156.00	154.00
Average gain, lb.	21.40	21.40	31.20	14.90
Effect on Production				
Number barren ewes	5	1	1	1
Lambing percentage	142.00	158.00	183.00	155.00
Lamb birth wt., lb.				
Singles	12.50	11.70	10.80	11.90
Twins	10.60	10.60	9.90	9.90
Lamb gain per day				
First 30 days, lb.	.34	.39	.37	.36

* Digestible energy values were obtained from a digestion trial

Table 6. Effect of grazing management of perennial grass pastures with nonlactating ewes (summary of 1959 and 1960—90 days of grazing).

Stocking rate grazing time	Heavy restricted	Heavy continuous	Light continuous
Number ewes*	40	40	20
Initial wt., lb.	125.60	125.40	121.90
Weight change, lb.	—10.00	—0.70	10.70ˣ
Available forage dry matter/acre, ton	.32	.31	.29
Dry matter consumed daily, lb.	3.03	3.54	5.70
Residual forage dry matter remaining at end of trial, ton/acre	.48	.18	.56
Ewe grazing days/acre†	1,359.00	1,319.00	659.00
Ewe production			
Fleece wt., lb.‡	8.45	8.55	9.00
Lambing percent§	149.00	160.00	167.00
Number barren ewes	3	0	1
Lamb birth wt., lb.	10.60	10.60	10.10

* Each treatment replicated each year.
† Grazing days include tester and grazer ewes.
‡ Significantly different from the other weight changes.
§ Based only on ewes that lambed.
ˣ ($P < .05$)

Table 7. Effect of grazing management of perennial grass pastures with nonlactating ewes (1961).

Stocking rate grazing time	Heavy restricted	Heavy continuous	Light continuous
Number ewes*	24	20	10
Initial wt., lb.	155.60	159.30	157.80
Weight change, lb.	—18.80	—9.20	—2.80
Ewe grazing days/acre	1,047.00	833.00	410.00
Ewe grazing days compared with "heavy" continuous, percent	126.00	100.00	49.00
Ewe production			
Fleece wt., lb.	10.50	9.60	10.70
Lambing percentage†	171.00	177.00	142.00
Lamb birth wt., lb.	10.90	11.00	11.20
Lamb weight at 30 days of age, lb.	28.50	28.00	29.20

* Each treatment was replicated.
† Based only on ewes that lambed.

creased, some scheme to reduce the feed intake per ewe uniformly over the season must be employed. The scheme used in this series of trials was to reduce the amount of time the ewes were permitted to graze (hereafter referred to as restricted time grazing).

In two trials conductd in 1959 and 1960 in which nonlactating ewes were grazed on non-bloating forages (bromegrass-quackgrass mixture), the following experimental procedures were employed: 1) Restriction of grazing time was for relatively long periods at one time. In this case the ewes were permitted to graze from Friday (4:30 p.m.) until Monday noon. They were then confined in a drylot pen constructed within the pasture from Monday noon until Wednesday (4:30 p.m.). They were grazed from Wednesday (4:30 p.m.) until Thursday noon and were restricted within the drylot pen from Thursday noon until Friday at 4:30 p.m. This weekly procedure was repeated throughout the summer. 2) To test the efficacy of such a system, it was first necessary to determine the amount of available forage in each pasture. This was done by taking clippings prior to grazing. To determine the amount of forage produced during the grazing season, forage clippings from protected areas (cages strategically placed throughout the pasture) were taken. In addition a relatively high stocking rate was employed (14 ewes per acre) to be certain that adequate consumption of the forage ensued.

The treatments employed during the first 2 years on brome-quackgrass pasture were as follows:

1. **Restricted time grazing:** Ewes were initially stocked at 14 head per acre (heavy restricted).

2. **Continuous grazing:** Ewes were stocked at 14 head per acre (heavy continuous).

3. **Continuous grazing:** Ewes were stocked at 7 head per acre (light continuous).

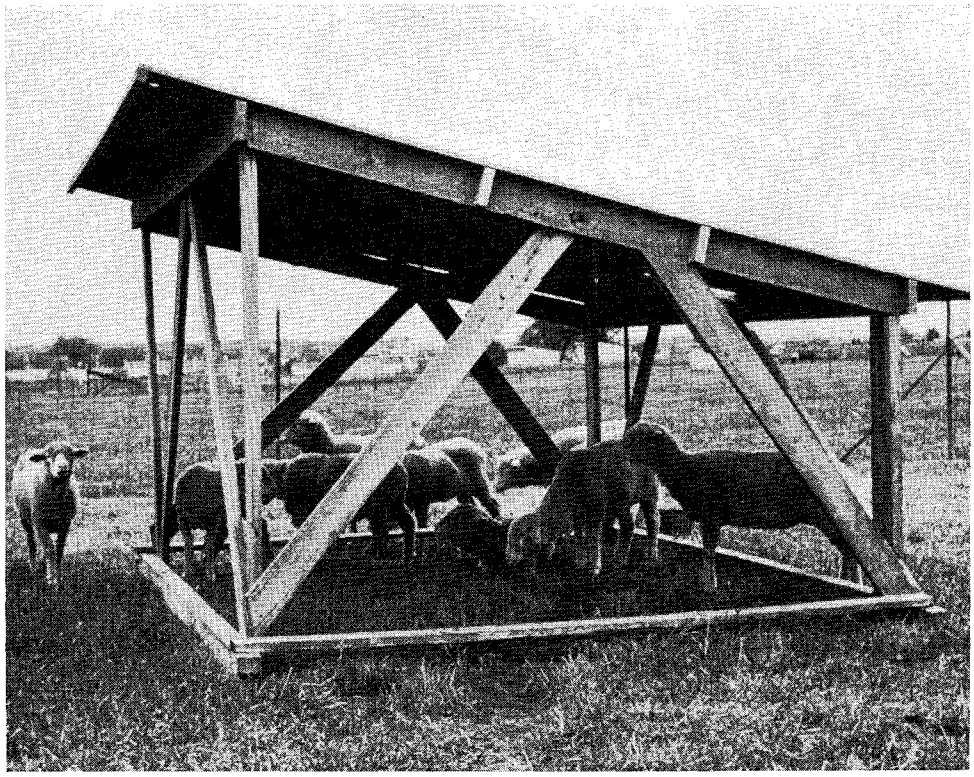
Apparent feed intake, residual forage, weight changes of the ewes during the experiment, and treatment effects on subsequent lamb and wool production were recorded. The data are presented in table 6.

CONCLUSIONS

Ewes restricted in amount of grazing time consumed less dry matter per ewe daily (3.03 pounds) than ewes heavily stocked and continuously grazed (3.54 pounds) or lightly stocked and continuously grazed (5.7 pounds). This lower dry matter intake resulted in significantly greater weight losses. This was expected since they ate decidedly less feed. The most striking observation in this series of studies was that at the end of the grazing seaosn there was appreciably more remaining forage (table 6) where the ewes were restricted in grazing time than was the case where the same stocking rate was employed but the ewes grazed continuously. Restricted time grazing had no significant effect on fleece production, lambing percentage, or lamb birth weights.

1961 TRIAL

The experiment was repeated in 1961 except that more ewes were grazed per acre under restricted time grazing, resulting in more comparable forage removal in relation to the heavy continuous grazing treatment. Four 50′ x 42′ strips from each pasture were clipped at the end of the grazing season to determine the amount of residual forage remaining. While more ewes per acre were grazed under restricted grazing, more residual forage remained with restricted grazing than with heavy stocking continuous grazing. (table 7).



Ewes in a confinement area being managed under restricted-time grazing. For success with this system, ewes should be confined in a small area that provides shade, water, and salt for periods as long as 2 days in order to significantly reduce forage intake.

CONCLUSIONS, 1961 Trial

Restricted time grazing of brome-quackgrass pasture resulted in: 1) greater weight losses, 2) a 26 percent increase in ewe grazing days, and 3) no significant effect on ewe productivity (table 7).

1962 TRIAL

The same basic procedure (restricting the amount of time the ewes were permitted to graze) was employed in 1962 and 1963 with the following exceptions:

1. Oats and rape (mixture) and Sudan grass were the forage species grazed.
2. The amount of forage available at any one time in the various pastures was kept uniform by adding or subtracting "grazer" ewes (put-and-take system). This meant that to keep the amount of available forage comparable between the two treatments, at times pastures grazed by ewes on the restricted time basis had from 50 to 100 percent more ewes per acre than pastures grazed on a continuous basis. The basic design and results of the experiments conducted in 1962 and 1963 are presented in table 8.

CONCLUSIONS, 1962 TRIAL

1. Restricting the amount of grazing time to about 50 percent of normal on oats-rape increased the number of ewe grazing days (number of ewes times the number of days they grazed) from 689 for the continuously grazed ewes to 1,467 for the ewes grazed on a restricted time basis, an increase of 113 percent.
2. Cage clippings taken prior to grazing and immediately following grazing indicated that initial forage production was the same in the various paddocks. Since about twice as many ewe grazing days had been obtained by restricted time grazing, it is evident that the system did in fact reduce feed intake.
3. Ewes grazed on an oats-rape mixture on a restricted time basis lost 8.6 pounds, whereas ewes grazed on a continuous basis gained 4.9 pounds. This difference was statistically significant.
4. Ewe production factors such as fleece weight, number of barren ewes, lambing percentage, and lamb birth weight were not affected by treatment.
5. Restricted time grazing of oats-rape resulted in an appreciably greater increase in number of ewe grazing days than the same system employed with ewes grazing Sudan grass. However, restricted time grazing of Sudan grass increased carrying capacity 60 percent.
6. The drylot pen constructed within the pasture should provide water, salt and other minerals, and shade. Shade is essential so that the ewes will enter the pen, and confining them will be merely a matter of closing the gate.

The above described system of grazing management of nonlactating ewes offers an opportunity to increase tremendously the number of ewes that can be pastured per acre and thereby cut the feed bill for the ewe during this relatively long period. At the same time, this system of pasture management involves a minimum of labor. Thus this plan should have considerable application for the commercial sheepman who is weaning his lambs at an early age.

GESTATION RATIONS

Hay pellets and beet pulp pellets. Alfalfa or mixed hay is considered the standard ration for gestating ewes. However, many sheepmen are interested in handling less bulk and would like to substitute other feeds that are more easily handled or that may cost less. Pelleted alfalfa is easily handled. However, the typical cost of grinding and pelleting hay is about $10 to $12 per ton. Therefore, it is not an inexpensive ration in comparison to baled hay. Unless smaller amounts of pelleted hay can be fed per ewe daily and still provide the same level of production, it would appear that hay pellets have a limited place in commercial ewe rations.

Beet pulp pellets, a by-product of the sugar beet industry, are not only in a convenient form to feed but are often quite economical in comparison to hay and shelled corn. The usual cost of beet pulp pellets is $35 to $40 a ton. Beet pulp is somewhat lower in TDN than corn and is considerably higher in fiber.

A series of trials were conducted to determine the relative value of pelleted alfalfa hay and long hay as well as the value of beet pulp pellets when fed in relatively large amounts to gestating ewes. The experimental treatments were as follows:

1. Control ration: Ewes were fed 4 pounds of long alfalfa hay per head daily. During the last 30 days of the experiment .5 pound of shelled corn per ewe was added to the daily hay ration.
2. Alfalfa hay pellets were fed at 60 percent by weight of the amount fed in treatment 1. During the last 30 days .5 pound of shelled corn was added to the above ration.

Table 8. Effect of grazing management on nonlactating ewes (summary of 1962 and 1963).

Forage grazing treatment*	Oats-rape		Sudan grass	
	Continuous	Restricted	Continuous	Restricted
Number tester ewes†	14	29	13	16
Initial wt., lb.	152.20	148.90	156.30	154.50
Weight change, lb.	4.90	−8.60^{xx}	−1.50	−5.20
Ewe grazing days/acre‡	689.00	1,467.00	766.00	1,224.00^{xx}
Increase in ewe grazing days, percent		113.00		60.00
Ewe production				
Fleece wt., lb.	9.20	9.20	8.10	8.00
Number barren ewes	1	2	0	1
Lambing rate, percent§	161.00	158.00	154.00	153.00
Lamb birth wt., lb.	10.80	11.10	11.70	12.10

* Average of 3 replications each.
† Weight changes of the ewes, fleece weights and lamb production were obtained only from the "tester" ewes. Weight changes and lamb production of ewes grazed on Sudan represent only one year's data.
‡ Ewe grazing days includes tester and grazer ewes.
§ Based only on ewes lambing.
^{xx} Significantly ($P < .01$) different.

Table 9. Effect of pelleted alfalfa hay and beet pulp in gestating ewe rations (summary of 3 trials).

Treatments*	Alfalfa hay	Alfalfa hay pellets (60%)	Alfalfa hay pellets (80%)	Alfalfa hay and beet pulp pellets (50%)
Lot Number	1	2	3	4
Number of ewes	42	42	42	42
Days fed	115.00	115.00	115.00	115.00
Average initial wt., lb.	176.40	176.20	176.90	177.80
Average gain, lb.	31.50^{xx}	11.20	22.20^{x}	13.00
Average daily feed consumed, lb.				
Alfalfa hay	3.91	...	...	...
Shelled corn	.10	.10	.10	...
Hay pellets	...	2.40	3.20	1.19
Beet pulp and SBM (4:1)	...	...	...	1.00
T.M. salt and dicalcium phosphate	.07	.24	.25	.26
Ewe production†				
Average fleece wt., lb.	10.60	9.80	10.60	10.40
Number of barren ewes	3	4	2	1
Average lambing rate, percent	194.10	173.30	183.70	168.20
Average lamb birth wt., lb.	10.40	10.40	10.40	10.30
Average lamb wt., 30 days	28.50	27.80	28.40	28.10

* Alfalfa hay pellets in treatments 2 and 3 were fed at 60 percent and 80 percent respectively, by weight of the hay fed in treatment 1. The beet pulp and hay fed in treatment 4 was at 50 percent by weight of the hay in treatment 1. During the last 3 weeks ewes in treatments 1, 2, and 3 were fed. .5 pound shelled corn and ewes in treatment 4, 1.0 pound additional hay per ewe daily. Soybean meal abbreviated SBM.

† Lambing rate is based on ewes lambing. Four ewes in Lot 4 and one ewe in treatment 3 aborted. Two ewes in each of treatments 2 and 3 choked to death.

^{xx} $P < .01$.

^{x} $P < .05$.

3. Alfalfa hay pellets were fed at 80 percent by weight of the amount fed in treatment 1. During the last 30 days .5 pound of shelled corn was fed per ewe daily.
4. Equal parts by weight of pelleted beet pulp and long alfalfa hay were fed in an amount equal to 50 percent by weight of that fed to the ewes in treatment 1. During the last 30 days an additional 1 pound of alfalfa hay was fed per ewe daily.

There was good agreement among the three trials, thus permitting pooling of the data. The design of the experiment, number of ewes, feed consumption, and other pertinent data from the three trials are presented in table 9.

CONCLUSIONS

1. When the majority of the ration of gestating ewes was fed as either pelleted alfalfa hay or long alfalfa hay, pelleting **per se** did not enhance its value as a source of energy. Based on weight gain of the ewes, the level of feed consumed largely determined the amount of ewe gains. In this case 4 pounds of long alfalfa hay per ewe daily resulted in significantly greater weight gains than 2.4 pounds (60 percent by weight) of alfalfa hay pellets or than 3.2 pounds (80 percent by weight) of alfalfa hay pellets.
2. Equal parts of pelleted beet pulp and alfalfa hay when fed at 50 percent by weight of the amount of long hay fed resulted in significantly lower weight gains. However, the amount of weight gained by ewes fed beet pulp was very similar to the amount gained by the ewes fed hay pellets at the 60 percent level.
3. Fleece weights, lamb birth weight, and lamb gains to 30 days were not affected by any of the treatments. Ewes fed alfalfa hay or hay pellets at the 80 percent level had a greater lambing percentage. This difference is statistically significant. However, since the ewes were bred before being placed on experiment, there may be some question if there was a real difference, particularly since this difference has not appeared in other experiments where low levels of TDN were fed.
4. Abnormal amounts of salt and trace minerals were consumed by the ewes fed these low levels of TDN. For example, ewes fed the ⅜-inch hay pellets or the beet pulp consumed about four times more salt and mineral than the ewes fed long hay. In addition, ewes fed hay pellets (limited amounts) tended to bolt their feed. This caused considerable difficulty with ewes choking.

To minimize the problem of ewes choking, another trial with pelleted hay was conducted. In this case rations containing various levels of pelleted hay were limited to 80 percent by weight of that fed ewes receiving the standard long hay ration. The following treatments were employed:

1. Control ration: Ewes received 4 pounds of alfalfa hay per ewe daily. During the last 30 days an additional .5 pound of shelled corn was fed per ewe daily.
2. Ewes received .5 pound of long hay plus 2.5 pounds of hay pellets or a total 3.2 pounds of feed (80 percent of the amount fed in treatment 1). In addition .5 pound of shelled corn was fed during the last 30 days.
3. Ewes were fed 1 pound of hay and 2.2 pounds of hay pellets per ewe daily plus .5 pound of shelled corn during the last 30 days.
4. Ewes were fed 1.5 pounds of long hay and 1.7 pounds of hay pellets per ewe daily plus .5 pound of shelled corn the last 30 days.

The results of the trials are presented in table 10.

CONCLUSIONS

1. Ewes fed 4 pounds of hay gained significantly more than ewes fed pellets and long hay (80 percent by weight of that fed in treatment 1).
2. There was no difference in weight gain of the ewes fed either .5 pound, 1 pound, or 1.5 pounds of long hay in addition to hay pellets.

3. None of the levels of long hay added to the hay pellet rations completely eliminated the problem of choking or significantly reduced the amount of trace mineral consumed. For example, ewes fed rations containing hay pellets (80 percent by weight of the control ration) consumed two to two and one-half times more of a mixture of salt and dicalcium phosphate and about six to 10 times more dicalcium phosphate than the ewes fed the standard hay ration.
4. While weight gains were greater among the ewes fed the standard hay ration, fleece weight, lamb birth weight, and lamb weight at 30 days were not affected. Ewes fed the long hay ration tended to have higher lambing rates. However, the difference between treatments was not statistically significant.

POULTRY LITTER AND OYSTER SHELLS FOR GESTATING EWES

While high corn and low roughage rations fed at 50 percent by weight of a conventional hay ration have resulted in satisfactory production, it was quite apparent that the ewes had a craving for additional roughage and usually ate two to three times more salt and mineral mixture than normal. To minimize these problems and at the same time reduce the amount of bulky hay fed, poultry litter and oyster shells were added to gestation rations.

Poultry litter is not only a source of bulk but is also a source of protein and energy. Analyses of poultry litter fed at the Minnesota station and also at the Virginia station are presented in table 11.

Oyster shells were added to the gestation ration as it has been demonstrated that these shells have some value as a roughage substitute when added to fattening cattle rations.

Two replicated trials involving the use of poultry litter in gestation rations and one replicated trial with oyster shells were conducted. Treatments of the first trial were as follows:

1. **Control ration**—Four pounds alfalfa-brome hay per ewe daily. During the last 28 days of the experiment .5 pound of shelled corn was added.
2. **Low hay**—2.25 pounds of alfalfa-brome hay, .5 pound of shelled corn, .1 pound of soybean meal per ewe daily. During the last 28 days .5 pound of shelled corn per ewe daily was added.
3. **Poultry litter**—2.25 pounds of hay, .5 pound of shelled corn, .75 pound of poultry litter, plus .5 pound of shelled corn the last 28 days. The poultry litter replaced the soybean meal.
4. **Oyster shells**—1.5 pounds shelled corn, .4 pound of soybean meal, .1 pound oyster shell per ewe daily. During the last 28 days an additional 1 pound of alfalfa-brome hay was fed per ewe daily.

The control ration was fed at a level to meet the National Research Council requirements for gestating ewes and supplied more calculated TDN than any of the other rations.

A second trial involving poultry litter was conducted and involved the following replicated treatments:

1. Control ration: 4 pounds of hay per ewe daily plus .5 pound of shelled corn per ewe daily during the last 28 days.
2. 1.5 pounds of alfalfa-brome hay, .65 pound shelled corn, .65 pound of poultry litter per ewe daily plus 1 pound of alfalfa-brome hay during the last 28 days.

The design of the experiment and the results are presented in tables 12 and 13.

Table 11. Chemical composition of wood shaving poultry litter.

Component	Experiment Station	
	Virginia Broiler litter	Minnesota Layer litter
Dry matter, percent	88.90	87.70
Crude protein, percent	30.60	18.70
Crude fiber, percent	14.60	33.30
Ether extract, percent	2.80	1.50
Ash, percent	19.00	13.40
NFE, percent	33.10	20.90
Calcium, percent	2.50	...
Phosphorus, percent	2.30	...
Gross energy, kcal/gm.	3.75	3.46

CONCLUSIONS

1. Weight gains of the ewes fed limited amounts of alfalfa-brome hay supplemented with shelled corn were greater than those of the ewes fed the standard hay ration even though the hay ration provided

Table 10. Effect of feeding various proportions of hay pellets and hay to gestating ewes.

Treatment*	Alfalfa hay	Pellets and .5 lb. hay	Pellets and 1.0 lb. hay	Pellets and 1.5 lb. hay
Number of ewes	16	16	16	16
Average initial wt., lb.	176.90	176.40	178.90	178.00
Average gain, lb.	18.70‡	14.30	12.50	15.40
Days fed	103.00	103.00	103.00	103.00
Average daily feed consumed, lb.				
Hay	3.89	.50	1.00	1.50
Pelleted hay	...	2.70	2.20	1.70
Shelled corn	.09	.09	.09	.09
T.M. salt and dicalcium phosphate (2:1)	.063	.187	.175	.161
Ewe production†				
Average fleece wt., lb.	12.80	12.30	12.80	12.50
Number barren ewes	2	2	...	1
Lambing rate, percent	192.80	178.50	168.80	173.30
Lamb birth wt., lb.	10.60	11.00	11.00	10.80
Lamb wt., 30 days, lb.	25.10	27.50	28.40	26.80

* The amount of the combined hay pellet and hay ration fed per ewe daily was limited to 80 percent of the amount fed as hay in treatment 1. During the last 19 days an additional .1 pound of corn was fed per ewe daily.
† Lambing rate is based on ewes lambing.
‡ $P < .05$

more calculated TDN. These results are in agreement with earlier reported data and again indicate that the calculated TDN values for hay may be overestimated.

2. The greatest weight gains were made by the ewes supplemented with poultry litter. Futhermore, there was less fluctuation in their weights during the course of the experiment. The ewes tended to gain slightly more throughout the trial, whereas ewes fed corn, hay, and soybean meal (limited amounts) made the majority of their weight gains during the last 28 days when additional feed was fed.
3. Production factors such as fleece weight, lamb birth weight, and lamb gains to 30 days were not affected by treatment. Ewes fed dry poultry litter tended to have a lower lambing percentage. The number of ewes involved in the experiment was not sufficient to demonstrate that these differences were significant, but it should be pointed out that in both experiments involving poultry litter lower lambing rates resulted.

In the second trial involving poultry litter there was little difference in weight gains of ewes fed the standard hay ration and those fed limited amounts of hay supplemented with corn and poultry litter. This was true in spite of the fact that the poultry litter ration provided appreciably less calculated TDN from corn and hay. How valuable poultry litter is as a source of protein and feed nutrients is largely dependent upon the proportion of bedding (wood shavings or oats hulls) that it contains and also the amount of spilled feed in it.

For these reasons it is quite difficult to realistically calculate TDN. Poultry litter does provide a good source of bulk and no difficulty was experienced in getting the ewes to consume rather liberal amounts of it. Furthermore, no disease problems were encountered among ewes fed poultry litter and it had no effect on ewes carrying lambs to term.

Oyster shells were satisfactory as a roughage substitute for gestating ewes. The ewes had a definite craving for roughage and tended to consume some of the woodshavings which were used as bedding. However, their weight gains were good (23.8 pounds of gain), and wool and lamb production was as great as that of ewes fed the standard hay ration.

Table 12. Effect of poultry litter and oyster shells when fed in conjunction with low level of roughage to gestating ewes.

Treatment*	Hay	Hay Corn SBM	Hay P. Litter Corn	Corn SBM Oyster shells
Item				
Number of ewes	20	20	20	20
Initial wt., lb.	176.70	176.40	176.00	178.80
Weight change, lb.	16.90	20.50	24.60	23.80
Days fed	84.00	84.00	84.00	84.00
Daily feed consumed, lb.				
Alfalfa-brome hay	3.91	2.24	2.25	.30
Poultry litter	...	...	.75	...
Shelled corn	.15	.65	.65	1.50
Soybean Meal	...	.10	...	.40
Oyster shells	...	...	...	.10
TDN, calculated	2.08	1.72	1.64	1.67
Ewe production†				
Fleece wt., lb.	8.80	8.90	8.60	8.80
Lambing rate, percent	178.00	182.00	157.00	179.00
Number barren ewes	1	1	0	0
Lamb birth wt., lb.	10.30	10.30	10.70	10.10
Lamb wt., 30 days, lb.	24.70	24.60	24.90	24.50

* All ewes were fed once daily. The shelled corn was cracked and pellet size oyster shells and soybean meal (SBM) were fed on top of the corn.
† Lambing percent is based on ewes lambing and includes lambs that appeared normal but were born dead. The number of lambs born dead was the same for all treatments.

Table 13. Effect of poultry litter in gestating ewe rations.

Treatment*	Hay	Hay poultry litter, shelled corn
Item		
Number of ewes	20	20
Initial wt., lb.	160.80	152.70
Weight change, lb.	26.40	27.70
Days fed	110.00	110.00
Daily feed consumed, lb.		
Alfalfa-brome	3.95	1.70
Poultry litter	...	.65
Shelled corn	.12	.65
TDN, calculated†	2.08	1.36
Ewe production‡		
Fleece wt., lb.	10.30	9.90
Lambing rate, percent	176.00	152.00
Number barren ewes	2	2
Lamb birth wt., lb.	10.70	10.20
Lamb wt., 30 days, lb.	27.00	25.80

* All ewes were fed once daily.
† Average TDN consumed. No TDN value credited to the poultry litter.
‡ Lambing rate based on ewes lambing.

GRASS SILAGE AND CORN SILAGE RATIONS

It is often more economical to harvest grass forages as silage or haylage than as hay. Top producing varieties and modern methods of production of corn silage often provide more nutrients at less cost per acre than any other crop. Thus it may be more economical to produce corn and use it as the source of forage than to diversify and produce some corn silage and some hay. Both of these types of silage (grass or corn) are bulky, high-moisture feeds. However, many sheepmen have the misconception that ewes fed silage will produce excessively large but weak lambs.

Is it feasible to feed ewes silage three times per week? Should some hay be fed with the silage? Can we substitute shelled corn for the hay and a portion of the silage, thereby reducing the bulk and labor required to feed it? To answer these questions a series of experiments were conducted that involved the feeding of 1) grass silage daily or three times per week, and 2) corn silage with and without hay.

The specific treatments were as follows:

Grass Silage

1. Control ration: Ewes were full-fed grass silage (6 to 7 pounds per ewe daily) 1 pound of hay and .1 pound of soybean meal. During the last 28 days of the experiment an additional .5 pound of shelled corn was fed per ewe daily. The grass silage was made from alfalfa and bromegrass forage and contained 48.5 and 28.2 percent dry matter in 1963 and 1964, respectively.
2. The ewes received half as much grass silage as in treatment 1. No hay and more shelled corn were fed. The amount of corn fed was determined by assuming that 3 pounds of silage were equal to .5 pound of shelled corn. Sufficient soybean meal was fed to provide adequate protein to the ewes. During the last 28 days an additional .5 pound of shelled corn was fed per ewe daily.
3. The kind and amount of feed was the same as that in treatment 1 with the exception that the ewes were fed three times per week.
4. The ewes were fed as in treatment 2 with the exception that they received their feed three times per week.

Corn Silage

The experiments involving the feeding of corn silage three times per week to gestating ewes included the following specific treatments:

1. Ewes received a full feed of corn silage and the equivalent of .3 pound soybean meal per ewe daily.
2. Ewes received the equivalent of 1 pound of hay daily and as much corn silage as they would readily eat.

These treatments were replicated during each of 2 years. The corn silage was immature and had very few ears the first year of the experiment. Therefore to make the silage more typical, 10 percent by weight of the amount of corn silage fed was added as shelled corn. The second year only 5 percent shelled corn was added to the silage and this for only the first 28 days.

The results of the experiments involving grass silage are presented in table 14 and those with corn silage with and without added hay are presented in table 15.

CONCLUSIONS

Grass Silage

1. Substituting shelled corn for a portion of the grass silage resulted in significantly greater ewe gains in both trials. This was true in spite of the fact that the calculated TDN the ewes consumed was somewhat less that that consumed by ewes receiving the high silage rations.
2. Feeding high levels of grass silage three times weekly rather than daily was economical from a labor standpoint, as choring time (including tractor time) is approximately the same irrespective of the amount of silage fed per ewe daily.
3. Weight gains of the ewes fed daily were somewhat greater than those fed three times per week. This may be explained by the fact that during extremely cold weather (—20° and colder) the silage froze before the ewes had an opportunity to eat all of it. During those cold periods their intake was more variable.
4. Ewe production factors such as fleece weight, lambing percentage, lamb birth weight, and lamb weights at 30 days were not affected by treatment (table 14).

Corn Silage

1. In one trial, ewes fed corn silage plus hay gained somewhat more (both replications) than ewes fed only the corn silage. However in the second replicated trial, weight gains were almost identical among treatments. Calculated TDN intake was the same among the various treatments (table 15).
2. Ewe production—including fleece weight, lambing percentage, lamb birth weight, and weight gains of lambs to 30 days—was not affected by treatment. It was concluded that high amounts of either grass silage or corn silage (plus a protein supplement) can be fed as the sole forage to gestating ewes. Feeding silages three times per week rather than daily saves labor and does not adversely affect production.

Table 14. Grass silage and hay rations compared to grass silage and corn rations for gestating ewes (1963 to 1965).

	Fed daily		Fed 3 times weekly	
	Silage	Silage	Silage	Silage
Ration*	hay	shelled corn	hay	shelled corn
Number ewes	49	49	49	48
Initial wt., lb.	126.50	123.60	126.70	128.70
Weight change, lb.	13.60	21.10	10.60	15.20
Days fed	105.00	105.00	105.00	105.00
Daily feed, lb.				
Alfalfa-brome hay	1.00	.22	1.00	.22
Alfalfa-brome silage	6.90	3.48	6.90	3.48
Shelled corn	.13	1.12	.13	1.12
Soybean meal	.13	.13	.13	.13
TDN, calculated†	2.29	1.91	2.29	1.91
Ewe production				
Fleece wt., lb.	7.00	6.80	6.80	7.30
Lambing percent	132.00	149.00	145.00	142.00
Number barren ewes	0	7	4	3
Lamb birth wt., lb.	9.70	9.90	9.50	9.00
Lamb 30 day wt., lb.	24.20	24.20	22.70	23.10

* Dry matter content: grass silage 48.5 and 28.2 percent in 1963 and 1964, respectively; hay, 92-90 percent; crude protein: grass silage, 7.8 and 4.3 percent in 1963 and 1964, respectively; hay, 9.8 and 16.3 percent.
† TDN calculated using the following values: hay, 50 percent, corn and soybean meal 80 percent, and silage 28.5 and 18 percent in 1963 and 1964, respectively.

Table 15. Effect of corn silage when fed with and without supplemental hay to gestating ewes (average of 4 replications per treatment).

Ration*	Corn silage	Corn silage hay
Number ewes	56	56
Initial wt., lb.	132.40	132.50
Weight change, lb.	26.40	29.30
Days fed	100.00	100.00
Daily feed, lb.†		
Alfalfa-brome hay		.95
Corn silage	10.20	8.07
Shelled corn	.54	.43
Soybean meal	24.00	.15
TDN, calculated‡	2.11	2.13
Ewe production		
Fleece wt., lb.	8.10	8.40
Lambing percent	151.70	149.50
Number barren ewes	3	4
Lamb birth wt., lb.	9.50	9.70
Lamb 30 day wt., lb.	24.40	25.30

* Rations were fed 3 times weekly.
† Dry matter content of the feeds were: shelled corn, 88 percent; alfalfa-brome hay, 89-90 percent; corn silage (immature and few ears) 22.5-25 percent; crude protein (dry matter basis) corn, 10.7 percent; hay, 15.9-18.8 percent and corn silage, 11.3 and 8.7 percent.
‡ TDN was calculated using the following values: corn silage 1965, 13 percent and 1966, 16 percent; hay, 50 percent and shelled corn and soybean meal, 80 percent.

SUMMARY

A series of experiments involving the nutrition and management of ewes at various stages of production were conducted. The data warrant the following conclusions:

1. Feeding three times per week rather than daily has no bearing on performance of the ewes. Further, the scheme may be used with conventional hay rations, high grain rations, or all silage rations. It saves labor.

2. High energy rations (half hay and half grain) fed ewes at reduced levels result in as great production as conventional hay rations. The high energy rations are more digestible, require less labor to feed, and often result in lower feed cost per ewe.

3. Feed costs per ewe can be drastically reduced by feeding less feed during the summer dry period. Two pounds of good hay, equivalent to 1 pound TDN or 2,000 Kcal. of digestible energy per 100 pounds of body weight per day, maintained dry ewes. Weight losses of 5 to 10 percent in the summer followed by adequate feeding during gestation did not affect subsequent wool and lamb production.

4. Restricting grazing time of nonlactating ewes to about 50 percent of normal increased the number of ewes that could be maintained per acre by 25 to 113 percent. Ewes lost weight but weight loss occurring at this period had no effect on later wool or lamb production.

5. Pelleted hay is convenient to feed but under most conditions is too costly a feed for ewes. Restricting the amount of pellets fed resulted in considerable choking among the ewes and a four- to tenfold increase in salt and mineral (calcium and phosphorous) consumption.

6. So long as the nutrient requirements (energy, protein, minerals, and vitamins) of the ewe are met, it seems to make little difference what feed source is used to provide them. Corn, supplement and oyster shells, corn and poultry litter, or all silage rations worked equally well.

7. There are many feeding and management schemes that can result in lower costs of production without reducing production level. Efforts to reduce costs may result in greater net return for some sheep producers than increased inputs in hopes of increasing production. Obviously, maximum returns will occur when both lower production costs and high production accompany one another.