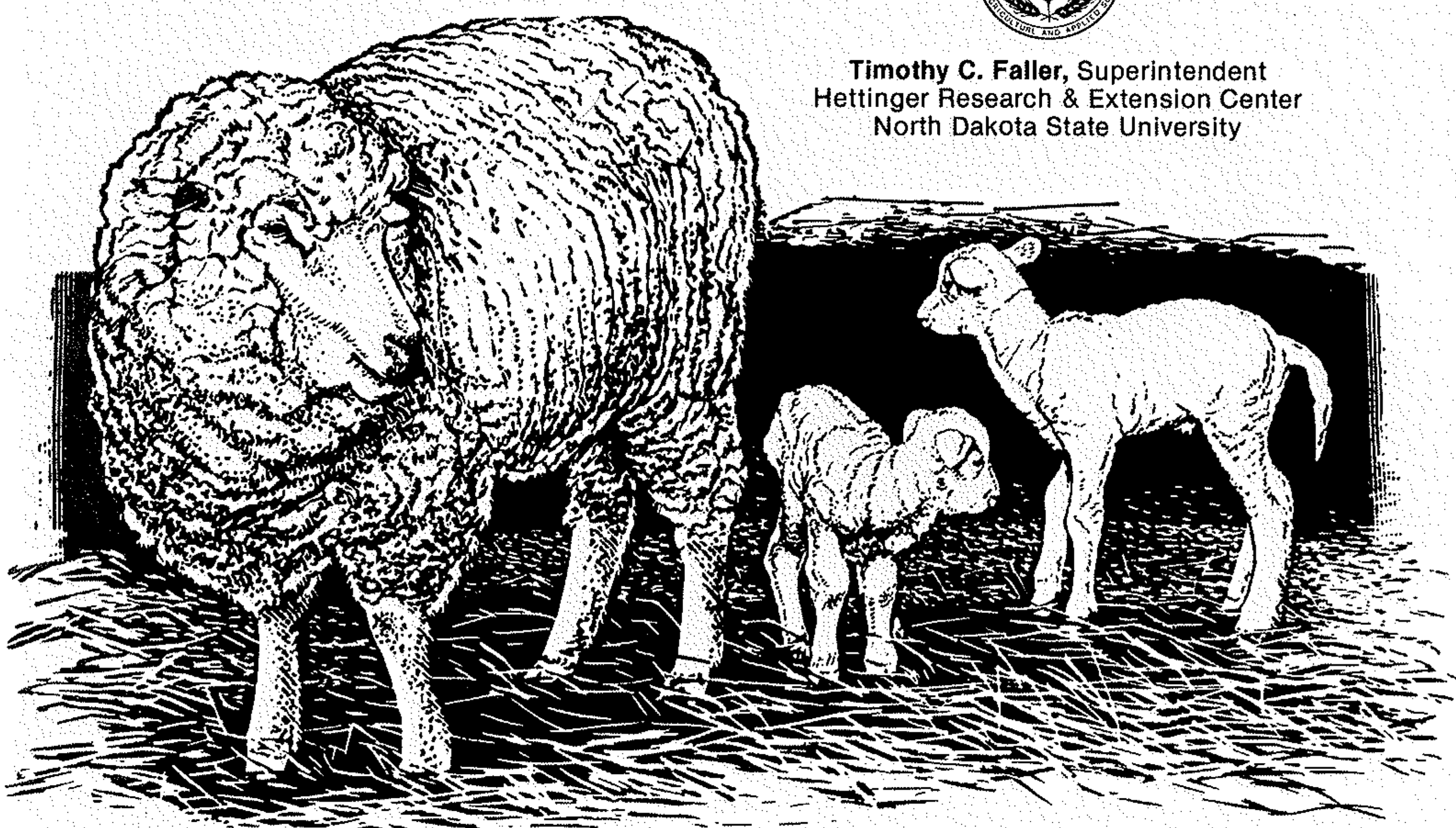
28th Annual Western Dakota SHEEP DAY

Hettinger Armory
February 11, 1987

Timothy C. Faller, Superintendent
Hettinger Research & Extension Center
North Dakota State University



PROGRAM

9:00 AM (MST)	Tours at the Station
10:00 AM	Coffee
10:20 AM	HETTINGER & FARGO STATION REPORTS Dr. Duane Erickson Roger Haugen Dr. Kris Ringwall Mr. Timothy Faller
12:00 NOON	LUNCH: ROAST AMERICAN LAMB
1:10 PM	WELCOME Dr. H.R. Lund, Director Agriculture Experiment Station North Dakota State University
1:25 PM	CONTROL OF THE KED Dr. Dennis Kopp & Dr. Hendrik Meyer Entomology Department North Dakota State University
2:05 PM	FARM FLOCK MANAGEMENT Mr. Gerhard Reichenbach Sidney, Montana
2:35 PM	MEETING THE MINERAL NEEDS OF YOUR SHEEP OPERATION Dr. Art Pope Animal Scientist University of Wisconsin
3:20 PM	CLOSING REMARKS Fred Eagleson President N.D.L.W.P.A. Buchanan, North Dakota

*There will be a program for the ladies in the afternoon featuring "The Red Meat Controversy" and "New Techniques for Sewing with Wool in '87"

SHEEP DAY DIGEST
by
Timothy C. Faller, Superintendent
Hettinger Research and Extension Center
North Dakota State University

SECTION I

REPORTS OF RESEARCH IN PROGRESS

AT THE

HETTINGER RESEARCH & EXTENSION CENTER

AND MAIN STATION

PRESENTED BY

TIMOTHY C. FALLER
SUPERINTENDENT

DR. DUANE ERICKSON
ANIMAL & RANGE SCIENCE DEPT.
NORTH DAKOTA STATE UNIVERSITY

DR. KRIS RINGWALL
HETTINGER RESEARCH & EXTENSION CENTER

ROGER HAUGEN
EXTENSION LIVESTOCK SPECIALIST
FARGO, NORTH DAKOTA

AT THE

28TH ANNUAL SHEEP DAY

HETTINGER RESEARCH & EXTENSION CENTER
HETTINGER, NORTH DAKOTA

FEBRUARY 11, 1987

BARLEY (LIGHT AND HEAVY) COMPARED TO CORN FOR FEEDER LAMBS

Lamb Feeding Experiments
Spring and Summer 1986

D.O. Erickson, T.C. Faller, K.A. Ringwall, J.T. Schmidt, W.D. Slanger, M.J. Marchello and P.T. Berg

Summary

To determine the relative feeding value of barley (light and heavy) alfalfa-SBM diets to a standard corn-alfalfa-SBM for finishing lambs in terms of lamb performance, digestibilities and carcass characteristics. The diets of heavy barley (HB) light barley (LB), a combination of light and heavy barley (Comb) and corn (C) were tested in three 2x4 experiments utilizing 640 early weaned lambs. This design resulted in six replicates per dietary treatment. Initial weights for the lambs averaged 65, 70 and 79 pounds respectively for the three experiments. Daily feed intakes were for 3.68 (HB), 3.95 (LB), 3.79 (Comb) and 3.89 (C). In each experiment the lambs consumed more of the light barley diet compared to heavy barley but the differences were not significant. Feed/gains were 7.27 for light barley which was higher ($P<.05$) than 6.35 for corn. There were no differences in feed efficiency among the barley diets. The corn fed lambs gained more ($P<.05$) rapidly than those fed any of the barley diets. There were no differences in gain among the barley lots. Digestibilities (IVDMD) of the diets were 69 (HB), 67 (LB), 68 (Comb) and 71 (C) with the corn diet being higher ($P<.05$) than the light barley diet. The carcass parameters of grade, fat, yield grade and loin area were unaffected by diet. The dressing percentage was slightly higher ($P<.05$) for corn 50.9 compared to 49.7 (HB), 49.7 (Comb) and 49.3% (LB). These data would indicate that barley fed lamb produce carcasses of comparable merit to those fed corn. The work reported from the Fargo Station indicated that all the lambs graded choice both on corn or barley. The quality of the barley, when fed in high energy diets, did not affect any of the carcass traits. All of the lambs responded satisfactorily to all the diets in performance and carcass characteristics. Producers can utilize the feed grains available to them (economically) and with proper supplementation expect satisfactory feeder lamb production.

Introduction

Information concerning the use of barleys as the primary energy source for finishing lambs is limiting. There is a need to determine the nutritional comparisons of barley to corn and how these nutritional comparisons affect the performance of finishing lambs. The differences or similarities of the resulting carcasses produced from corn or barley feeding is currently unknown. It is possible that barley fed lambs are discriminated against at the market in comparison to corn fed lambs. There is a need to determine the effect of various barley qualities on lamb performance and carcass characteristics. Comparisons need to be made on a one to one replacement of barley for corn and light barley for heavy barley on an equal protein basis. The information generated from these comparisons concerning rate of gain, feed efficiency, dressing percentage, shrink, quality grade and yield grade would be very useful to the feed industry, sheep producers and the meats industry.

Objectives

The major objectives of these studies concerning the feeding of barley and barleys of different quality in an alfalfa/SBM diet to finishing lambs are:

> To compare the standard corn-alfalfa-SBM diet to light, heavy and a mixture of light and heavy barley on a one to one grain replacement basis and on an equal protein but a variable TDN basis.

Procedures

Early weaned lambs (56 day) were allotted by sex, breed and weight and put on experiment at an average weight of between 65 to 79 pounds. They were weighed individually every two weeks and feed intakes by pens were recorded. Each of the three experiments had four dietary treatments and each treatment was duplicated in each experiment. The three experiments involved 640 lambs (160/diet) with a total of 6 replications on each diet. The individual identities of the lambs were lost at the slaughter plant from 2 experiments therefore carcass data were obtained only from experiment three. The lambs were taken off experiment when they averaged about 100 pounds.

Feedstuff samples were taken prior to the experiments and the diets formulations are based on the results of these sample analysis (Tables 1 and 2). Approximately 20 samples of each diet were taken for nutritional analysis during the trial in order to more accurately relate lamb performance and carcass characteristics to diet composition (Table 3). Diets were fed ad libitum in complete mixed ground form. Feed residues will be weighed back at the close of each experiment to more accurately measure feed intake and feed efficiency. The diets were balanced to contain 16% protein. The grains were on a one to one replacement so the digestible energy (TDN) varied among the diets ranging from 64% for light barley to 74% for corn (Table 2). These differences would be expected to result in variable feed efficiencies and possibly other parameters.

Results and Discussion

The composition of the diets based on the analysis of the samples taken during the experiments is shown in Table 3. The proteins were all above 14% which meets the requirements for finishing lambs. These values are lower than the intended 16% protein (Table 2). The fiber levels ranged from 12.5 (C) to 14.8 (LB) (Table 3) which was not as wide a range as the calculated values of 11.5% (C) to 15.8% (LB) (Table 2). This might account for the similar digestibilities among the diets as measured by IVDMD which were 71 (C), 67 (LB), 69 (HB) and 68% (Comb) (Table 4) compared to the calculated TDN values (Table 2) of 74, 64, 69 and 67% respectively for those diets. The Ca:P ratios and concentrations were very acceptable in all diets (Table 3).

The results of lamb performance, digestibilities and carcass parameters are all given in Table 4. Gains were similar among the barley diets but the lambs fed corn gained faster ($P<.05$) than those on light barley (.615 vs .547#/d). The response was the same in all 3 experiments. The lambs fed any of the barley diets had similar requirements of feed/gain 6.73 (HB), 7.27 (LB) and 7.06 (Comb) compared to corn 6.35 which was more ($P<.05$) efficient than light barley. Those results were also very similar across the 3 experiments. Feed intakes were variable among experiments with the most intake on light barley 3.95#/d compared to 3.68 (HB) and 3.79 (Comb). The lambs on corn ate 3.87#/d. None of these values varied significantly but it does appear that the lambs attempt to consume more of the lower energy barley diets. The carcass parameters of grade, fat, yield grade and loin eye area were similar among diets (barley quality and barley vs corn). The dressing percentage for corn was higher ($P<.05$) 50.9 compared to 49.7 for HB and Comb and 49.3 for LB. This information suggests that the bushel weight of barley has little effect on lamb performance and carcass characteristics if fed in high energy (low roughage diets). The lambs appear to consume more of the diets containing the low bushel weight to compensate for the lower energy level of those diets. Based on these data and that reported in previous years supports the recommendation that a producer can utilize the feed grains that are economically available with proper supplementation and expect satisfactory lamb performance and acceptable carcasses. Information is needed concerning the various grain quality and grain comparisons in diets of equal energy. Information is also needed concerning the feeding of whole grains compared to ground.

Acknowledgment

The support of the North Dakota Barley Council in supplying all of the barley used in this research is sincerely appreciated by the Agricultural Experiment Station NDSU at Hettinger and the Animal and Range Sciences Department at NDSU.

TABLE 1. COMPOSITION[a] OF FEEDSTUFFS USED IN THE DIETS FOR LAMB FINISHING EXPERIMENTS CONDUCTED AT HETTINGER 1986

Feedstuff	Bu. wt.	Protein	% TDN	ADF	Ca	P
Alfalfa	-	16.0	52	34.0	1.25	.173
Barley (L)	39.8	14.5	69	9.5	.056	.330
Barley (H)	49.6	12.5	77	6.2	.046	.290
Corn	52.0	8.7	84	2.0	.012	.285
SBM	-	44.0	78	10.0	.250	.600
Limestone	-	-	-	-	36	-
Dicalcium phosphate	-	-	-	-	22	18

[a]As is or 90% Dry

Composition common to all diets
- Trace mineral salt .5%
- Limestone .5% (36% Ca)
- Dicalcium phosphate .5% (22% Ca and 18% P)
- Ammonium chloride .5%
- Super pellets (rumensin) 1.25%
- Vitamins ADE .05% according to recommendations
- Terramycin 2.5g/100# of diet

TABLE 2. EXPERIMENTAL DIETS FOR FINISHING LAMB EXPERIMENTS AT HETTINGER 1986

Feedstuff	% of diet	Protein	% TDN	ADF	Ca[a]	P[a]
Corn - Control						
Alfalfa	26.0	4.16	13.52	8.84	.325	.045
Corn	57.5	5.00	48.47	1.15	.007	.163
SBM	15.5	6.82	12.09	1.55	.039	.093
Totals	99	15.98	74.08	11.54	.671	.391
Light Barley						
Alfalfa	26.0	4.16	13.52	8.84	.325	.045
Barley (LB)	68.8	9.98	47.61	6.54	.039	.227
SBM	4.2	1.85	3.28	.42	.010	.025
Totals	99	15.99	64.41	15.8	.674	.387
Heavy Barley						
Alfalfa	26.0	4.16	13.52	8.84	.325	.045
Barley (HB)	64.4	8.05	49.59	3.99	.030	.187
SBM	8.6	3.78	6.71	.86	.022	.052
Totals	99	15.99	69.82	13.69	.677	.374
Mixed Barley						
Alfalfa	26.0	4.16	13.52	8.84	.325	.045
Barley (LB)	33.3	4.82	22.98	3.16	.019	.110
Barley (HB)	33.3	4.16	25.64	2.06	.015	.097
SBM	6.4	2.82	4.99	.64	.016	.038
Totals	99	15.97	67.13	14.70	.675	.380

[a]Ca & P calculated with .5% each of limestone and dicalcium phosphate.

TABLE 3. AVERAGE NUTRITIONAL COMPOSITION[a] AND STANDARD DEVIATIONS[b] OF THE DIETS USED IN THE THREE EXPERIMENTS FOR FINISHING LAMBS HETTINGER 1986.

	Corn		Barley (L)		Barley (H)		Barley (L&H)	
Component	Ave	SD±	Ave	SD±	Ave	SD±	Ave	SD±
Protein	15.1	1.52	14.6	1.00	14.4	.82	14.1	.99
ADF	12.5	1.68	14.8	2.16	12.9	2.27	13.3	2.05
ADL	2.49	.62	2.59	.51	2.26	.52	2.37	.51
Ash	5.0	.72	5.2	.94	4.8	.94	4.6	.69
P	.39	.053	.37	.040	.34	.042	.34	.047
Ca	.57	.111	.56	.170	.51	.237	.51	.143
Mg	.20	.017	.19	.020	.19	.037	.18	.025

[a]As is basis except minerals on dry basis.
[b]20 samples of each and duplicate lab analysis.

TABLE 4. A SUMMARY OF THE LAMB[1] PERFORMANCE AND CARCASS PARAMETERS OF LAMBS FED BARLEY AND CORN HETTINGER 1986.

		Diets				
		Heavy barley	Light and heavy barley	Corn	Light barley	
	Experiment					
Gain/day	1	.618	.591	.709	.607	
	2	.460	.443	.529	.442	
	3	.556	.552	.607	.592	
	$\bar{x}$	.545[ab]	.529[a]	.615[b]	.547[ab]	
	SE	±.032	±.031	±.034	±.035	
Feed/gain	1	6.96	7.65	6.20	7.52	
	2	7.33	7.55	6.50	7.64	
	3	5.90	5.97	6.36	6.66	
	$\bar{x}$	6.73[ab]	7.06[ab]	6.35[b]	7.27[a]	
	SE	± .367	± .390	± .098	± .218	
Feed/day	1	4.48	4.68	4.41	4.57	
	2	3.30	3.41	3.40	3.35	
	3	3.27	3.29	3.87	3.93	
	$\bar{x}$	3.68[a]	3.79[a]	3.89[a]	3.95[a]	
	SE	.248	.285	.189	.228	
Digestibility	$\bar{x}$	69[ab]	68[ab]	71[a]	67[b]	
(IVDMD)	SD	±3.0	±2.2	±2.5	±2.2	
						SD
Dressing %	$\bar{x}$	49.7[a]	49.7[a]	50.9[b]	49.3[a]	2.60
Carcass grade	$\bar{x}$	10.8[a]	10.8[a]	11.0[a]	11.0[a]	.94
Carcass fat	$\bar{x}$	.179[a]	.162[a]	.164[a]	.161[a]	.080
Yield grade	$\bar{x}$	3.32[a]	2.95[a]	2.99[a]	2.93[a]	.700
Loin area	$\bar{x}$	2.00[a]	2.08[a]	2.09[a]	2.00[a]	.330

[a,b]Different P<.05 within a row except g/d P<.10.
[1]160 lambs per dietary treatment (initial wt of 65, 70 and 79# for experiments 1, 2 and 3)
(eye)

BARLEY AND CORN (LIGHT AND HEAVY) FED IN GROUND OR PELLETED FORM TO LAMBS

D.O. Erickson, B.L. Moore, J.T. Schmidt and M. Hankel

Research Center NDSU Fargo 1986

Summary

Barley (40 or 49#/bu.) or corn (49 or 56#/bu.) was fed in either ground or pelletted complete high energy diets (64 to 73% TDN) containing 16% protein to early weaned lambs (69#). Lambs gained faster P<.05 on either light (.86 vs .67) or heavy (.86 vs .70) barley fed in pellet form. Lambs on the ground barley required about 5% more (P<.05) feed/gain when combining both the light and heavy barley comparisons. Pelletted heavy barley was digested to a greater (P<.05) extent (65 vs 61%) than ground heavy barley but protein digestibilities were similar between barley weights and forms. Pelleting light corn increased (P<.05) gains and feed efficiency whereas the lambs fed heavy corn (ground or pelletted) responded similarly in all parameters measured. Lamb gains, feed efficiencies, feed/day and digestibilities were similar (P>.05) between corn and barley (both light and heavy) if it was fed in pellet form. Lamb performance was somewhat lower by the above parameters for barley in the ground form compared to corn (both light and heavy). Lamb performance and digestibilities were similar between light and heavy barley when averaging both forms. The same pattern was observed for either light and heavy corn. Lambs on heavy corn gained .84#/d compared to light corn .75#/d which was different at the P<.07 level. The grain, quality of grain or the physical form of ground or pellets did not effect carcass grade. All lambs in this experiment graded choice. The information generated from this experiment should be useful in making feed-management decisions for finishing lambs. All the diets support very acceptable lamb performance and feed utilization.

Introduction and Justification:

The major cereal grain fed in lamb finishing diets has been and is corn. North Dakota leads in barley production and much of the barley produced enters feed channels. The use of barley in finishing diets for ruminants reduced the amount of protein supplement needed because of the higher protein content of barley compared to corn. There is limited information concerning the substitution of barley for corn and also for the comparisons of light and heavy corn and barley in diets for finishing lambs. There is a need to establish the comparative feeding values of these major cereals of varying quality for lambs in terms of lamb performance and resulting carcass characteristics. There is also a need to determine if these parameters are affected by the physical form of the complete diets (ground and pelletted). The information will be useful to the sheep producer, feed industry and meats industry in terms of management decisions concerning the utilization of the cereals, sales of the cereals and purchasing of the lamb carcasses.

Objectives:

The major objectives of these studies are to determine the performance and carcass characteristics of lambs fed alfalfa/SBM equal protein with; 1) light and heavy barley or light and heavy corn and 2) pelletted or ground diets.

Procedures:

Early weaned lambs (56 day) were allotted into 16 lots of 9 by sex, breed and weight and put on experiment at an average weight of 69 pounds. They were weighed individually every two weeks and feed intakes by pens were recorded. The experiment had four dietary treatments and each diet was fed in ground or pelletted form. The lambs were taken off experiment when they averaged 110 to 115 pounds. At the close of the experiment a representative group of lambs from each pen were used to determine the shrink, dressing percentage, quality grade and yield grade. Statistical procedures will be employed to assist in the interpretation of results.

Feedstuff samples were taken prior to the experiments and the diet formulations were based on the results of these sample analysis (Tables 1 and 2). Approximately 10 samples of each diet were taken for nutritional analysis during the trial in order to more accurately relate lamb performance and carcass characteristics to diet composition. Analysis of nutritional components include 10 fractions including an in vitro digestibility determination (Table 3). Diets were fed ad libitum in complete mixed ground or pelletted form. Feed residues will be weighed back at the close of each experiment to more accurately measure feed intake and feed efficiency. All diets contained alfalfa as the roughage. Fecal samples were taken during the experiment and the internal indicator of acid insoluble ash (AIA) was determined and used for digestibility determinations.

The diets were on an equal protein basis (16%). The energy values varied depending on the TDN content of the grain (Table 2). The dietary treatment identity of the lamb was lost at the slaughter plant. The carcass parameters could not be measured but all the lambs graded choice.

Results and Discussion:

The diets were formulated to be isonitrogenous (16% protein) and not isocaloric (TDN) (Table 2). The light and heavy corn diets contained 1.46 (73% TDN) and 1.49 Mcal of DE/pound respectively (74% TDN) and the light and heavy barley diets contained 1.29 (64% TDN) and 1.40 Mcal of DE/pound respectively (70% TDN). Based on the digestible energy differences of the experimental diets it would be expected that the lambs on the barley diets would require more feed/gain. The average feed required for gains were 5.24 and 5.50 ($P<.05$) respectively for corn and barley (Tabel 5-K). The average digestible drymatters for the corn and barley diets were 67 and 62% ($P<.05$) respectively. The digestibility of protein was similar between the corn (70%) and barley (71%) diets.

Diets fed in pellet form resulted in similar gains between light and heavy corn or barley (Tables 4 and 5-B and D) and this is due to increased intake of the barley diets which compensates for the lower digestibility. When the diets were fed in ground form the lambs ate more of both the light and heavy corn diets ($P<.05$) (Table 5-A and C) however feed efficiencies were similar for ground corn and ground barley. This may be due in part to the higher ($P<.05$) digestible protein (Table 5-A) value of barley over corn and based on previous experiments (NDSU) comparing corn and barley, more propionic acid is produced during rumen fermentation. Increased propionic acid results in improved feed efficiencies and gains. Information concerning the feeding of whole grains of various quality compared to processed grains has not been determined. Sheep generally perform very well on whole grains and many producers feed the grains in whole form along with a supplement and a roughage. Even though pelleting results in improved ($P<.05$) gains, feed/gain, and digestibilities (Table 5-J and K) the economics would have to be considered.

The bushel weights of barley had no significant affect on lamb performance parameters and digestibilities within each physical form (Table 5-E, F and N). Heavy corn in ground form resulted in slightly higher gains ($P<.07$) and a pattern of higher digestibilities of drymatter and protein and a reduced feed/gain (Table 5-G). Those differences were not evident when the light and heavy corns were fed in pellet form (Table 5-H).

The bushel weights of the grains or the comparison of barley to corn or the physical form in which the grains were fed had no effect on carcass grade as all the lambs graded choice (Table 4).

All of the diets light or heavy and pelletted or ground barley or corn resulted in very acceptable lamb performance. Grain quality may have more effect on lamb performance if fed in higher roughage diets. These diets contained 26% alfalfa (Table 2). As the roughage increases in a diet feed intake usually decreases. Therefore the quality of grain would have a potential to exert more influence on lamb performance.

Acknowledgment:

The North Dakota Agricultural Experiment Station and the NDSU Animal and Range Sciences Department appreciate the support of the North Dakota Barley Council by procuring and supplying all of the barley used in this experiment.

TABLE 1. COMPOSITION[a] OF FEEDSTUFFS USED IN DIETS FOR LAMB FINISHING EXPERIMENTS CONDUCTED AT THE NDSU RESEARCH CENTER 1986 FARGO

	%					
Feedstuff	bu.wt.	Protein	TDN	ADF	Ca	P
Corn (L) 49#/bu.	49	8.6	82.5	2.1	.04	.29
Corn (H) 56#/bu.	56	8.8	84.8	2.0	.02	.28
Barley (L) 40#/bu.	39.5	13.7	69.0	9.5	.20	.38
Barley (H) 49#/bu.	49.8	11.6	77.0	6.2	.05	.34
Alfalfa	-	16.0	52.0	34.0	1.25	.17
SBM	-	44.0	78.0	10.0	.25	.60
Limestone	-	-	-	-	36	-
Dicalcium Phosphate	-	-	-	-	22	18

[a]As is or 90% Dry

Composition common to all diets
- Trace mineral salt .5%
- Limestone .5% (36% Ca)
- Dicalcium phosphate .5% (22% Ca and 18%P)
- Ammonium Chloride .5%
- Super pellets (rumensin) 1.25%
- Vitamins ADE .05% (excess of NRC requirements)
- Terramycin 2.5 g/100# diet

TABLE 2. DIETS FOR THE FINISHING LAMB EXPERIMENTS CONDUCTED AT THE NDSU RESEARCH CENTER 1986 FARGO.

		%				
Feedstuff	% of diet	Protein	TDN	ADF	Ca[a]	P[a]
Corn (light)						
Alfalfa	26.0	4.16	13.52	8.84	.325	.045
Corn (L)	57.3	4.93	47.27	1.20	.023	.166
SBM	15.7	6.91	12.25	1.57	.039	.094
Totals	99.0	16.00	73.04	11.61	.677	.395
Corn (heavy)						
Alfalfa	26.0	4.16	13.52	8.84	.325	.045
Corn (H)	57.6	5.07	48.84	1.15	.016	.161
SBM	15.4	6.77	12.01	1.54	.038	.092
Totals	99.0	16.00	74.37	11.53	.669	.388
Barley (light)						
Alfalfa	26.0	4.16	13.52	8.84	.325	.045
Barley (L)	66.9	9.16	46.16	6.36	.134	.254
SBM	6.1	2.68	4.76	.61	.015	.037
Totals	99.0	16.00	64.44	15.81	.764	.426
Barley (heavy)						
Alfalfa	26.0	4.16	13.52	8.84	.325	.045
Barley (H)	62.6	7.26	48.20	3.88	.031	.213
SBM	10.4	4.58	8.11	1.04	.026	.062
Totals	99.0	16.00	69.83	13.78	.672	.410

[a].5% limestone and .5% dicalcium phosphate added to each diet and is reflected in the total Ca & P.

TABLE 3. NUTRITIONAL COMPOSITION OF THE DIETS FED TO LAMBS COMPARING LIGHT AND HEAVY BARLEY AND CORN BASED ON LABORATORY ANALYSIS[a]. RESEARCH CENTER 1986 FARGO.

	Light corn		Heavy corn		Light barley		Heavy barley	
	pellets	ground	pellets	ground	pellets	ground	pellets	ground
Protein %	15.9	15.9	15.5	15.9	15.7	16.1	15.1	16.0
ADF %	14.2	13.3	14.6	13.7	19.1	17.4	16.1	15.6
Ash %	6.35	5.60	6.28	5.67	6.91	6.71	6.25	6.83
Ca %	.74	.63	.62	.71	.59	.87	.52	.66
P %	.46	.45	.44	.42	.46	.44	.43	.45
IVDMD %	72	72	69	71	65	65	68	67
TDN (Calc)	73	73	74	74	64	64	69	69

[a]Dry basis.

TABLE 4. LAMB PERFORMANCE AND DIGESTION COEFFICIENTS OF LAMBS FED LIGHT AND HEAVY CORN AND BARLEY IN PELLET AND GROUND FORM. RESEARCH CENTER 1986 FARGO.

	Light corn		Heavy corn		Light barley		heavy barley		
	pellets	ground	pellets	ground	pellets	ground	pellets	ground	SE
Final wt.[1]	119^{a}	110^{bc}	117^{ab}	116^{ab}	117^{ab}	107^{c}	118^{ab}	108^{c}	2.38
Gain/day	$.88^{a}$	$.75^{bc}$	$.85^{ab}$	$.84^{ab}$	$.86^{ab}$	$.67^{c}$	$.86^{ab}$	$.70^{c}$	.037
Feed/day	4.32^{ab}	4.32^{ab}	4.22^{bc}	4.42^{ab}	4.57^{a}	3.81^{d}	4.60^{a}	3.92^{cd}	.105
Feed/gain	4.91^{b}	5.76^{a}	5.00^{ab}	5.32^{ab}	5.37^{ab}	5.70^{ab}	5.32^{ab}	5.63^{ab}	.247
Dig. DM[2]	67^{ab}	65^{ab}	68^{a}	67^{a}	60^{bc}	60^{c}	65^{ab}	61^{c}	1.17
Dig. Protein[2]	71^{ab}	66^{b}	71^{ab}	70^{ab}	70^{ab}	72^{a}	73^{a}	69^{ab}	1.99
Carcass grade	ch	ch	ch	ch	ch	ch	ch	ch	-

[a,b,c and d]Different superscripts differ $P<.05$.
[1]Average initial weight of each pen 69#.
[2]Digestion coefficients were determined with acid insoluble ash as an internal indicator in the feed and feces.

TABLE 5. LAMB PERFORMANCE AND DIGESTION COEFFICIENTS OF SEVERAL COMPARISONS OF DIETS AND PHYSICAL FORM.

	Diet	form	g/d	F/d	F/g	DDM	D Protein
A	L corn L barley	grd.	$.75^a$ $.67^a$	4.32^a 3.81^b	5.76^a 5.70^a	65^a 60^b	66^a 72^b
B	L corn L barley	pell.	$.88^a$ $.86^a$	4.32^a 4.57^a	4.91^a 5.37^a	67^a 63^a	71^a 71^a
C	H corn H barley	grd.	$.84^a$ $.70^b$	4.42^a 3.92^b	5.32^a 5.63^a	67^a 61^b	70^a 69^a
D	H corn H barley	pell.	$.85^a$ $.86^a$	4.22^a 4.60^a	5.00^a 5.32^a	68^a 65^a	71^a 73^a
E	L barley H barley	grd.	$.67^a$ $.70^a$	3.81^a 3.92^a	5.70^a 5.63^a	60^a 61^a	72^a 69^a
F	L barley H barley	pell.	$.86^a$ $.86^a$	4.57^a 4.60^a	5.37^a 5.32^a	63^a 65^a	71^a 73^a
G	L corn H corn	grd.	$.75^a$ $.84^b$ (P<.07)	4.32^a 4.42^a	5.76^a 5.32^a	65^a 67^a	66^a 70^a
H	L corn H corn	pell.	$.88^a$ $.85^a$	4.32^a 4.22^a	4.91^a 5.00^a	67^a 68^a	71^a 71^a
I	Barley Barley	pell. grd.	$.86^a$ $.69^b$	4.58^a 3.86^b	5.35^a 5.67^b	64^a 61^b	72^a 71^a
J	Corn Corn	pell. grd.	$.87^a$ $.80^b$	4.27^a 4.37^a	4.96^a 5.54^b	68^a 66^b	71^a 68^b
K	Corn Barley	(both) (both)	$.83^a$ $.77^b$	4.32^a 4.23^a	5.24^a 5.50^b	67^a 62^b	70^a 71^a
L	(both) (both)	pellets ground	$.86^a$ $.74^b$	4.43^a 4.12^b	5.15^a 5.60^b	66^a 63^b	72^a 69^b
M	Light Heavy	(both) (both)	$.79^a$ $.81^a$	4.26^a 4.29^a	5.44^a 5.32^a	64^a 65^a	70^a 71^a
N	Barley Barley	light heavy	$.76^a$ $.78^a$	4.19^a 4.26^a	5.54^a 5.48^a	62^a 63^a	72^a 71^a
O	Corn Corn	light heavy	$.82^a$ $.85^a$	4.32^a 4.32^a	5.34^a 5.16^a	66^a 68^a	68^a 71^a
	SE		.037	.105	.247	1.17	1.99

[a,b] P<.05

A PROGRESS REPORT OF ALFALFA/STRAW DIETS FOR CONFINED EWES AND SUBSEQUENT REPRODUCTIVE PERFORMANCE

J.T. Schmidt, R. Wasson, D.O. Erickson and J.E. Tilton

Summary

Ewes were self fed chopped diets of either 100% alfalfa (0S), 80% alfalfa:20% straw (20S), 60% alfalfa:40% straw (40S), or 40% alfalfa:60% straw (60S) for two years. Half of the 40S ewes did not recieve a flushing diet and were designated a negative control (NC). Twentyfive ewes were fed in individual pens (trial 1) and fifty ewes were fed in groups of ten (trial 2). Diets were fed from post weaning (April) to flushing (August) and from post breeding (October) to mid gestation (December). Dry matter intake and weight gains decreased as percent straw in the diet increased. Straw should be fed with a high quality roughages if ewe requirements are to be met. Digestibilities of treatment diets have not been completed at this time. An attempt to correlate ewe performance during maintenance with reproductive performance will not be made until the second years lamb crop is weaned. This information should be useful in helping producers make feed management decisions in the feeding of reproducing ewes.

COMBINED YEARS (1985-1986 AND 1986-1987)

Ewe dry matter intake and body weight for trials one and two decreased (P<.05) as the percent straw in the diet increased. Combined lambing data is not available at this time.

TRIAL 1 1985-1986

Ewe dry matter intake, body weight, and condition score decreased (P<.05) as the percent straw in the diet increased. Total lamb weight born/ewe exposed was greater (P<.05) for the 0S, 40S and NC treatments compared to the 60S treatment. Total weight of lamb weaned/ewe exposed was greater (P<.05) for the 0S, 20S, 40S and NC treatments compared to the 60S treatment. Individual lamb birth weights were greater (P<.05) for the 60S treatment compared to the 40S treatment. Individual lamb average adjusted 60 d weaning weights were greater (P<.05) for the 0S and 60S treatment compared to the 40S treatment.

TRIAL 2 1985-1986

Ewe body weights generally decreased (P<.05) as the percent straw in the diet increased; however, the 20S treatment gained the least weight. Total lamb weight born and weaned/ewe exposed was greater (P<.05) for the 40S treatment compared to the NC and 60S treatments.

TRIAL 1 1986-1987

Ewe dry matter intake and body weight decreased (P<.05) as the percent straw in the diet increased. No lambing data is available at this time.

TRIAL 2 1986-1987

Ewe dry matter intake and body weight decreased (P<.05) as the percent straw in the diet increased. No reproductive data is available at this time.

Introduction

Self feeding chopped straw/alfalfa diets can reduce feed costs and save labor. North Dakota produces about 9.2 million tons of straw/ year (4 million tons of TDN)(USDA 1984). Feed costs are about 60% of the annual cost/ewe/year. Straw could replace a substantial portion of the feed energy required for ewes during periods of low energy requirements (maintenance and early gestation). It cannot be overemphasized that straw must be fed with a high quality roughage if nutritional requirements are to be met. Cereal straws limit intake so they could be used in a self feeding program, thereby saving labor. Past experiments (Light et al, 1984; Faller et al, 1986) involving alfalfa diets with 0, 20, 40, and 60% straw have indicated that ewes can perform satisfactorily on high straw diets. Much of the straw used in these studies was of higher nutritional quality than average straws. However, earlier work (Light and Faller, 1981) indicated that high levels of wheat straw lower lambing rates and increased the percent of barren ewes. Other work (Laytimi et.al 1984) indicated that high levels of wheat straw do not affect conception rates, but limits the number of multiple births. It has been shown (Barry and Johnstone, 1976; Brown and Johnson, 1985) that dry matter intake and digestible energy rapidly decrease below recommended levels (NRC. 1975) as percent straw increases. Additional research is needed to determine the relationships of several dietary nutritional components in alfalfa:straw based diets and to relate the levels of nutrition to reproductive efficiency. The purpose of this project is to determine the nutritional parameters of chopped alfalfa:straw diets and to relate the parameters to subsequent ewe reproductive performance.

Experimental Procedure

This project will continue through two reproductive cycles.

Trial 1. Twenty five second or third parity ewes were randomly assigned to five treatments. The ewes were penned individually (indoors) in adjacent pens.

Trial 2. Fifty third to fifth parity ewes were randomly assigned to five treatments and penned in groups of ten. The 40S and NC treatments were penned together during the treatment periods. Only ewe and lamb performance data were collected for trial 2.

The treatments for trials 1 and 2 were as follows:

treatment	diet
OS	100% alfalfa
20S	80% alfalfa:20% straw
40S	60% alfalfa:40% straw
NC	60% alfalfa:40% straw (negative control to be fed treatment diet from April 20 to November 25)
60S	40% alfalfa:60% straw

Half a pound soybean meal and free choice 20% phosphorous mineral and trace mineral salt were supplemented to all ewes. The treatment diets were self fed from April - August and continued from October - November for a total of about 167 days. During flushing (prebreeding) (August 21 - September 4) and breeding (September 4 - October 8) all ewes except the negative control treatment were fed a common diet (alfalfa:barley). The negative control ewes were fed the treatment diet from April 20 - November 25. The ewes were taken off the flushing diet after 2 heat cycles (October 8) and returned to the treatment diets. During year two the soybean meal supplementation was discontinued to help determine digestibilities of the treatment diets. After November 25 all ewes were fed a gestation diet (alfalfa). After the lambs were weaned (March 31 - April 15) the ewes were again randomized and placed back on the dietary treatments for year 2. Fecal samples were collected rectally three times each during maintenance and early gestation and once during flushing and breeding. Representative diet samples were collected throughout the experiment and ewe weights were recorded at weaning, preflushing, postbreeding, and mid-gestation. Diets and feces were analyzed as follows. Dry matter, protein, energy, ash, calcium, magnesium and phosphorous were determined by AOAC (1984) methods. Acid insoluble ash (AIA), acid detergent fiber (ADF), and acid detergent lignin (ADL), were determined by methods of Goering and Van Soest (1970). Dry matter (DM) energy, protein, ADF, and ADL digestibilities were determined using AIA as an internal indicator. Blood Phosphorous will be determined by AOAC (1984) methods. The weight data of lambs and ewes, feed intake, and digestibilities will be analyzed as a completely randomized design (Gill 1978). Orthogonal contrasts will be used to test hypotheses about treatment comparisons (Gill 1978). The reproductive data such as conception and lambing rates will be analyzed using the chi-square statistic (Gill 1978).

Results and Discussion

For trial one ewe dry matter intake and weight gains decreased ($P<.05$) as the percent straw in the diet increased (Tables 1-6). Work by Blaxter et al (1961) and others show a direct relationship between the digestibility of a diet and voluntary intake. The decrease in dry matter and digestible energy intake make decreased performance inevitable. In trial two, all ewes consumed enough dry matter to increase their final weights over their post flushing weights. However, in trial 1 the 60S and NC(40S) ewes lost weight. All ewes gained weight during the flushing and breeding periods.

Remarkably, NC ewes (no flushing diet) gained the same weight ($P>.05$) as the other ewes during the flushing and breeding period. It can be speculated that the increase in physical activity and increase in hormone concentrations associated with the season of the year and cyclic activity triggered an increase in voluntary dry matter intake. Following breeding for 1986-1987 (Tables 3 and 4) SBM supplement was not included in the diet so that digestibilities of the treatment diets could be more accurately determined. Ewe performance following breeding decreased over 1985-1986 (Tables 1 and 2), but more so for trial 1 than trial 2.

For trial 1 ewes in the OS, 40S and NC treatment (table 7) had more pounds of lamb born/ewe exposed ($P<.05$) compared to the 60S treatment. However average lamb weight was greater for the 60S treatment compared to the 40S treatment. This reflects the number of lambs born/ewe exposed (.4 for the 60S treatment vs 1.8 for the 40S treatment). Pounds of lamb weaned/ewe exposed was lower ($P<.05$) for the 60S treatment compared to all other treatments. Average adjusted 60 d weaning weight was greater ($P<.05$) for the 60S treatment compared to the 40S treatment; again reflecting lambing rate.

For trial 2 (Table 8) average pounds of lamb born and weaned/ewe exposed was greater ($P<.05$) for the the 40S treatment compared to the NC and 60S treatments. Average lamb weight and average adjusted 60 d weaning weight did not differ ($P>.05$) between treatments. The difference in pounds of lamb born and weaned/ewe exposed between treatments 40S and NC reflects the flushing effect of the 40S treatment.

TABLE 1. INTAKES, WEIGHTS AND WEIGHT CHANGES FOR TRIAL 1, 1985

	TREATMENT					
	0S	20S	40S	NC(40S)	60S	SEM
AS FED INTAKES						
APRIL 15 TO AUG. 19 (maintenance)	4.2 a	3.4 b	2.8 bc	2.8 c	2.1 d	0.2 d
SEPT. 12 TO NOV.25 (early gest.)	3.9 a	2.8 b	2.9 b	3.0 b	2.6 b	0.21 d
APRIL 15 TO NOV. 25 (overall)	4.1 a	3.2 b	2.9 b	2.8 b	2.2 c	0.19 d
WEIGHTS						
APRIL 20	141.6	146.2	147.2	151.6	139.0	
maintenace wt. change	8.0 a	-5.4 b	-6.6 b	-8.2 bc	-17.8 c	3.26 d
AUGUST 21	149.6	140.8	140.6	143.4	121.2	
flushing:breeding wt. change	12.4 a	8.0 a	14.2 a	11.8 a	12.0 a	3.79 d
OCTOBER 8	162.0	148.8	154.8	155.2	133.2	
early gest. wt. change	0.7 a	1.4 a	2.4 a	2.0 a	0.6 a	1.89 e
NOVEMBER 25	165.7	150.2	157.2	157.2	133.8	
OVERALL WT. CHANGE	19.7 a	4.0 ab	10.0 ab	5.6 ab	-5.2 b	5.41 e

a,b,c Means in the same row bearing unlike superscripts differ ($p<.05$)
d n=5
e Harmonic mean = 4.76

TABLE 2. WEIGHTS AND WEIGHT CHANGES FOR TRIAL 2, 1985

	TREATMENT					
	0S	20S	40S	NC(40S)	60S	SEM
WEIGHTS						
AUGUST 1, 1985	189.0	186.4	180.0	190.0	183.4	
maintenace wt. change	8.4 a	-3.4 c	-2.0 c	-1.2 c	3.6 b	1.38 d
AUGUST 21	197.4	183.0	178	188.8	187.0	
flushing:breeding wt. change	0.2 c	0.8 bc	16.0 a	6.4 b	3.8 bc	2.17 d
OCTOBER 8	197.6	183.8	194.0	195.2	190.8	
early gest. wt. change	14.4 a	7.6 b	4.9 b	1.8 b	3.8 b	2.34 d
NOVEMBER 25	212.0	191.4	198.9	197.0	194.6	
OVERALL WT. CHANGE	23.0 a	5.0 c	18.9 ab	7.0 c	11.2 bc	2.92 d

a,b,c Means in the same row bearing unlike superscripts differ ($P<.05$).
d n=10

TABLE 3. INTAKES, WEIGHTS AND WEIGHT CHANGES FOR TRIAL 1, 1986

	TREATMENT					
	0S	20S	40S	NC(40S)	60S	SEM
AS FED INTAKES						
APRIL 15 TO AUG. 15 (maintenance)	4.6 a	4.2 ab	3.8 b	4.0 ab	3.0 c	0.25 d
SEPT. 12 TO NOV.25 (early gest.)	4.7 a	4.4 ab	3.9 b	3.9 b	3.2 c	0.19 d
APRIL 15 TO NOV. 25 (overall)	4.6 a	4.3 ab	3.8 b	3.9 b	3.1 c	0.22 d
WEIGHTS						
APRIL 15, 1986	152.2	166.4	156.2	169.5	173.6	
maintenance wt change	11.8 a	3.6 ab	2.4 ab	-6.5 cb	-16.0 c	3.54 d
AUGUST 21, 1986	164.0	170.0	158.6	163.0	157.6	
flushing:breeding wt. change	5.2 a	7.6 a	6.2 a	7.5 a	10.4 a	3.13 d
OCTOBER 14, 1986	169.2	177.6	164.8	170.5	168.0	
early gest. wt. change	1.0 a	-2.8 ab	-6.0 abc	-13.0 bc	-15.8 c	3.54 d
DECEMBER 1, 1986	170.2	174.8	158.8	157.5	152.2	
OVERALL WT. CHANGE	18.0 a	8.4 ab	2.6 b	-12.0 c	-21.4 c	4.24 d

a,b,c Means in the same row bearing unlike superscripts differ (P(.05).
d Harmonic mean=4.76

TABLE 4. WEIGHTS AND WEIGHT CHANGES FOR TRIAL 2, 1986

	TREATMENT					
	0S	20S	40S	NC(40S)	60S	SEM
WEIGH DATES						
APRIL 15, 1986	184.2	182.5	210.4	182.3	191.2	
maintenance wt. change	26.8 a	25.5 a	-1.2 c	8.1 b	2.2 bc	3.09 d
AUGUST 21, 1986	211.0	208.0	209.2	190.4	193.4	
flushing:breeding wt. change	15.0 b	24.9 a	17.6 ab	14.7 b	14.7 b	3.06 e
OCTOBER 14, 1986	226.0	232.9	226.8	205.1	208.8	
early gest. wt. change	8.6 a	-4.6 b	-3.9 b	0.0 ab	-2.0 b	3.07 f
DECEMBER 1, 1986	234.6	228.3	228.8	205.1	206.9	
OVERALL WT. CHANGE	23.6 a	20.3 ab	12.1 b	14.7 b	12.7 b	3.09 f

a,b,c Means in the same row bearing unlike superscripts differ (P(.05).
d n=10
e Harmonic mean=9.78
f Harmonic mean=9.57

TABLE 5. INTAKES, WEIGHTS AND WEIGHT CHANGES FOR TRIAL 1, 1986 AND 1987

	TREATMENT					
	0S	20S	40S	NC(40S)	60S	SEM
AS FED INTAKES						
APRIL TO AUGUST (maintenance)	4.4 a	3.8 ab	3.3 b	3.3 b	2.5 c	0.22 d
SEPT. TO DECEMBER (early gest.)	4.3 a	3.6 b	3.4 bc	3.4 bc	2.9 c	0.2 d
APRIL TO DECEMBER (overall)	4.4 a	3.8 b	3.3 b	3.3 b	2.6 c	0.21 d
WEIGHTS						
APRIL	146.9	156.3	151.7	159.6	156.3	
maintenance wt change	9.9 a	-0.9 b	-2.1 b	-7.4 b	-16.9 c	2.48 d
AUGUST	156.8	155.4	149.6	152.1	139.4	
flushing:breeding wt. change	8.8 a	7.8 a	10.2 a	9.9 a	11.2 a	2.49 d
OCTOBER	165.6	163.2	159.8	162.0	150.6	
early gest. wt. change	0.9 a	-0.7 ab	-1.8 ab	-4.7 ab	-7.6 b	2.63 e
DECEMBER	168.2	162.5	158.0	157.3	143.0	
OVERALL WT. CHANGE	18.8 a	6.2 b	6.3 b	-2.2 b	-13.3 c	3.76 e

a,b,c Means in the same row bearing unlike superscripts differ (P<.05).
d Harmonic mean=9.78
e Harmonic mean=9.57

TABLE 6. WEIGHTS AND WEIGHT CHANGES FOR TRIAL 2, 1986 and 1987

	TREATMENT					
	0S	20S	40S	NC(40S)	60S	SEM
WEIGH DATES						
AUGUST '85 AND APRIL '86	186.6	184.5	195.2	186.2	187.3	
maintenance wt. change	17.6 a	11.1 a	-1.6 b	3.5 b	2.9 b	2.46 d
AUGUST	204.2	195.5	193.6	189.6	190.2	
flushing:breeding wt. change	7.6 b	12.9 ab	16.8 a	10.6 ab	8.9 b	2.44 e
OCTOBER	211.8	208.4	210.4	200.2	199.4	
early gest. wt. change	11.5 a	1.5 b	0.7 b	0.9 b	1.1 b	2.06 f
DECEMBER	223.3	209.9	213.1	201.1	200.4	
OVERALL WT. CHANGE	36.7 a	25.4 b	15.5 bc	14.9 c	12.8 c	3.67 f

a,b,c Means in the same row bearing unlike superscripts differ (P<.05).
d n=10
e Harmonic mean=19.79
f Harmonic mean=19.59

TABLE 7. LAMBING DATA FOR TRIAL 1, 1985 (e)

PRODUCTION DATA	TREATMENT 0S		20S		40S		NC(40S)		60S		SEM
NUMBER OF EWES EXPOSED	4		4		5		5		5		
NUMBER OF EWES LAMBING	4		3		5		5		2		
NUMBER OF LAMBS BORN	5		5		9		7		2		
NUMBER OF LAMBS BORN LIVE	5		5		9		7		2		
NUMBER OF LAMBS WEANED	5		5		9		7		2		
% LAMBING RATE/EWE EXPOSED	125		125		180		140		40		
POUNDS BORN/EWE EXPOSED	17.25	a	15.62	ab	21.9	a	18.4	a	5.9	b	3.44 c
AVERAGE LAMB WEIGHT	14.1	ab	13	ab	12.3	b	13.5	ab	14.7	a	0.81 d
% LAMBS WEANED/EWE EXPOSED	125		125		180		140		40		
POUNDS WEANED/EWE EXPOSED	88.24	a	80.7	a	108.9	a	87.4	a	28.4	b	17.55 c
AVE. ADJ. 60 DAY WEIGHT	72.3	a	66	ab	60.8	b	63.8	ab	71	a	3.01 d

a,b Means in the same row bearing unlike superscripts differ (P(.05).

c Harmonic mean=4.55

d Harmonic mean=3.37

e Statistics not available for balance of data.

TABLE 8. LAMBING DATA FOR TRIAL 2, 1985 (f)

PRODUCTION DATA	TREATMENT 0S		20S		40S		NC(40S)		60S		SEM
NUMBER OF EWES EXPOSED	10		9		10		10		10		
NUMBER OF EWES LAMBING	9		7		10		7		9		
NUMBER OF LAMBS BORN	19		14		20		12		16		
NUMBER OF LAMBS BORN LIVE	19		13		20		12		14		
NUMBER OF LAMBS WEANED	16		13		18		10		9		
% LAMBING RATE/EWE EXPOSED	190		140		200		120		160		
POUNDS BORN/EWE EXPOSED	20.9	ab	18.5	ab	25.3	a	14.8	b	15.8	b	3.16 c
AVERAGE LAMB WEIGHT	11.3	a	12.5	a	12.9	a	11.9	a	10.1	a	1.08 d
% LAMBS WEANED/EWE EXPOSED	160		140		180		100		90		
POUNDS WEANED/EWE EXPOSED	100.3	ab	89.3	ab	122.3	a	65.3	b	58.9	b	17.21 c
AVE. ADJ. 60 DAY WEIGHT	63.1	a	62.4	a	66.3	a	66	a	67	a	4.04 e

a,b Means in the same row bearing unlike superscripts differ (P(.05).

c Harmonic mean=9.78

d Harmonic mean=8.38

e Harmonic mean=7.27

f Statistics not available for balance of data.

LITERATURE CITED

AOAC. 1984. Official methods of Analysis (13th ed.). Association of Official Analytical Chemists, Washington, DC.

Barry, T.N. and P.D. Johnstone. 1976. A comparison of supplementary sources of nitrogen and energy for increasing the voluntary intake and utilization of barley straw by sheep. J. Agric. Sci. UK. 86,1. pp 163-169.

Brown, L.E. and W.L. Johnson. 1985 Intake and digestibility of wheat straw diets by goats and sheep. J. Anim. Sci. 60:1318.

Blaxter, K.L., F.W. Wainman and R.S. Wilson. 1961. Animal Prod. 3:51.

Faller, T.C., C.N. Haugse and D.O. Erickson. 1986. An Updata on Wheat Straw as a Feed for Confined Ewes. North Dakota Farm Research. Vol. 43 No. 5. pp 22-23.

Gill, J.L. 1978. Design and Analysis of Experiments. The Iowa State Univ. Press. Ames Iowa.

Goering, H.K. and P.J. Van Soest. 1970. Forage fiber analysis. ARS Handbook No. 379, USDA, Washington, DC.

Light, M.R., T.C. Faller and D.O. Erickson. 1984. Wheat straw for self feeding confined ewes. Western Dakota Sheep Day Report. North Dakota State Univ. pp22-24.

Light, M.R. and T.C. Faller. 1981. Wheat straw for self feeding confined ewes. Western Dakota Sheep Day Report. North Dakota State Univ.

NRC. 1975. Nutrient Requirements of Domestic Animals, No. 5. Nutrient Requirements of Sheep. Fifth Revised Ed. National Academy of Sciences - National Research Council. Washington DC.

Tilley, J.M.A. Terry, R.A. A two-stage technique for the in-vitro digestion of forage crops. J. Br. Grassl. Soc. 1963. 18, 104-111.

SHEEP PRODUCTION AND GROWTH
PROJECT ND3732
1986 UPDATE

K.A. RINGWALL, T.C. FALLER, P. T. BERG,
D. O. ERICKSON, B. L. MOORE, D. A. REDMER AND L. D. YOUNG

INTRODUCTION

The 1986 update of the current sheep research involving reproductive genetics and growth of sheep at the Hettinger Research Extension Center covers the second year for project ND3732. The data is presented to illustrate developing trends in the data but complete statistical analysis has not been done. Early trends in the data can lead to speculation of the end conclusions, however caution must be applied to any early results. The project is ND03732 - SHEEP PRODUCTION AND GROWTH and is a cooperative effort between the Department of Animal and Range Science and the Hettinger Research Extension Center within the North Dakota State University Agricultural Experiment Station.

The project is serving a two-fold purpose. Many producers have taken advantage of the educational opurtunities available through the sheep involved in the project. Three indepth three day sheep schools have been held and a fourth one is scheduled and already full. Daily visitors and those people attending Sheep Day each year routinely view proper sheep management techniques. All of these activities have not interfered with the detailed scientific questions that are being proposed and answered concerning the biological mechanisms that cause the outward appearances producers see.

This project continues to be dedicated to overcome the factors that decrease the efficiency of sheep production, primarily seasonal infertility and low prolificacy. The end result of this project will improve the profitability of agriculture for individual North Dakota producers and, in turn, increase the efficiency of North Dakota agriculture.

PROJECT OBJECTIVES

1. Evaluate ewe production and offspring performance of specific crosses of Booroola Merino, Finnish Landrace, Rambouillet, Border Leicester and Suffolk breeds of sheep under different management systems.

2. Determine the effect of season on scrotal circumference of Rambouillet rams and reproductive characteristics of their offspring. Evaluate ewes lambing during January and May under total confinement exposed to natural versus artificial light.

3. Evaluate the genetic mechanism which determines increased prolificacy of Booroola Merino ewes and develop breeding schemes to introduce Booroola fertility into North Dakota fine wool flocks. Evaluate the Columbia breed for a similar genetic mechanism.

PROJECT PROCEDURE

OBJECTIVE ONE

EVALUATION OF BREEDS UNDER DIFFERENT MANAGEMENT SYSTEMS

TRIAL ONE EXPERIMENTAL PROCEDURE. Reproductive performance and longevity of Suffolk x Rambouillet, Rambouillet x Finnish Landrace and Rambouillet x Finnish Landrace x Border Leicester ewes under total confinement versus semi-range management are being evaluated. The effects of warm barn confinement on longevity, health, lamb production and breed cross suitability are being monitored on two hundred thirty two crossbred ewes composed of 81 1/4 Finn x 1/4 Border Leicester x 1/2 Rambouillet (1/4 Finn), 76 1/2 Suffolk x 1/2 Rambouillet (1/2 Suff), and 81 1/2 Finn x 1/2 Rambouillet (1/2 Finn). Crosses to obtain these ewes were made in 1980 and 1981 utilizing a group of Wyoming white-faced range ewes and Finn, Suffolk or 1/2 Finn X 1/2 Border Leicester rams.

Two hundred seven ewes were placed on trial during the summer of 1981 and 25 ewes were added during the summer of 1982. The project was modified for 1987 since feed restrictions during maintaince were dropped, both groups were mated at the same time and lambs weaned at the same time. The ewes are being fed according to National Research Council (NRC) requirements. The ewes under semi-range are placed on native or tame grass pastures each spring and wintered in drylot. Outside ewes are fed the same ration as confined ewes during gestation and lactation. All groups are allowed free access to a mineral mix of equel parts trace mineral salt, dicalcium phosphate and iodized salt. Both the confinement and semi-range groups were mated from November 17 to December 22, 1986 to Suffolk rams. All lambs will be weaned at approximately 56 days and finished to a market weight of 120 pounds.

TRIAL ONE RESULTS AND DISCUSSION. This trial will continue for one more year and a detailed report will be completed at the temination of the trial. Currently 39 1/4 Finn x 1/4 Border Leicester x 1/2 Rambouillet, 39 1/2 Suffolk x 1/2 Rambouillet, and 33 1/2 Finn x 1/2 Rambouillet remain as productive ewes at seven years of age. Total attrition rate is 52% since 1980.

As of the last analysis, total estimated annual lamb production based on 80 day old lambs and ewe annual replacement rate within each management system and crossbred group was as follows. Under confinement, the 1/2 Finn produced 1.24 48 pound lambs for a total of 60 pounds with a 13% ewe replacement rate; the 1/4 Finn produced 1.12 51 pound lambs for a total of 57 pounds with a 9% ewe replacement rate; the 1/2 Suffolk produced 1.02 54 pound lambs for a total of 55 pounds with a 10% ewe replacement rate. Under semi-range conditions, the 1/2 Finn produced 1.37 48 pound lambs for a total of 66 pounds of lamb and a 6% ewe replacement rate; the 1/4 Finn produced 1.38 49 pound lambs for a total of 68 pounds and a 4% ewe replacement rate, the 1/2 Suffolk produced 1.27 53 pound lambs for a total of 67 pounds of lamb and a 4% ewe replacement rate.

Wool production for each group was as follows. Under confinement, the 1/2 Finn produced 8.9 pounds, the 1/4 Finn produced 8.8 pounds and the 1/2 Suffolk produced 8.7 pounds. Under semi-range conditions, the 1/2 Finn produced 10.1 pounds, the 1/4 Finn produced 10.3 pounds and the 1/2 Suffolk produced 9.8 pounds.

TRIAL TWO EXPERIMENTAL PROCEDURE. The reproductive performance, wool production, and longevity are being evaluated for F1 Booroola Merino x Rambouillet, F1 Finnish Landrace x Rambouillet and Rambouillet (control) ewes under confinement versus semi-range management. Crosses to obtain these ewes were made in 1984 and 1985 utilizing a group of Wyoming Rambouillet range ewes and Finn or Booroola Merino rams leased from USDA-Roman L. Hruska U.S. Meat Animal Research Center, Clay Center, Nebraska. The Rambouillet control ewes were purchased from the same source as the ewes utilized in making the F1 crosses. In the fall of 1986, 36 Booroola cross, 36 Finn cross, and 36 control ewes were randomly selected from those lambs born in 1985 and the same will be done during the fall of 1987 from ewes born in 1986. All ewes and lambs are fed by current NRC requirements for sheep.

Puberty was monitored as ewe lambs from August until December. On August 1, two wethers per 100 ewe lambs were placed with the ewe lambs. Wethers which have been implanted with testosterone were equipped with Sire-Sine marking harnesses and mating activity was recorded at alternate 16 day intervals. The implants were ten cm long and made from silicone tubing (6.4 mm internal diameter, 9.5 mm outside diameter) by sealing one end with silicone rubber adhesive, filling the tube with testosterone propionate and sealing the open end with adhesive (Endocrinology 78:208-211 1966). Four wethers were used during 1985 and six wethers were used during 1986 and wethers were rotated throughout the marking season. In an effort to monitor estrus activity, mating marks were recorded as light if no more than 2 marks were evident on the ewes rump, medium if three or more marks were evident and heavy if individual marks could not be counted because of excessive mounting by the teaser wether. Ovulation rates will be determined during January by laparoscope techniques.

Currently those ewes born during 1985 were exposed to Rambouillet rams from November 17 to December 4 and Suffolk rams from December 4 to December 22. The 1986 ewe lambs will be added to the group in 1987. Following weaning, the ewe groups will be split in half. One half of the Booroola, Finn and control ewes will be placed in dry lot, and the other half maintained under semi-range conditions. The two groups will be combined for breeding the following year and allowed to stubble graze until winter weather forces the ewes to be drylotted. Each succeeding year the same cycle will be imposed on the two groups of ewes until an overall 40% attrition rate is reached for the ewes. Ewes will be removed from the study by posting any chronic health disorder or two consecutive failures to give birth to a lamb. At lambing, ewes producing greater than two lambs will have excess lambs removed by 24 hours. Lambs will be creep fed and weaned from 50 to 63 days of age. Standard data collected on each ewe throughout this trial are: 1. Prebreeding weight and condition score. 2. Lamb birth date and sex plus birth, weaning, and market weight. 4. Attrition cause for ewe and lambs. 5. Udder score and lambing ease. 6. Yearly fleece weight and a lifetime fleece grade.

TRIAL TWO RESULTS AND DISCUSSION. The Booroola and Finn crossbred ewe lambs and Rambouillet control ewe lambs born during 1985 are presently grazing stubble and are approximately two months pregnant. Those ewe lambs born during 1986 are being grown out. Weaning weights and early growth data are not available on all breed groups since the Rambouillet control ewe lambs must be purchased and they are born and raised under range conditions, while the crossbred ewe lambs are raised under drylot conditions. Differences between the two rearing systems are assumed to be nonsignificant as the ewes start the trial at eighteen months of age.

Table 1 presents the growth data concerning the three types of sheep involved. The Finn ewe is the largest at all ages. The Finn ewe is 20 pounds heavier than the Booroola yearling ewe and 38 pounds heavier than the straight Rambouillet yearling. Throughout summer grazing, the Rambouillet ewe gained more weight than either the Booroola or Finn. Prior to breeding at 20 months of age, the Finn is still the heaviest ewe, followed by the Rambouillet and the Booroola is the lightest. Puberty was monitored and the results presented in Table 2. Through September, only marginal estrus activity was detected, but by mid October 39% and 49% of the Finn ewe lambs started estrus activity during 1985 and 1986, respectively. The Booroola ewe lambs expressed only slight estrus activity during the same period in either year, while 18% of the Rambouillet ewe lambs expressed estrus during 1986. Almost 100% of the Finn ewe lambs expressed estrus by December while only 49% of the Booroola ewe lambs or 58% Rambouillet ewe lambs had expressed estrus through December.

The ovulation rates are presented in Table 3 by sire and are obtained by viewing the ovary through laparoscope. Additional data can be obtained in regards to puberty in the ewe lamb because those ewe lambs that ovulated but did not express estrus can be determined. The percent cycling ewe lambs based on ovulation rate for each breed group were 82.9% for Booroolas, 68.2% for Rambouillet and 96.3% for Finn. The 1986 results indicate that all the Finn ewes that were cycling expressed estrus, but 17.6% of the Booroola and 15.9% of the Rambouillet ewe lambs were ovulating but not expressing estrus. When the sire groups were combined, average Corpra Lutea (CL) for Booroola was 1.79 CL, Rambouillet was 1.23 CL, and Finn was 1.77 CL.

During the development of prolific breeds of sheep, the performance of the male lamb must be evaluated to accurately estimate the cost of producing more prolific females. Table 4 compares Booroola, Finn, Suffolk and Rambouillet sire lambs for growth and carcass traits. Suffolk, Rambouillet and Finn sired lambs are similar in growth, although the Finn sired lambs are heavier conditioned and have smaller rib eyes. The Booroola is the slowest growing, smallest framed sheep, but has less condition and a larger loin eye than the Finn. Because of the small frame of the purebred Booroola Merino, approximately 10% of the lambs sired by Booroola Merino rams would not make acceptable market lambs.

OBJECTIVE TWO

SEASONAL EFFECTS ON SHEEP REPRODUCTION

TRIAL FIVE. The influence of season on scrotal circumference of Rambouillet rams and reproductive characteristics of their offspring are being evaluated. Rambouillet rams are evaluated yearly and classified as seasonal or nonseasonal rams. Seasonal rams are defined as those rams whose scrotal circumferences decrease dramatically from fall to spring while non-seasonal rams show no seasonal trend to change in scrotal circumferences. Scrotal measurements are obtained in late February and late July from the Glenn Brown flock, Buffalo, SD and ram selection is based on these two measurements. Four seasonal rams and four nonseasonal rams have been purchased and evaluated monthly at the Research Extension Center. Blood sampling for later analysis for luteinizing hormone was started in November 1986.

TABLE 1

Body weight (lbs) of F1 Booroola x Rambouillet, F1 Finn x Rambouillet and Rambouillet ewes lambs

	Total Ewe Lambs (1985)	Seven Month Weight	Yearling Weight	Pre-Breeding Weight
Rambouillet	35		103	125
Booroola x	36	91	121	119
Finn x	36	109	141	137
	(1986)	Seven Month Weight		
Rambouillet	48	97		
Booroola x	57	80		
Finn x	36	102		

TABLE 2

Number of F1 Booroola x Rambouillet, F1 Finn x Rambouillet and Rambouillet ewe lambs that expressed estrus during the fall of 1985 and 1986.

	Total Ewe Lambs	Sept 16,85	Oct 9,85	Nov 19,85
Booroola x	36	0 (0%)	0 (0%)	18 (50%)
Finn x	36	5 (4%)	14 (39%)	34 (94%)
		Sept 16,86	Oct 15,86	Dec 9,86
Rambouillet	48	5 (10%)	4 (8%)	23 (48%)
Booroola x	57	2 (4%)	10 (18%)	33 (58%)
Finn x	35	2 (6%)	17 (49%)	35 (100%)

TABLE 3

Number of ewe lambs with none, single, twin, triplet, quadruplet or quintruplet ovulation rate during 1985 and 1986 for nine individual Booroola Merino sires, four individual Rambouillet sires and two groups of Finnish Landrace sires.

	Booroola									Rambouillet				Finn	
Ovulation Rate	1	2	3	4	5	6	7	8	9	1	2	3	4	1	2
None	3	1	2	0	2	2	0	5	3	5	1	3	5	2	0
Single	10	6	2	4	2	3	1	3	1	6	7	6	4	3	11
Twin	1	1	5	10	3	3	4	6	11	3	4	0	0	9	22
Triplet	0	0	0	0	1	1	1	3	3	0	0	0	0	4	0
Quadruplet	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Quintruplet	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Total Ewe Lambs	14	8	9	15	8	10	6	17	18	14	12	9	9	18	33
Average Corpus Luteum	1.09	1.14	1.71	1.87	1.83	2.13	2.00	2.00	2.13	1.33	1.36	1.00	1.00	2.06	1.74

TABLE 4

Comparsion of Booroola Merino, Finnish Landrace, Suffolk and Rambouillet sired lambs for growth (lbs) and carcass traits.

Traits	Booroola	Finn	Suffolk	Rambouillet
Weight per day of age				
Pre-weaning	.54	.60	.63	.66
Post-weaning	.43	.51	.54	.50
Birth to Market	.46	.54	.58	.54
Weaning Weight	32.42	37.06	49.54	39.16
Weaning Age	60.06	62.15	77.78	59.75
Final Weight	99.21	106.94	108.66	109.97
Carcass Weight	47.61	52.45	52.81	54.16
Dress Percent	47.94	49.03	48.18	49.26
Leg Score	10.30	10.70	11.12	10.59
Quality Grade	10.39	10.82	10.94	10.88
Kidney Percent	3.09	3.74	2.83	2.56
12th Rib Back Fat	0.17	0.19	0.10	0.11
Rib Eye	1.96	1.74	2.12	2.05
Yield Grade	3.34	3.60	2.79	2.78

TABLE 5

Scrotal circumference change from March to September for seasonal and nonseasonal rams during the first and second year of evaluation

Ram Number	Initial Classification	Average change (cm) 1985	1986	1987
2532	nonseasonal	3.50	2.12	
3289	seasonal	10.05	8.73	
4066	nonseasonal	0.05	3.85	
4162	seasonal	7.35	6.53	
5303	seasonal		8.35	
5367	seasonal		8.15	
6014	nonseasonal		1.25	
6135	nonseasonal		0.60	

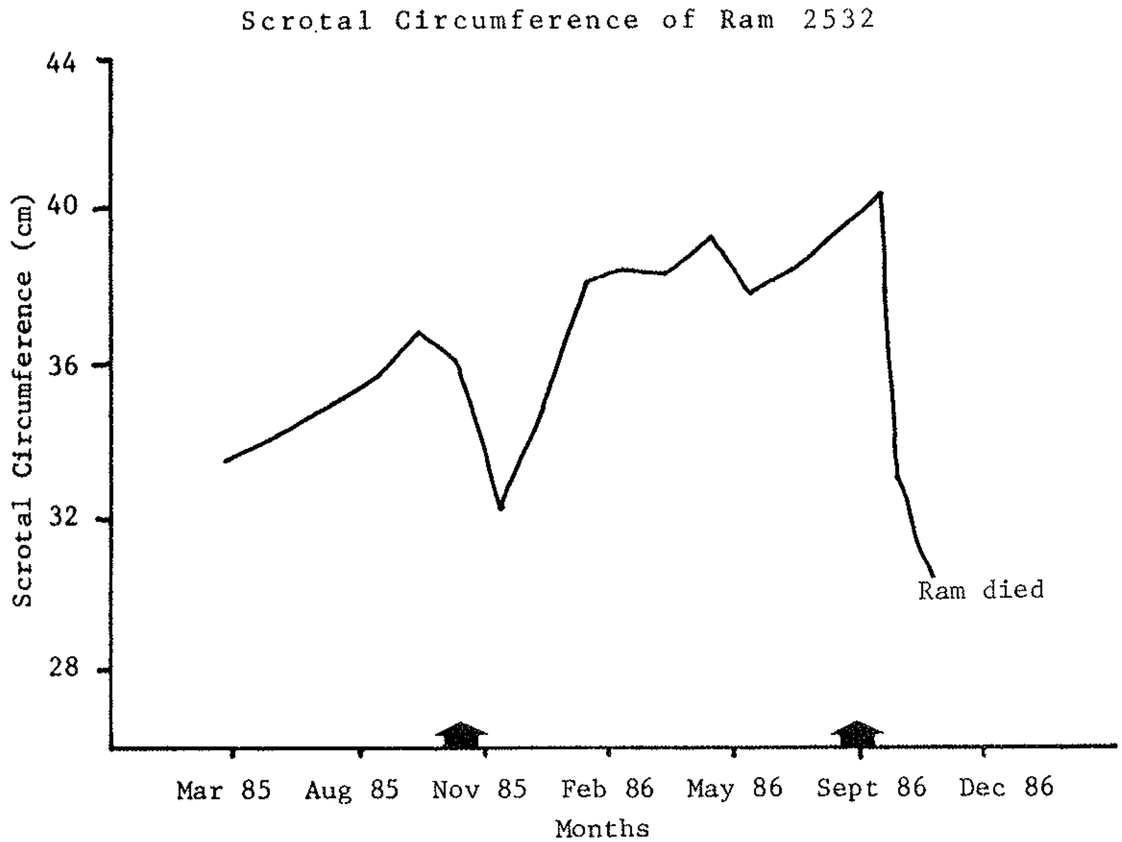
Currently 96 purchased Rambouillet ewes were mated to seasonal and nonseasonal rams. The purchased ewes will gradually be replaced with their daughters and granddaughters. An upgrading breeding program will be practiced by continually breeding seasonal sired ewes to seasonal rams and nonseasonal sired ewes to nonseasonal rams. Those ewe lambs born in 1986 were placed with teaser rams in August 1986 and estrus was monitored as previously defined under trial 2 and will be continued until the ewes are mated to seasonal and nonseasonal rams during August 1987. The older ewes (two years old and older) are maintained under semi-range and stubble grazing systems except for breeding and lambing. The degree that a ewe is seasonally reproductive will be determined by the teaser ram, blood analysis for progesterone, and laparoscopy.

TRIAL FIVE RESULTS AND DISCUSSION. Four Rambouillet rams were purchased in August of 1985 and 1986 after initial evaluation of Brown's Rambouillet rams. In 1985 two rams were selected each from two different age groups of rams, while in 1986 all four rams were from the same age group. These rams have had scrotal circumference measurements taken on a monthly bases since arriving at the station and are noted in Figure 1. Based on the March and September measurements (the scrotal circumferences used to select the rams) rams 2532, 4066, 6014 and 6135 were classified as nonseasonal and rams 3289, 4162, 5303 and 5367 were classified as seasonal.

The accuracy of classification based on two measurements appears to be repeatable (Table 5). The first four rams that were purchased have had the March through September measurements retaken and the scrotal circumference change the following year from March through September were similar. Those rams purchased in 1986 do not have one full years measurements available. Reviewing figure 1, a distinct seasonal trend can be noted in the seasonal rams. Maximal scrotal circumference for rams 3289 and 4162 occurs just prior to fall breeding and is attained very rapidly. In contrast, the nonseasonal rams also show trends in scrotal circumference, but scrotal size remains elevated for a longer period prior to maximal scrotal circumference. Both types of rams appear to decrease in scrotal size following ewe exposure.

The mating and lambing performance of ewes exposed to each ram is presented in Table 6. The ability of seasonal or nonseasonal rams to mate and conceive lambs during the fall appears to be similar. The difference between the number of ewes mated during the first cycle from 1985 versus 1986 is accounted for by the change in breeding times. The 1985 breeding season was through the month of October, while the 1986 breeding season was from August 18 to September 22. Ram 2532 had a lower conception rate (ewes lambed of those mated) in 1985 due to unexplained reasons. This ram died after the 1986 breeding season. The specific cause of death is unknown, however, congestion and edema of the lung indicated congestive heart failure. The ram showed little evidence of orderly spermatogenesis at the time of death due to orchitis and epididymitis. The ram did mate 12 ewes prior to death and 10 ewes subsequently lambed.

Those ewe lambs sired by rams purchased in 1985 were evaluated for puberty and ovualtion rate during the fall of 1986. In table 3, Rambouillet rams 1 and 2 are seasonal and Rambouillet rams 3 and 4 are nonseasonal. Twenty six of 32 (72.2%) seasonal ewe lambs were cycling by December 9, 1986 and 18 of 26 (69.2%) nonseasonal ewe lambs were cycling. Ovulation rate was 1.34 CL for ewe lambs sired by seasonal rams and 1.00 CL for ewe lambs sired by nonseasonal ewe lambs (table 3).



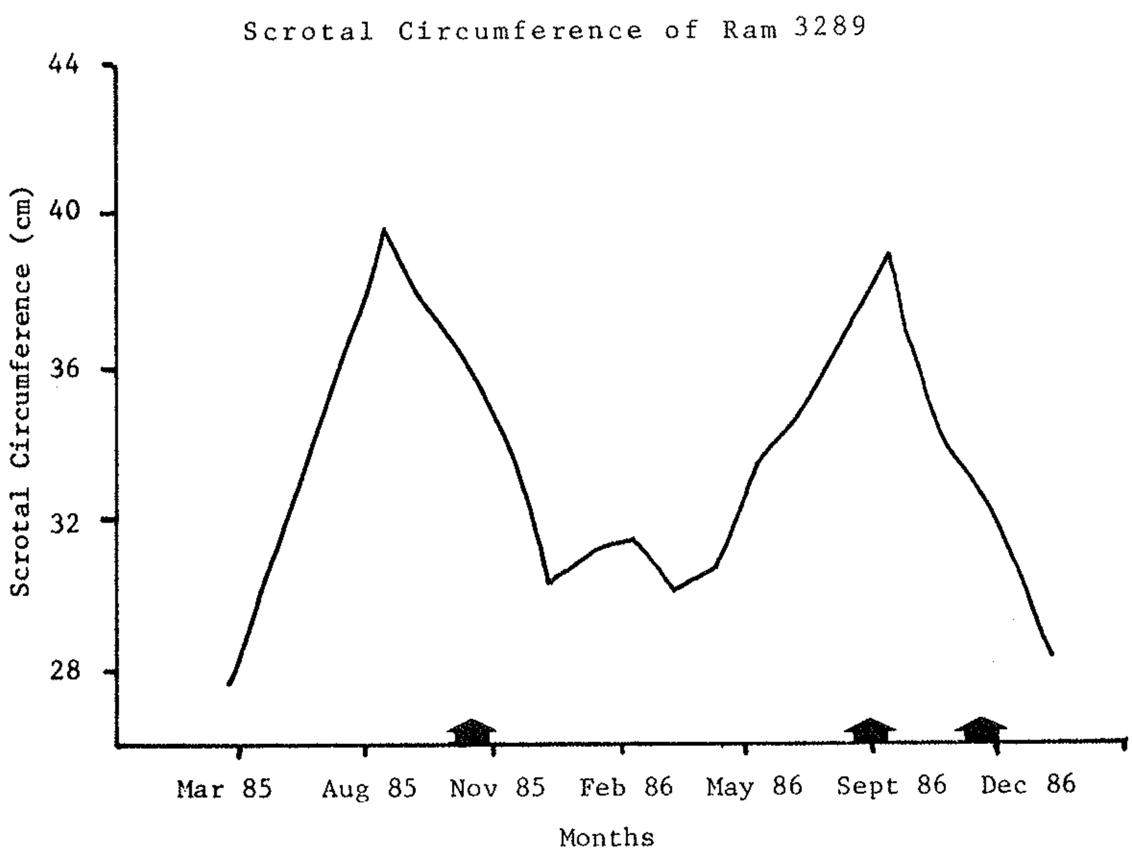
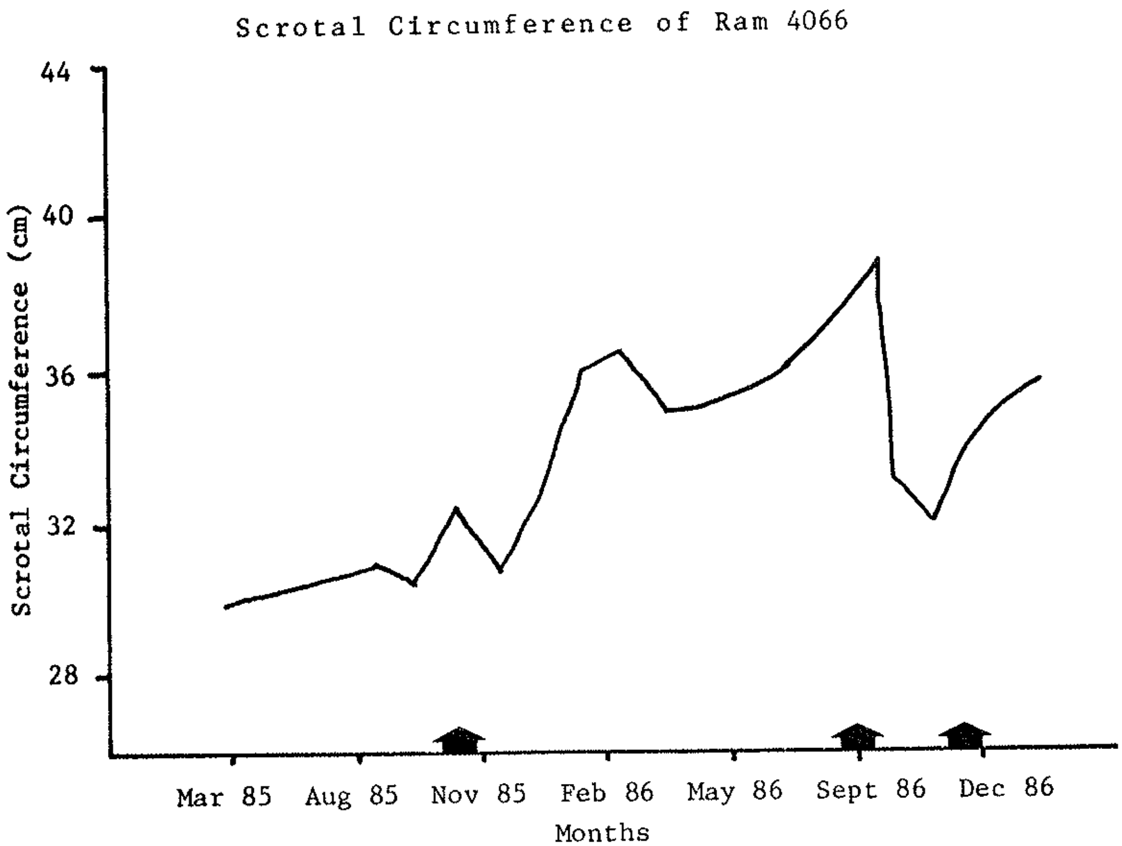


Figure 1 Scrotal circumference of Rambouillet rams from March 1985 through Jan. 1987. (☗ indicates 30 day ewe exposure)



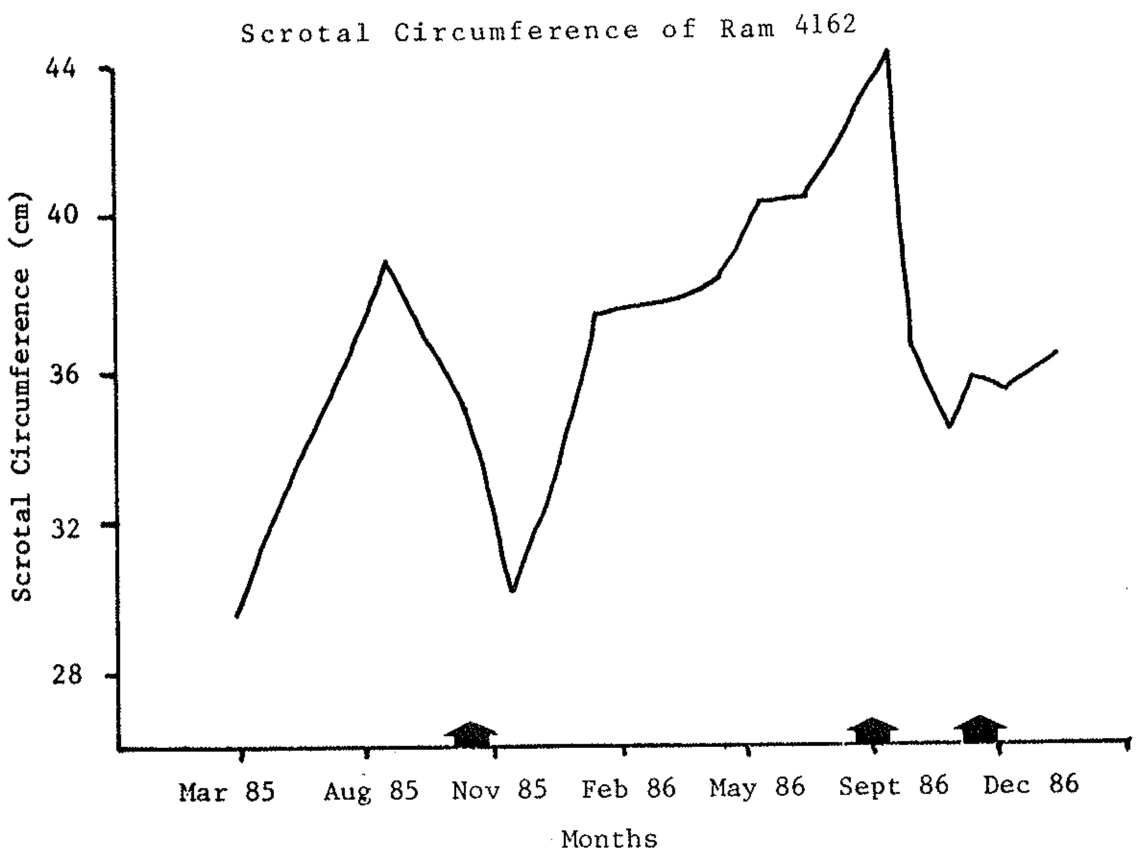
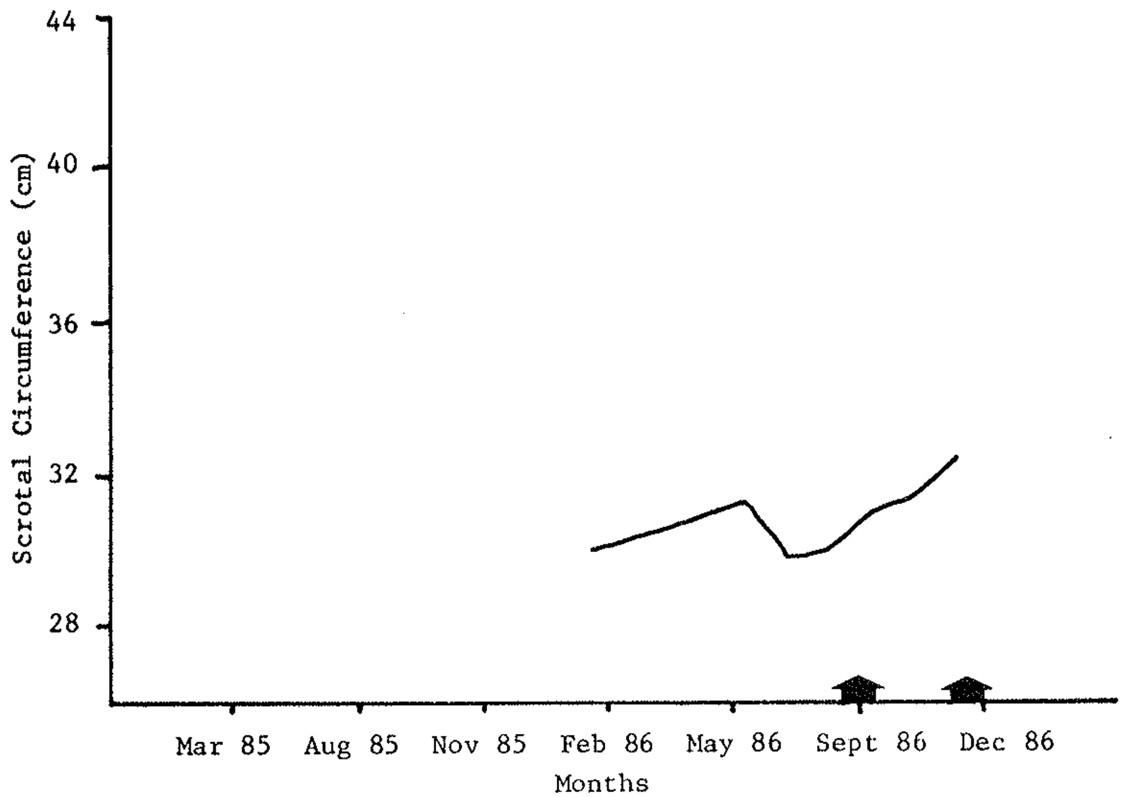


Figure 1 Cont.

Scrotal Circumference of Ram 6014



Scrotal Circumference of Ram 5303

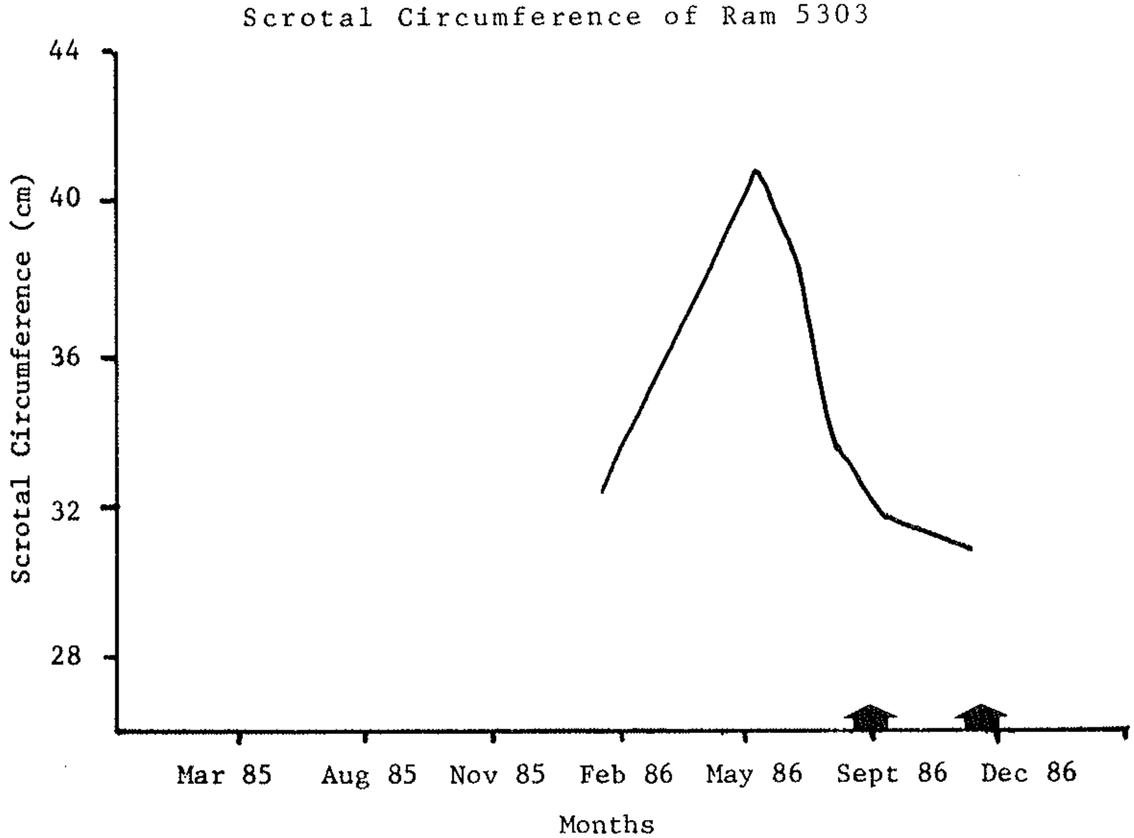
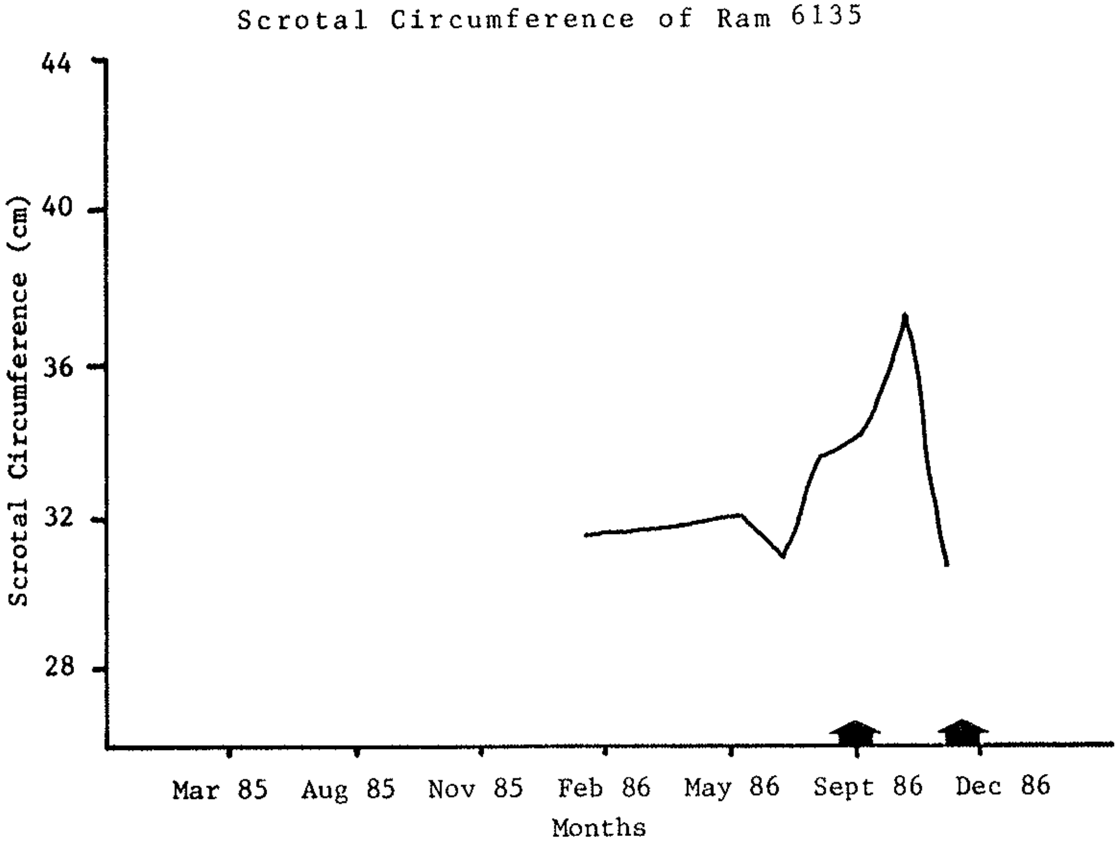


Figure 1 Cont.



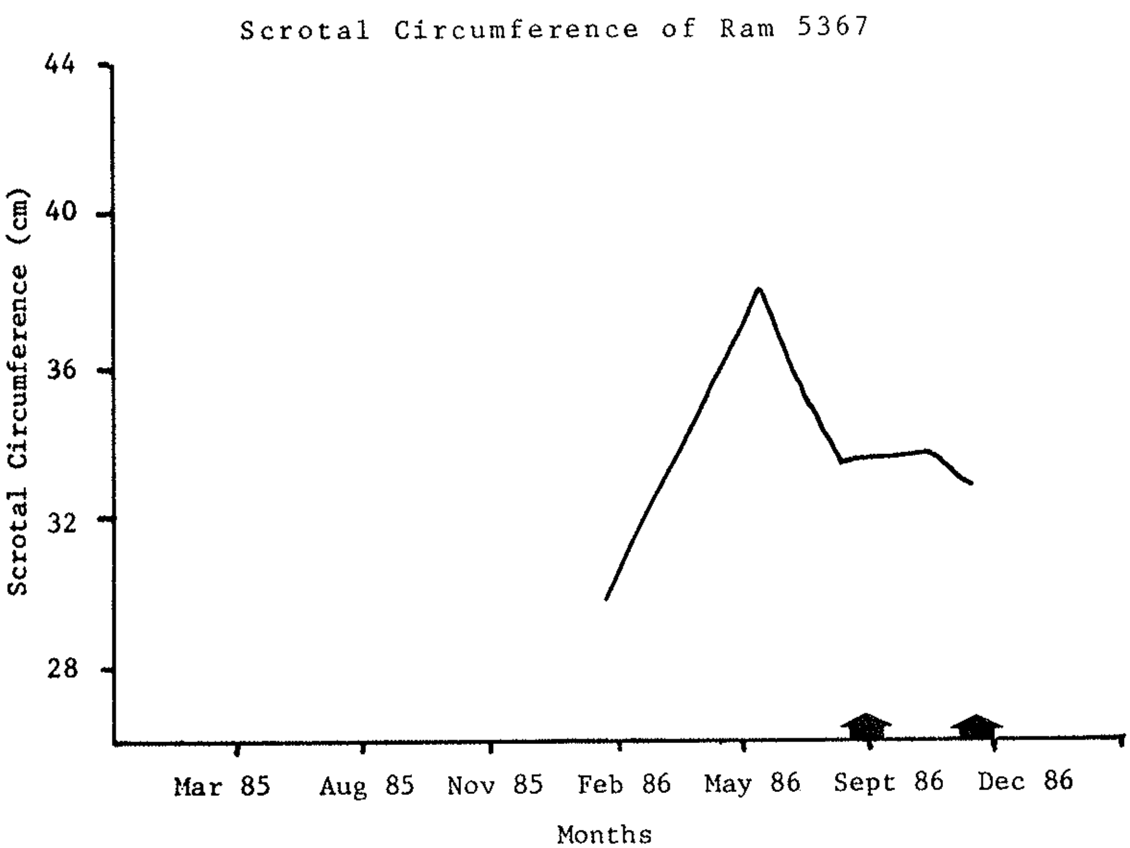


Figure 1 Cont.

TABLE 6

Number of ewes mated and lambed by nonseasonal and seasonal Rambouillet rams during fall breeding when exposed for two estrus cycles.

Ram	Class	Year	Ewes	Percentage Mated: 1st Cycle	2nd Cycle	Both Cycle	Ewes Lambing
2532	N	1985	27	20	6	26	14
		1986	12	0	12	12	10
3289	S	1985	26	23	3	26	22
		1986	12	1	11	12	11
4066	N	1985	27	24	3	27	22
		1986	12	0	12	12	10
4162	S	1985	27	24	3	27	22
		1986	12	3	9	12	11
5303	S	1986	12	4	8	12	10
5367	S	1986	12	1	11	12	11
6014	N	1986	12	1	11	12	11
6135	N	1986	12	2	10	12	11

Table 7

Production characteristics of foundation Dakota Booroola ewes and rams born in 1985

	Total numbers	Yearling weight (lbs)	Pre-breeding weight (lbs)	Annual wool (lbs)
Ewes	39	106	115	12.7
Rams	13	160	186	17.1

Table 8

Production characteristics of Columbia ewes during 1986

Pre-breeding weight (lbs)	Annual wool (lbs)	Lambs born/ ewe lambing	Lambs wean/ ewe lambing	56 day lamb weaning wt (lbs)	Pre-weaning ADG (lbs)
205	12.9	2.02	1.45	47.9	.86

OBJECTIVE THREE

GENETIC ENGINERING

DEVELOPMENT OF THE DAKOTA BOOROOLA

TRIAL EIGHT EXPERIMENTAL PROCEDURE. A flock of 68 yearling and 21 Booroola x Rambouillet ewe lambs as well 6 yearling and 5 ram lambs of the same breeding are maintained under semi-range conditions at the Hettinger Research Extension Center. Initial crosses to obtain these ewes and rams were made in 1984 and 1985 utilizing a group of Wyoming Rambouillet range ewes and nine Booroola Merino rams leased from USDA-Roman L. Hruska U.S. Meat Animal Research Center, Clay Center, Nebraska. Selection efforts are for homozygousity of the Booroola fertility gene. All ewes and rams must have fleeces that grade 60s or higher and ewes and rams must be classified as homozygous or heterozygous for the Booroola fertility gene based on either production or ovulation rate. Rams selected must have a minimum of .6 lbs weight per day of age up to 150 days of age.

As ewe lambs, ewes will have laparotomies done during December to determine ovulation rate. Those ewe lambs with ovulation rates greater than four will be classified as homozygous and the ewe lambs with ovulation rates of two, three or four will be classified as heterozygous. Ewes will be culled for chronic health reasons. Stud rams will be progeny tested to determined if they are homozygous or heterozygous for the Booroola fertility gene.

Those ewes born in 1985 and sired by Booroola rams 3, 4 and 5 from Table 3 were mated to purebred Booroola Merino rams from August 18, 1986 through September 22, 1986. Those ewes sired by rams 1 and 2 were mated to Rambouillet rams. None of the 1986 ewe lambs were mated in 1986 due to the poor results achieved from mating the 1985 ewe lambs.

TRIAL EIGHT RESULTS AND DISCUSSION. All ewe lambs were exposed to Booroola Merino sires during the fall of 1985 and 12 of the ewes lambed. These 12 ewes produced 17 lambs and raised 7. Milk appeared to be limited and the 7 lambs averaged 24.4 lbs at weaning. Table 7 indicates the production characteristics of the foundation ewes and rams. The Booroola x Rambouillet ewes are heavier than the straight Booroola sheep. The prebreeding weight on the Dakota Booroola rams was 186 lbs versus 116.7 lbs for older purebred Booroolas and 186 lbs for Rambouillet rams of the same age.

The results of the laparotomies have been presented in Table 3 in terms of ovulation rates detected from ewe lambs of each sire. After two years data, not all the purebred Booroola rams leased from MARC at Clay Center, Nebraska would appear to be homozygous for the Booroola fertility gene. The data presented in Table 3 would suggest that rams 1 and 2 are non-carriers of the gene, rams 5 and 6 may be heterozygous, rams 3, 7 and 8 are either heterozygous or homozygous and rams 4 and 9 are homozygous. Additional colaborative research between federal and state research stations will help confirm these observations. Based on the previous results the 29 yearling ewes sired by rams 1 and 2 may be removed from the selection efforts to develop the Dakota Booroola.

Nine groups of progeny test ewes were mated to Dakota Booroola rams during the fall of 1986. The progeny from these matings will be evaluated during December of 1987. At the time of this publication, early 1987 lambing results would suggest that those Dakota Booroola ewes backcrossed to Booroola Merino sires and heterozygous for the Booroola fertility gene will produce an average of 2.5 lambs per ewe lambing.

TRIAL NINE. After a long term single trait selection project was completed in 1983, the three lines of Columbia sheep were reduced to two. The visually selected and those selected for wool production were combined to form one visually selected line and the line selected for lamb production was kept separate. The objective for maintaining the two lines was to help understand the large number of multiple births (triplets and quadruplets) occuring in the line selected for lamb production. Selection will be continued for prolificacy within the lamb production line and for Columbia type standards within the visually selected line.

TRIAL NINE RESULTS AND DISCUSSION. Since the project revision, Table 8 gives the overall performance of both groups of ewes. Growth and mature body size is similar between both lines of ewes. The Columbia ewes produced 47.9 lbs of lamb at 56 days of age in 1986. The pre-weaning average daily gain for these lambs was .86 lbs per day. Pre-breeding body weight for the ewes in 1986 was 205 pounds. Lambing performance averaged 2.02 lambs born per ewe lambing and 1.45 lambs were weaned per ewe lambing. Wool production was 12.9 lbs per ewe. Ewe lambs were evaluated for ovulation rate during December, the ewes from the visual line averaged 1.4 CL per ewe and the prolificacy line averaged 1.8 CL per ewe. At the time of this publication, the visually selected ewes had produced 1.77 lambs per ewe lambing and the prolificacy ewes had produced 1.90 lambs per ewe lambing. Considerably more visually selected ewes had lambed, however.

SECTION II

REPORT ON

CONTROL OF THE KED

DR. DENNIS KOPP AND DR. HENDRIK MEYER
ENTOMOLOGY DEPARTMENT
NORTH DAKOTA STATE UNIVERSITY

FARM FLOCK MANAGEMENT

MR. GERHARD REICHENBACH
FAIRVIEW, MONTANA

ALFALFA WHEAT STRAW RATIONS

DR. JAMES TILTON
ANIMAL & RANGE SCIENCES DEPARTMENT
NORTH DAKOTA STATE UNIVERSITY

THE MINERAL NEEDS OF YOUR SHEEP OPERATION

DR. ART POPE
ANIMAL SCIENTIST
UNIVERSITY OF WISCONSIN

AT THE

28TH ANNUAL SHEEP DAY

HETTINGER RESEARCH & EXTENSION CENTER
HETTINGER, NORTH DAKOTA

FEBRUARY 11, 1987

ECTOPARASITES OF SHEEP

by
D. D. Kopp and H. J. Meyer
Dept. of Entomology, NDSU, Fargo

Three parasitic pests of sheep were discussed at the 1987 Hettinger Sheep Day. These are some of the most commonly encountered ectoparasites of sheep.

Sheep Ked, Melophagus ovinus (L.)

The sheep ked is a wingless fly with a tick-like appearance. The larvae develop within the adult female, one at a time. The female attaches a fully developed larva to the fleece, and the larva transforms into a red, barrel-shaped puparium.

The entire life of a sheep ked is spent in the fleece of the host. Populations build up during autumn and reach peak numbers in winter. They then decline to lower numbers which are carried over the summer. Adult keds are thought to spread from one host to the next by direct contact, although they are able to relocate a host if they are placed on the ground.

The sheep ked is a blood feeder that can move rapidly through the fleece of the host animal. Damage results from bites of the ked and irritation to the sheep.

Keds are responsible for a 2 lb. reduction in dressed carcass weights of lambs, a 20% reduction in clean dry weight of fleece, and a reduction of about 7% in clean fiber present. Many producers report that keds are responsible for "back loss," or death of pregnant ewes that roll onto their backs and become stuck while attempting to relieve irritation.

Keds repeatedly puncture the skin and cause a series of firm, hard nodules to develop in the grain layer of sheepskin. This seriously damages the sheepskin, reducing its value by causing a defect known as "cockle".

Control. Several methods of control are available for sheep keds. Each has its advantages and disadvantages, depending on the particular sheep management program. Most often, sheep are successfully treated in the spring after shearing. Flocks that are shorn prior to lambing tend to have lighter ked burdens than those shorn afterward. All sheep in a flock must be treated, and all new animals in a flock should be isolated and treated prior to their introduction in order to prevent reinfestation. Methods of application, depending on the insecticide selected, for sheep ked control include the dipping vat, high-pressure spray, low-pressure spray, sprinkler-can application, low-volume spray, pour-on, power dusting and hand dusting.

Sheep Lice

Several species of lice can infest sheep. These include one species of chewing or biting louse, the sheep biting louse, *Bovicola ovis* (Schrank) and several species of sucking lice, including the sucking body louse, *Linognathus ovillus* (Neumann); the African blue louse, *L. africanus* (Kellogg and Paine) (also a parasite of goats); and the sucking foot louse. *L. pedalis* (Osborn). The adult, nymphal, and egg stages all appear on the host. The three nymphal stages resemble adult lice in general appearance but are smaller. The eggs are glued to wool fibers or hairs.

Various breeds of sheep are reported to be more, or less, susceptible to lice infestation. Lice are supposed to be more prevalent on open-fleeced or loose-wool sheep than on the fine-wool breeds. In a flock in Arizona, only the coarse-wool Suffolk and Hampshire rams, and not the fine-wool Rambouillet rams, harbored the African blue louse.

Typically, lice demonstrate a pronounced seasonal fluctuation in populations, numbers being greatest in winter and early spring, and lowest in summer. Generally, lice are spread by direct contact between sheep; however, the sheep foot louse may also be acquired from an infested pasture.

The sheep biting louse is usually most abundant on older sheep and animals in poor condition. Their preferred location is along the middorsal line and down the sides, but in heavy infestations, they may be found anywhere on the body.

Biting lice feed on skin scurf. They are very irritating, and cause sheep to bite and pull their wool, and rub against objects. The fleece of heavily infested sheep becomes ragged and torn, and in heavily infested animals, large areas of wool are completely removed. In an Australian study of sheep biting lice it was determined that clean wool production of Merino sheep was reduced by 0.3 to 0.8 kg per ewe. Also, lice-infested sheep yielded a lower-quality fleece.

The sheep foot louse is not considered very injurious because feeding occurs on the hairier parts of the sheep's body, and the animal exhibits little discomfort. Younger animals are more heavily infested, and rams appear to be preferred. Light infestations commonly occur as clusters of lice around the accessory digits. They may spread to the foot and the shank, and in heavy infestations, they may infest the scrotum and belly.

Linognathus ovillus is found on all areas of the sheep except the extremities such as the lower parts of the limbs. When their numbers are low, they are found principally on the hair-covered parts, particularly, the face. For this reason *L. ovillus* has been called "the face louse of sheep."

The African blue louse may be less known than other lice species that occur on sheep. This species causes considerable damage to the "fleece" of Angora goats. Massive infestations are reported to cause severe anemia, and if not controlled, death of the animal, particularly kids. On sheep, these lice have been found on the lateral aspect of the ribs. In heavy infestations, patches on the sides of the body have been denuded of wool, possibly because of biting and rubbing in an attempt to relieve irritation.

Control. The sheep body louse, sheep foot louse, and other species that occur on sheep are usually controlled by the use of an insecticide dip or spray. Dusts are occasionally used, especially when a few animals must be treated by hand.

Sheep Bot Fly, Oestrus ovis (L.)

The sheep bot fly, is a worldwide pest of sheep and goats. The persistence of the adult flies in depositing larvae in the nostrils annoys the animals and interferes with grazing. The larval stages of the fly, known as head grubs, live as parasites on the mucosa of the nasal passages and sinuses. They may irritate membranes lining the nasal cavities and cause a mucopurulent discharge. The maggots can also predispose sheep to bacterial infection.

In controlled studies of lamb performance, sheep bot fly infestations have reduced weight gains as much as 4%. Control of infestation by means of experimental drugs also reduces the numbers of sheep with nasal discharges.

In temperate regions, first-instar larvae are deposited in the nostrils during the warmer months of the year. In warm regions, the flies may be active year round. The small larvae remain in the nasal passages for a time, then migrate to the frontal or maxillary sinuses for further development. After reaching full growth in the sinuses, larvae work their way out of the nostrils and drop to the ground where they bury themselves and pupate.

Studies in temperate areas of the United States indicated that there are two generations per year. First-instar larvae continue to develop in nasal passages, but at a reduced rate, throughout the winter.

Control. Currently, there is no practical and effective control method for this pest in the United States, although effective drugs are approved in other parts of the world.

INSECTICIDE FOR SHEEP AND GOATS

PEST	INSECTICIDE	TREATMENT FOR 100 GALS. WATER	REMARKS
SCREW WORMS Wool Maggots	Preventive Sprays and Dips: Spray animals thoroughly or treat the wounded areas with one of the following:		
	Coumaphos (Co-Ral) 25% WP	8 lbs. per 100 gals. water (spray or dip)	Do not use on lactating animals. Restriction on slaughter. Do not apply to lactating goats or goats within 14 days of freshening.
SHEEP TICKS or KEDS, LICE	Anchor 10% EC**	1 pt. per 100 gals. water	Spray to run-off or fog or mist using 1 qt. spray mix per head.

** Registered under state label in North Dakota.

PEST	INSECTICIDE	TREATMENT FOR 100 GALS. WATER	REMARKS
SHEEP TICKS or KEDS, LICE Continued	Ciovap 12.5% EC	2 gals. per 100 gals. water	Spray animals thoroughly using up to 1 gal. of finished spray per animal with a second spray 10-14 days later. Repeat as necessary, but no more often than once every 7 days. Minimum days from last application to slaughter is 1 day.
	Coumaphos (Co-Ral) 25% WP	4 lbs. per 100 gals. water	Do not treat within 15 days of slaughter. Do not apply to lactating goats or goats within 14 days of freshening.
	Dioxathion (Delnav) 30% EC	2 qts. per 100 gals. water	No time limitation on slaughter. Do not use more often than once every 2 weeks.
	Fenvalerate (Ectrin) 10% WDL	Follow label directions for application and rates.	
	Lindane 20% EC	2 pts. per 100 gals. water	Do not use within 30 days of slaughter. Do not treat dairy goats or animals under 3 months of age.
	Malathion 25% WP	16 lbs. per 100 gals. water	No waiting period necessary. Do not use on lambs under 1 month old. Do not apply to milk goats.
	Malathion 57% EC	1 gal. per 100 gals. water	
SCABIES or MANGE of SHEEP	Lindane 25% WP	3 lbs. per 100 gals. water	Do not use within 30 days of slaughter. Do not treat dairy goats or animals under 3 months of age.
	Lindane 20% EC	3 pts. per 100 gals. water	

NOTE: The North Dakota Livestock Sanitation Board has specific recommendations relative to treating scabies infested animals; therefore, contact the local or State veterinarian immediately.

THE EFFECT OF ALFALFA-WHEAT STRAW RATIONS ON REPRODUCTIVE PERFORMANCE IN EWES

R. Wasson, J. Schmidt, J.E. Tilton, D.O. Erickson and R.M. Wiegl

SUMMARY

Seventy-five ewes were randomly assigned to one of five nutritional treatments; 1-100% alfalfa (A), 2-80% A/ 20% straw (S),3-60% A/40% S, 4-40% A/60% S, 5-`negative control'-60% A/40% S. Twenty-five ewes were housed in individual pens to allow measurement of nutritional and endocrinological parameters. Blood samples were collected at five time periods to assess luteinizing hormone (LH) secretion patterns and twenty-five times for progesterone determinations. Analysis of body weight data indicated no significant difference in the live weight gain or loss of the ewes. Radioimmunoassay of luteinizing hormone (LH) and progesterone (P4) is being completed at this time. Lambing data for 1985 indicates no significant difference between treatments in number of lambs born per ewe exposed.

INTRODUCTION

In a sheep operation feed constitutes the largest production cost, representing approximately 60% of the budget. One method to lower this cost would be to substitute low cost roughages for more expensive dietary components. Past experiments at the Hettinger Experiment Station demonstrated that partial substitution of straw for alfalfa during pre and post-breeding periods could be achieved without hindering reproductive performance of the ewe flock. In these experiments, all ewes were fed a common flushing diet which may have masked any nutritional deficiencies of the treatment diets. Additional research is needed to evaluate hormonal differences among nutritional treatment groups and determine if there is a in flushing effect on ewe reproduction following partial inclusion of straw feeding, prebreeding.

PROCEDURE

Twenty-five three or four year old ewes were randomized to individual indoor pens. One of five nutritional treatments was assigned to each ewe, (5/treatment). Fifty additional ewes (ten/treatment), were placed in one of four outdoor pens, with ewes on treatment 3 and 5 maintained as a group except for the flushing and breeding period. The nutritional treatments imposed were:

1. 100% alfalfa
2. 80% alfalfa/20% straw
3. 60% alfalfa/40% straw
4. 40% alfalfa/60% straw
5. negative control (60% alfalfa/20% straw)

Treatments 1-4 were fed from weaning until two weeks prior to breeding. After a two-week flushing period and a 35 day breeding period, the ewes were returned to their treatment diet and maintained on such through early gestation. All ewes were then fed on a gestation ration of 100% ad lib alfalfa until parturition. Ewes on treatment 5 were fed the treatment ration without flushing from weaning through early gestation. In addition, .25 pounds of soybean meal was fed to all ewes throughout the treatment period. Prior to breeding ewes were sorted into groups (n=20) and fed a flushing ration consisting of one pound barley/hd/day and alfalfa ad lib. Teaser rams were allowed fenceline contact with all ewes for two weeks, then raddled, intact rams were introduced. All rams used were tested and found to be fertile. The rams were removed every morning to permit supplemental feeding and repainting. The ewes were observed at this time for breeding marks. Rams were reintroduced in the evening.

Throughout the straw-feeding period blood samples were taken to estimate hormone secretion rates. The hormones to be evaluated were progesterone (P4), and luteinizing hormone (LH). LH analysis requires "windows" or repeated sampling procedures to accurately determine release patterns. For a period of 4 to 6 hours, a one ml sample is taken every 20 minutes. During periods of seasonal activity this was changed to every 10 minutes to obtain a more detailed profile. The procedure used to analyze the LH samples is that of Ziecik et al. (1978). Two progesterone assays were used. Initially we used the extraction assay of Schneider et al. (1983). Later we changed to a direct assay. (Coat-A-Count, Diagnostic Products Corp., Los Angeles CA).

RESULTS

There was no significant difference between treatments in the number of lambs produced per ewe exposed in the first replication (Table 1). Although the variation seen between number of lambs produced by ewes in treatments 1-4 and those in treatment 5 (1.60 vs 1.27) cannot be completely attributed to the ration, it is a large enough difference to economically affect a sheep operation. Ewes bred in the second replication have not lambed yet, but the additional data will provide an indication as to whether this difference in number of lambs is related to a lack of flushing in treatment 5. Within replication there was no significant difference between treatments for live weight change of the ewes (Tables 2 and 3), indicating that the changes seen could be attributed to the normal variation encountered by individual animals throughout a relatively long treatment period. It should be noted that the direction of live-weight change (gain or loss), was the same over all treatments within replication in the last 2 weigh periods, even though this direction varied between replications. The one exception to this was treatment 1 in replication 2, which showed an increase in live-weight while treatments 2-5 all showed a decrease for the same time period (Table 3). Again, this difference was not statisticaly significant.

Between replication there is a significant difference at all dates when the data is pooled across treatments. This difference was caused by larger framed ewes being used for the second replication.

TABLE 1. Number of lambs born per ewe exposed - 1985 (n=71)

Treatment	lambs/ewe
1	1.71
2	1.46
3	1.67
4	1.57
5	1.27
mean =	1.53 lambs born/ewe exposed

TABLE 2. CHANGE IN BODY WEIGHT (POUNDS + SEM) WITHIN GROUP OVER TIME (1985)

	4/25/85	8/23/85	10/22/85	12/5/85
trt	wt s.e.	wt s.e.	wt s.e.	wt s.e.
1	173.20(7.56)	181.47(7.41)	185.73(6.39)	198.78(7.89)
2	173.00(8.61)	168.93(8.94)	172.13(8.85)	177.67(9.72)
3	171.33(7.00)	171.53(8.13)	178.80(7.90)	182.13(7.19)
4	166.33(8.17)	159.07(9.46)	173.73(9.96)	177.20(10.27)
5	177.20(6.33)	173.67(6.73)	181.73(6.04)	183.87(5.99)
	n=75	n=75	n=75	n=74

TABLE 3. CHANGE IN BODY WEIGHT (POUNDS + SEM) WITHIN GROUP OVER TIME (1986)

	5/13/86	8/21/86	10/14/86	12/1/86
trt	wt s.e.	wt s.e.	wt s.e.	wt s.e.
1	173.53(6.92)	195.33(7.74)	207.07(8.31)	213.13(9.44)
2	177.13(5.60)	195.33(6.68)	217.53(8.93)	210.80(8.53)
3	198.13(7.99)	192.00(9.05)	207.20(9.44)	201.43(11.37)
4	175.68(4.92)	181.11(4.67)	194.26(5.07)	193.16(5.79)
5	190.36(9.49)	184.91(9.81)	193.80(10.65)	183.80(11.62)
	n=75	n=75	n=74	n=73

DISCUSSION

It has been shown repeatedly that flushing (increasing the plane of nutrition prior to mating) will increase ovulation rate (Bellows et al., 1961; Haresign, 1981; Gunn et al., 1984; Lightfoot and Marshall, 1974; Gunn et al., 1979a). The absence of flushing may account for the slight decrease in number of lambs born per ewe in treatment 5 relative to treatments 1-4. This change in lambs produced would amount to a difference of forty-four lambs per 100 ewes, a substantial loss in production to a producer. The failure to detect a difference in live-weight between treatments does not weaken our hypothesis since it has been shown that the plane of nutrition causes the flushing effect, not a change in body weight (Gunn et al., 1984; Gunn et al., 1979; Geisler and Fenlon, 1979).

In early gestation (mating to approximatly day 40) it has been shown that undernutrition does not affect lamb survival or birth-weight (Edey, 1970; Parr et al., 1982) but a high level of nutrition at this time will increase embryonic death loss (Gunn et al., 1979). It may also have a detrimental effect on circulating progesterone levels in pregnant ewes (Cumming et al., 1971; Rhind et al., 1985; Williams and Cumming, 1982) and this may account for increased embryonic death loss (Brien et al.,1981). While our progesterone data has not been analyized yet, the lambing data would suggest there is little difference in embryonic loss, expressed as number of lambs born. However, this should be interpreted cautiously since many factors besides embryonic mortality have an effect on the number of lambs born (Bindon and Piper, 1985).

There is no obvious detrimental live-weight response to the amount of straw in the rations which indicates that there may be no deleterious effects of feeding a ration containing up to 60% straw. This is in agreement with Hettinger data and other experiments (Russel et al., 1969; Gunn et al., 1979b; Foote et al., 1959) supporting the practice of substituting more expensive roughages with cheaper, lower quality feeds.

LITERATURE CITED

Bellows, R.A., A.L. Pope, R.K. Meyer, A.B. Chapman, L.E. Casida. 1961. Physiological mechanisms in nutritionally-induced differences in ovarian activity of mature ewes. J. Anim. Sci. 22:93.

Bindon, B.M., L.R. Piper. 1985. Booroola (F) gene: major gene affecting ovine ovarian function. Basic Life Sciences vol. 37: GENETIC ENGINEERING OF ANIMALS: An agricultural perspective. J.W. Evans, A. Hollaender, eds. Plenum Publishing Corp., New York.

Brien, F.D., I.A. Cumming, I.J. Clarke, C.S. Cooks. 1981. Role of plasma progesterone concentration in early pregnancy of the ewe. Aust. J. Exp. Agric. Anim. Husb. 21:562.

Cumming, I.A., B.J. Mole, J. Obst, A. deB. Blockey, C.G. Winfield, J.R. Goding. 1971. Increase in plasma progesterone acused by undernutrition during early pregnancy in the ewe. J. Repro. Fert. 24:146.

Foote, W.C., A.L. Pope, A.B. Chapman, L.E. Casida. 1959. Reproduction in the yearling ewe as affected by breed and sequence of feeding levels. II. Effects on fetal development. J. Anim. Sci. 18:463.

Edey, T.N. 1970. Nutritional stress and pre-implantation embryonic mortality in Merino sheep, 1967. J. Agric. Sci., Camb. 74:193.

Geisler, P.A., J.S. Fenlon. 1979. The effects of body weight and its components on lambing performance in some commercial flocks in Britain. Anim. Prod. 28:245.

Gunn, R.G., J.M. Doney, W.F. Smith. 1979a. Fertility in Cheviot ewes 2. The effect of level of pre-mating nutrition on ovulation rate and early embryo mortality in North and South country Cheviot ewes in moderatly-good condition at mating. Anim. Prod. 29:17.

Gunn, R.G., J.M. Doney, W.F. Smith. 1979b. Fertility in Cheviot ewes 3. The effect of level of nutrition before and after mating on ovulation rate and early embryo mortality in South Country Cheviot ewes in moderate condition at mating. Anim. Prod. 29:25.

Gunn, R.G., J.M. Doney, W.F. Smith. 1984. The effect of level of pre-mating nutrition on ovulation rate in Scottish blackface ewes in different body conditions at mating. Anim. Prod. 39:235.

Haresign, W. 1981. The influence of nutrition on reproduction in the ewe I. Effects on ovulation rate, follicle development and luteinizing hormone release. Anim. Prod. 32:197.

Lightfoot, R.J., T. Marshall. 1974. Effects of lupin grain supplementation on ovulation rate and fertility of Merino ewes. Proc. Aust. Soc. Repro. Bio. 518.

Rhind, S.M., I.D. Leslie, R.G. Gunn, J.M. Doney. 1985. Plasma FSH, LH, prolactin and progesterone profiles of Cheviot ewes with different levels of intake before and after mating, and associated effects on reproductive performance. Anim. Repro. Sci. 8:301.

Rhind, S.M., J.J. Robinson, I. McDonald. 1980. Relationships among uterine and placental factors in prolific ewes and their relevance to variations in foetal weight. Anim. Prod. 30:115.

Russel, A.J.F., J.M. Doney, R.G. Gunn. 1969. Subjective assessment of body fat in live sheep. J. Agric. Sci., Cambridge 72:451.

Schneider, T.M., J.E. Tilton, S. Okrasa, J. Mah, R. Weigl, G.L. Williams. 1983. The effect of intrauterine infusions of prostaglandin E2 on luteal function nonpregnant gilts. Theriogenology 20:509.

Williams, A.H., I.A. Cumming. 1982. Inverse relationship between concentration of progesterone and nutrition in ewes. J. Agric. Sci., Cambridge 98:517.

Ziecik, A., M. Goralska, T. Krzymowski, K. Pogorzelski. 1978. Isolation and participation of porcine LH for radioimmunoassay and radioreceptor assay. Bull. Acad. Sci. Polon, Ser. Sci. Biol. 26:739.

MEETING THE MINERAL NEEDS OF YOUR SHEEP OPERATION

Art Pope
Meat and Animal Science Department
University of Wisconsin-Madison

It has been said that a stockman must pay whatever the cost for a mineral that is needed or go out of business. On the other hand, a mineral that is not needed could be costly even as a gift. Some minerals in excess are bad.

The following three subjects will be discussed:

1. Which minerals do our sheep need?

2. We should always consider the diets used and give credit to minerals contained in those feeds.

3. Let's make sure we add only those minerals that are not sufficiently supplied in the feed yet are needed to meet requirements.

SUBJECT NO. 1 - WHICH MINERALS ARE NEEDED?

The animal body contains approximately 40 mineral elements, many of which are present just because they are constituents of feeds. There are only 15, however, that can be described with certainty as nutritionally essential. Nutritionally essential means that they have been shown to have a specific metabolic role and that animals cannot live and reproduce unless they are present in the diet.

These 15 essential minerals are divided into major minerals and trace minerals depending entirely on the relative amounts needed by the animals. The seven major minerals include sodium (Na), chlorine (Cl), calcium (Ca), phosphorus (P), magnesium (Mg), potassium (K) and sulfur (S). Because they are needed in larger amounts we measure their need as a percent of the diet. The other eight minerals are trace minerals and are measured in parts per million (ppm) in the diet. They are iodine (I), cobalt (Co), manganese (Mn), zinc (Zn), selenium (Se), copper (Cu), molybdenum (Mo) and iron (Fe). Sheep obtain minerals from only three sources - feed, water and supplements.

Three of the 15 essential minerals are classified as toxic when consumed in large amounts; they are Cu, Se and Mo. Four non-essential toxic minerals are flourine, lead, cadmium and mercury.

Incidentally, there is growing evidence that additional minerals, such as chromium, flourine, silicon, tin and vanadium are essential for the rat and/or the chick. They have not been researched to know if they are needed by sheep.

Minerals have many functions - a few are:

I	for functioning of the thyroid gland.
Ca	for bone growth.
P	for bone growth and energy metabolism.
Na	is contained in bile.
Cl	is needed for stomach acidity.
K	plays important role in osmotic regulation of body fluids.
Cu	and Fe are necessary for the production of hemoglobin which transports oxygen in the blood.

Most trace minerals play a role in the enzyme functions of the body.

Sources Of Informatin On Mineral Nutrition

The basis for the minerals and other nutrients required by sheep is "Nutrient Requirements of Sheep", Sixth Revised Edition 1985, National Academy Press, 2101 Constitution Avenue, NW, Washington, DC 20418. This is the most recent information available and a copy costs $10.95. The nutrition section of SID's Sheepman's Productin Handbook was revised in 1986 and incorporates this latest information on nutrient requirements. This will be the source of information, along with University publications, of most interest to sheep raisers.

Facts About the 9 Minerals We Supplement in Sheep Mineral Mixtures

SALT

-Requirement - Na is .09-.18% of diet.
- Cl is unknown.

-Forage contains .10-.15% Na.
-Recommend 1/2% salt in total diet or 1% in grain.
-This probably supplies 2x requirement.
-But it is a carrier for other minerals.

CALCIUM AND PHOSPHORUS

-Needed with Vitamin D for bone growth
1% Ca in body
not found in bone
20% P in body
-Good feed sources
Ca in legumes
P in grains and protein supplement
-Ca:P ratio of 2:1 best
Narrower may cause urinary calculi
Wider O.K. with adequate P

IODINE

-Deficiency symptons = "Big Neck" and woolless newborn lambs.
-Crucifer pasture increases need.
-Great Lakes Region is a "Goiter Belt".

ZINC

-Requirement for reproductin higher than growth.
-Requirement for reproduction 33 ppm.

Alfalfa Hay	18-27 ppm
Bluegrass	22 ppm
Oats	37 ppm
Corn	14 ppm

-Diets high in Ca increase Zn requirement.

MANGANESE

-Requirement for reproduction higher than growth.
-High intakes of Ca and Fe increase need.
-Is added to sheep salt-mineral mixtures.

COBALT

-Only function = Vitamin B_{12} formation in rumen.
-Should be ingested daily.
-Main deficiency symptom = poor appetite.
-Midwest has deficient areas.

SELENIUM

-Area east of Mississippi and north of Ohio Rivers deficient
-Deficiency symptoms (white muscle disease) only in young in U.S.
-Present FDA allowance for Se addition to feed and salt "have been shown to be safe and effective." (NRC-1985)

<u>COPPER NOT ADDED</u>

-"Swayback" - A deficiency in many areas of world
- Also "steely" wool
- Toxicity is biggest problem in Midwest.
    Symptoms:
        Jaundice
        Heavy breathing
        Black urine, feces, kidney
    Causes:
        Low Mo
        Genetic
    Prevention:
        Provide <u>no</u> Cu
    Cure:
        100 mg Ammonuium molybdate plus
        1 g Sodium sulfate in 1-1/2 oz water daily for 3 weeks

FIVE MINERALS NOT SUPPLEMENTED

IRON (Fe)

- Very plentiful in pasture and hay
- Parasitism can cause deficiency
- Lambs raised on unfortified milk diet can show anemia
- Fe Dextrin Injection 2 weeks apart is beneficial

MAGNESIUM (Mg)

- Deficiency = Grass Tetany (convulsions)
- Legumes = good source
- Sometimes occurs when grass fertilized with N/K

POTASSIUM (K)

- 3rd most abundant in body
- Legumes have 2X requirement
- Beware: - When lambs fed all grain diet
  -When lambs are stressed

SULFUR (S)

- Important for wool growth
- Need 10:1 N:S ratio
- Legumes good source
- Add to all corn silage diet

MOLYBDENUM (Mo)

- Low in feed = Cu toxicity
- Efficiency lowered by high S
- Cannot be fed

SUBJECT NO. 2 - CREDIT THE FEEDS USED FOR THEIR MINERAL CONTENT

There is tremendous variation in the mineral content of feeds, especially forages. While the digestible energy content of feeds does not vary by much more than two-fold; a 50-fold or even greater variation may occur in the case of minerals contained in the same feedstuff. One must be mindful, too, of the different combinations of feeds that are used which result in different mineral content of the overall diet. In addition, the nature and fertility of the soil upon which the plant has grown, the climatic conditions and the stage of maturity all cause further variations in the mineral contribution made by the feeds used.

In spite of all this variation, there are some thumb rules we can follow. After all, most of these nutritionally essential minerals are contained in sufficient concentrations in the usual blends of forages and grains to satisfy the requirements for maintenance plus varying levels of production -- meat, milk and wool.

The mineral deficiencies of the typical ration indicates the top priority for the kind of supplements needed. For example, feeds are low in salt (Na and Cl) and thus salt is a top priority supplement. Here are some other guidelines to follow:

1. The P content of grains is higher than forages. Soybean meal is an excellent source of available P. Forages are better sources of Ca than P.

2. Mineral composition of forages varies more than seeds or grain.

3. There are few confirmed or obvious mineral deficiencies in the midwest - salt, Co, Se, I, Ca and P have been clearly demonstrated, but none other. On the other hand, Cu has been shown to cause serious toxicity.

4. It is not a case of the more minerals the better - this can be dangerous and the example of Cu toxicity in sheep is one.

Minerals in forages and diets

Alfalfa or legume hays are the choicest forage for sheep if produced on fertile soil, cut at the proper stage and well-cured. They are an excellent source of minerals, especially Ca. If high quality alfalfa hay is fed to lambs or ewes, very little mineral supplementation is needed.

Grass hays are not as high in Ca and other minerals as legumes.

Low-moisture, grass-legume silage (haylage) containing approximately 45-55% dry matter and stored in airtight or conventional silos is an excellent feed for ewes. The mineral content is somewhat higher than comparable hay because there is less leaf loss.

Corn silage differs from haylage in that it needs mineral and nitrogen supplementation at ensiling time for best results. It does not contain sufficient amounts of Ca, P, Na, S, Se and Zn. If these minerals are added, it can be fed as the only feed to pregnant and milking ewes. Ohio workers have shown that .5 to 1% limestone of the wet weight at ensiling time will not only correct the Ca deficiency of corn silage, but will improve feed efficiency from 6 to 8%. It will also reduce spoilage.

Supplementing S at the rate of 1.1 lbs. per ton wet weight at ensiling is also required. S increases consumption. Here it is important to maintain a nitrogen:sulfur ratio of 10:1 and this should be checked by analysis of the silage. (5 lbs. sodium sulfate = 1.1 lb. sulfur).

Avoid urinary calculi in growing-finishing lambs. Urinary calculi that form in lambs when they are fed dry diets are mostly of the phosphatic type, composed principally of Ca, Mn and ammonium phosphates. A number of experiments have been conducted at the South Dakota Agricultural Station to determine the extent that P and other causative factors may be involved in phosphatic calculogenesis and to establish methods for calculi prevention. Phosphorus intake of 0.62 to 0.81%, representing nearly a two- or three-fold increase (depending on age of lamb) above requirement, can cause a high incidence of urinary calculi formation. Of many other factors tested, none was found to be of comparable significance.

Practical prevention in drylot lamb production seems to be strict control of dietary P intake and of the Ca:P ratio. The use of ground limestone to provide a ratio of 2 to 2.5 parts of Ca to 1 part P in high-concentrate lamb diets has proved effective in lowering blood and urinary P concentrations and has yielded a high degree of protection against formation of urinary calculi.

SUBJECT NO. 3 - ADDING MINERALS THAT ARE NEEDED

Importance of feed mineral analysis.

Should minerals be offered free choice or should they be added to the diet? Do sheep have the ability to select individual minerals they need if offered in cafeteria style? Providing minerals in proper amounts in the feed can be a problem in many situations and it would be easier if animals could consume the minerals they need free choice.

A series of experiments at Minnesota with both cattle and sheep involving the mineral Ca have been conducted. Daily gains were greater for lambs fed the Ca adequate (Ca added) diet than for those fed the deficient diet with free choice supplements available. Feeding the lambs on the Ca deficient diet seven times their daily Ca requirements once a week resulted in similar daily gains, but lower bone Ca. These workers concluded that lambs cannot adequately supplement a Ca deficient diet with free choice Ca. Furthermore, the once a week consumption of Ca resulted in poor utilization and may explain a portion of the poor results when it is offered free-choice.

It would seem from these results and others that minerals and vitamins should be mixed into the diet of lambs. There are commercial salt-mineral mixtures made especially for sheep that can be added at the 1/2% level. The mixture can also be offered free-choice in addition to being added to the feed.

Under most circumstances, ewes can be supplied minerals free-choice without adding it to the grain mixture. An exception to this would be adding minerals to corn silage or other instances when the forage or by-product feed would show definite deficiencies.

There are commercial salt-mineral mixtures available that are prepared especially for sheep. They provide all the minerals we need to supplement. An example is shown below with approximate analysis:

MINERAL	% IN MINERAL MIXTURE
Salt	60.0
Ca	10.0
P	5.0
Zn	0.75
Mn	0.35
I	0.02
Co	0.003
Se	0.003

The difference between the sum of the % values here and 100 is the residue of the compounds used to supply the minerals. Beware of any mixture that contains Cu. Also, make sure the Se and Co content are .003%. Exact amounts of the others are not as important.

Summary

Supplying the necessary minerals to sheep is not complicated. Nine of the 15 required are supplemented by offering a sheep salt-mineral mixture to the flock continually. This mixture can be added to the complete diet of young lambs. The creep and drylot diets of lambs should be analyzed for minerals, protein and energy to make sure requirements are met.

SECTION III

MANAGEMENT SECTION

ROGER G. HAUGEN
EXTENSION LIVESTOCK SPECIALIST
NORTH DAKOTA STATE UNIVERSITY

DR. KRIS RINGWALL
LIVESTOCK SPECIALIST
HETTINGER RESEARCH & EXTENSION CENTER

TIMOTHY C. FALLER
SUPERINTENDENT
HETTINGER RESEARCH & EXTENSION CENTER

28TH ANNUAL SHEEP DAY

HETTINGER RESEARCH & EXTENSION CENTER
HETTINGER, NORTH DAKOTA

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SHEEP KED AND LICE CONTROL PROGRAM IN NORTH DAKOTA

Roger G. Haugen
Extension Sheep Specialist
North Dakota State University

The sheep ked and biting and sucking lice are economically important parasites common in North Dakota flocks. New treatment technologies make eradication of both realistic goals for North Dakota sheep producers. The North Dakota Lamb and Wool Producers Association adopted a resolution in November of 1985 supporting implementation of a ked and louse eradication program coordinated by the North Dakota Extension Service.

One of the most severe damages caused by the sheep ked is a skin condition called "cockle". Cockle is a rash or blemish in the skin caused by the host animal's reaction to the bite of the ked. In processed hides, cockle appears as light spots which cannot be softened, sueded or properly dyed. This type of defect in the leather side results in an inferior pelt to the garment industry. Cockle may effect 60 to 70 percent of pelts produced in the United States and annual losses in reduced marketability and value approach $4 million.

Other losses attributed to ked infestations are lighter lambs, reduced wool production, lower quality wool clips and higher ewe death losses. Although these losses are not as visible as cockle problem, they probably cost the U.S. sheep industry more in economic loss than the reduced hide values.

Damage caused to sheep by lice is due largely to skin irritation. The fleece of heavily infested sheep become ragged and the quality is reduced due to rubbing and scratching. Animals are restless and have a general appearance of unthriftiness. Light infestations are not harmful, but the increase and spread can be rapid, particularly in the cold weather months.

Both keds and lice reduce potential profits in the sheep business; however, current control methods can be economically applied to maximize productivity and increase profits for North Dakota sheep producers.

Because keds are host specific and all life stages live on sheep, an eradication program is possible. The first step would be to treat sheep with an effective insecticide. The second step would be to prevent reinfestation by the quarantine and treatment of all new animals prior to introduction into the flock. Lice control can be accomplished by the same steps.

Research has demonstrated that pyrethroid insecticides are quite effective at low application rates. Wyoming researchers have extensively evaluated the pyrethroid insecticide Fenvalerate sold under the tradename "Ectrin" and found it to bee effective against the ked. The product seems to be equally effective when applied as a dip, sprinkle, spray or pour-on. Ectrin™ is the only phrethroid presently registered for direct application to sheep.

A voluntary flock by flock program is suggested to accomplish the objective of making North Dakota a ked and louse free state. This program's success depends entirely on its acceptance by sheep producers and producers cooperation. North Dakota can gain most from an eradication program by realizing heavier lambs on less feed (both ewe and lamb) and higher quality wool clips. Research reports show advantages of ked-free animals of 4 pounds in lamb gains, 11% increase in wool production, and a 1% decrease in ewe death loss. A higher quality lamb pelt will also result from the program.

Implementing a ked and lice free program in North Dakota will require cooperation. The following were appointed by the President of the North Dakota Lamb and Wool Producers Association as committee members for the North Dakota Sheep Ked and Lice Control Program.

Chairman: Roger Haugen, NDSU Extension Livestock Specialist
Dr. Robert Velure, State Livestock Sanitary Board
Tim Faller, Hettinger Experiment Station
James Robertson, NE producer, Hope
James Goettle, NW producer, Donnybrook
Ronald Wanner, SW producer, Hebron
Joel Hamar, SE producer, Ellendale
Fred Eagleson, President of NDLWPA, Buchanan

Advisors: Dr. Dennis Kopp, NDSU Extension Entomologist
Dr. Kurt Wohlgemuth, NDSU Extension Veterinarian

Plans are to have a sign (metal) to designate a producer who is participating in the program. The sign can be displayed on the barn or wherever the producer so desires.

Sheep producers have no excuse for letting keds and lice cut into their profits. Control technology is proven and available for use. A voluntary control program has no restrictions, regulations, quarantines or fines; but it does provide an opportunity for producers to take action and make the sheep industry a better industry.

ORPHAN LAMBS - MANAGEMENT IDEAS

1. Buy a good milk replacer, should be 30% fat. Good replacer available from:
   a. K & K Mfg., Rogers, Minnesota
   b. Land O'Lakes
   c. G T A

   It will cost approximately 50¢ per pound and each lamb will require from 15 to 20 pounds.

2. Use good equipment. NDSU has had good success with the LAMB Bar, K & K Mfg., sells a felf priming nipple and tube assembly that we have found to be excellent for starting orphans.

3. Start on nurser quickly. Young lambs start easier. Check ewes udder right after she lambs and make decision. Lambs from ewes that are questionable in any manner should be put on artificial milk. Lambs will take to nurser best at young age.

4. Self feed cold milk replacer after lambs are started. Milk replacers should be mixed with warm water for best results and then cooled down. Lambs fed cold milk grow well with less problems from scours and other digestive disturbance. Cold milk keeps better too.

5. There is a Formaldahyde solution commercially available that retards bacterial growth in milk (1 cc/gallon milk).

6. Vaccinate to protect against overeating. For immediate protection use antitoxin. For long term protection use bacterial (cl. per fringens type C & D).

7. Vaccinate to protect against "white muscle" disease. Use 1 SE or Bo Se.

8. Best results have been obtained when lambs are fed in groups of 3 or 4. This would be advisable when lambs are just being started. After lambs are successfully trained, they can be handled in groups of 25.

9. Orphan lamb pens should be heated. A plastic tent can easily be devised and heated. Extra heat will save extra lambs.

10. Provide colostrum milk for all orphans. Colostrum should be provided as quickly as possible. Colostrum milk is rich in fats, vitamins, and anti-body globulins to protect against disease organisms. Cow colostrum milk can be substituted for ewe colostrum milk. It can be kept frozen in 1-4 ox. containers.

11. Provide supplemented feed immediately. Use high energy, highly palatable feed. Where few lambs are bing fed it may be advisable to purchase a good commerical lamb creep fed.

12. Provide clean, fresh water.

13. Wean lambs abruptly at 21-30 days of age. When to wean depends upon whether lambs are eating creep feed and drinking water. Newly weaned lambs will go backwards for several days. Do not worry - lambs will make compensating gains later on.

HETTINGER BRANCH EXPERIMENT STATION

FLOCK CALENDAR - OUTLINE

PRIOR TO BREEDING

1. Bag and mouth ewes and cull those that do not meet requirements.

2. Replace culled ewes with top-end yearlings saved for replacements.

3. Drench ewes (Phenothiazine).

4. Evaluate Sires:

    a. Be sure they are vigorous, healthy and in good breeding conditions (possibly production tested).

    b. Allow 3 rams to 100 ewes under range conditions and 2 when pen breeding, as in small lots or pastures.

5. Crutch ewes.

6. Flush ewes (if in thin condition).

    a. 1# grain 2 weeds to 5 weeks (usually 17 days).

    b. Moving ewes to a better quality pasture prior to breeding will serve as an effective flush.

    *If ewes are overconditioned the effect of flushing will be lessened.

BREEDING

1. Test rams with marking harness or water color paint on brisket to see if they are getting the job done (change colors at the end of first 17 days).

2. Leave rams in NO LONGER than 57 days (38-40 days more desirable).

3. Remove rams (do not sinter rams with ewes).

PRIOR TO LAMBING (First 15 weeks)
Early Pregnancy

1. Watch general health of ewes, if possible sort off thin ewes and give extra feed so they can catch up.

2. Feed the poor quality roughage you have on hand during this period saving the better for lambing.

LAST SIX WEEKS BEFORE LAMBING

1. Drench ewes (Thiabendazole).

2. Six-four weeks before feed 1/4 - 1/3 lb. oats per ewe per day.

3. Shear ewes, trim hoofs, and vaccinate ewes for example: Enterotoxemia, Vibriosis, and Soremouth.

4. Four weeks before lambing increase grain by 1/2 - 3/4 lb per head per day. (Usually done immediately after shearing).

5. Check facilities and equipment to be sure everything is in order.

6. Two weeks before lambing increase grain to 1 lb per head per day.

LAMBING

1. Watch ewes closely as extra effort will be repaid with more lambs at weaning time.

2. Put ewe and lambs in lambing pen (jug) after lambing (not before).

3. Be available to provide assistance if ewe has troubles.

4. Disinfect lambs navel with iodine as soon after birth as possible.

5. Use heat lamps in cold weather.

6. Be sure both teats are functioning and lambs nurse as soon as possible.

7. Brand ewes and lambs with identical numbers on same side.

8. Turn ewes and lambs out of pen as soon as all are doing well. (24 hours - 6 days)

9. Bunch up ewes and lambs in small groups 4-8 ewes and then combine groups until they are in a workable size unit.

10. Castrate and dock lambs 1-2 weeks after birth.

SUPPLIES THAT MAY BE NEEDED DURING SEASON

1. Good disinfectant.

2. Forceps or balling gun.

3. Syringe and needles.

4. Hoof trimmer.

5. Sulfa urea Boluses for ewes that were assisted in lambing.

6. Iodine for disinfecting navels.

7. Soap and mineral oil.

8. Tri-sulfa pills for treatment of early pneumonia symptoms.

9. Mastitis ointment.

10. Branding paint and irons.

11. Heat lamps for severe weather.

12. Docking and castrating tools.

13. Surgical scissors.

14. Needle and thread in case a suture is needed.

15. Crate for mothering-up lambs and adopting.

END OF LAMBING TO WEANING

1. Feeding practices will vary depending on the time that lambs were born.

    a. Dec. 15 - March 1 - lambs are usually creep fed and not allowed to go on pasture before market.

    b. Lambs born after March 1 are usually not creep fed and allowed to go on pasture during summer.

2. Drench ewes before turning them on pasture (Phenathiazine).

    * Try and drench according to a program that works for you, (do not wait until signs of wormines appear, it is too late then).

3. Rotate pastures if possible, this also is helpful in internal parasite control.

WEANING TO PRE-BREEDING

1. Time of rest for ewes.

2. Time for shepherd to adjust ewes conditions so they can be effectively flushed, for next breeding season.

SHEEP BARNS AND EQUIPMENT PLANS

Dexter W. Johnson
Extension Agricultural Engineer
North Dakota State University

NOTE: These and other plans are available through county agents or from Extension Agricultural Engineering, NDSU, Fargo, ND. The drawings show construction details and include a materials list for estimating. Due to changes in lumber sizes, lumber grades, plywood quality, and other developments in building materials, some adjustments are required for older plans. (Present charge is shown or $1.00 per sheet.)

CORRALS AND BARNS

Plan No.	Plan Title	Sheets
MW 72050	Pole Utility Buildings	$ 2.00
MW 72505	Slatted Floor, 40'x 72', Feeder Lamb Barn	3.00
MW 72506	240 Ewe and Lambing Barn, 40' x 104'	3.00
MW 72507	500 Ewe and Lamb Feeding Barn, 74' x 256'	3.00
MW 72508	12' x 16' Portable Lamb Feeding Shed	2.00
MW 72509	40 Ewe and Lambing Barn, 24' x 32'	2.00
ND Plan	Confinement Sheep Barn & Hay Storage (at Hettinger)	1.00
Reprint #759	Practical Sheep Housing for North Dakota	No Charge
USDA 6096	Shearing Shed & Corral Arrangement	1
USDA 6236	Portable Handling Corral for Sheep (Metal Wood)	1
AE-683	Sheep Barn Layout	No Charge
AED-13	Insulation and Heat Loss	No Charge
AED-19	Slip Resistant Concrete Floors	No Charge
AED-25	Earth Tube Heat Exchange System Planning	No Charge
MWPS-3	Sheep Housing and Equipment Handbook (This 116 page booklet was revised in 1982. It includes barn and layout planning plus plans for fences and sheep equipment.)	$ 6.00
MWPS-9	Designs for Glued Trusses	$ 5.00

FEED HANDLING & FEEDERS

USDA 5917	Fencing, Feeding, and Creep Panels	1
Reprint #409	Chopped Hay Feeder for Sheep	No Charge
Reprint	16 ft. Collapsible Fenceline Feedbunk for Sheep	No Charge
ND 872-1-1	Stationary Roughage Self Feeder for 70 Ewes or 160 Lambs	No Charge
ND 872-1-2	Portable Roughage Self Feeder for 40 Ewes or 80 Lambs	No Charge

Plan No.	Plan Title	Sheets
MW 73110	24 ft. Wide Clearspan Pole Frame Hay Shed	$ 3.00
MW 73111	36 ft. Wide Clearspan Pole Frame Hay Shed	3.00
MW 73112	48 ft. Wide Clearspan Pole Frame Hay Shed	3.00
MW 73113	32 ft. & 48 ft. Wide Pole Frame Hay Shed (Interior Poles)	3.00
MW 73210	Moveable Grain Storage Walls, 6' to 12' High	2.00
MW 73217	20, 45, 170, and 340 Bu. Hoppered Grain Bins	3.00
MW 73220	48 ft. Wide Pole Frame Grain Storage	2.00
MW 73250	Grain Storage Buildings, 600, 1000, 1200, 1500, or 2000 Bu.	3.00
MW 73293	Grain-Feed Handling Center, Work Tower Across Drive	4.00
MW 73294	Grain-Feed Handling Center, Work Tower Beside Drive	4.00
APA	10 Ton Hoppered Feed Bin	No Charge
APA	4 Compartment Bin for Feed Mill	No Charge
AED-15	Horizontal Bunker Silos, Concrete Tilt-up	No Charge
USDA 6090	5500 Bushel Wooden Grain Bin	2
MWPS-13	Planning Grain-Feed Handling Handbook	$ 5.00