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Sheep and Angora Goat, Wool and Mohair Research Reports

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Contents

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Influence of Protein Level on Performance of Lambs Fed High Concentrate Rations in Drylot

J. E. Huston and J. M. Shelton

Interest in high grain rations for finishing lambs has increased recently, therefore, it would be important to determine the most optimum protein level for such rations. The fact that the concentrated form of the high energy rations results in an increase in daily energy intake and a decrease in total dry matter intake suggests that the protein level of such a ration should be higher on a percentage basis than protein level in the more conventional rations. A series of experiments were conducted during the summer and fall of 1965 to study the effect of the protein level of high concentrate rations on performance of feeder lambs in drylot. The rations were not the same in all experiments, however, they were all similar to the following:

Ingredients	Percent
Alfalfa	5
Sorghum grain	60
Oats	12
Cottonseed meal	16
Urea	
Molasses	5
Calcium carbonate	0.5
Trace mineral salt	0.5
Potassium chloride[2]	0.5
Aureomycin[1]	+
Approx. Crude protein level	16

[1]Added in the belief that this material was beneficial in the prevention of urinary calculi.
[2]Added at the level of 30 mg. per pound of feed.

The protein level was varied by substitution of cottonseed meal for oats or vice versa since these are similar in TDN. Urea also was added at low levels (less than 1 percent) to obtain very high protein levels. In the first test, alfalfa was also increased to 12 percent.

Lambs were self fed from open troughs, and water was available at all times. A few lambs died during the experiments and others went off feed and were removed. Data from such lambs are not included in the summarized results.

There was no difference between the two treatments in daily gain, as shown in Table 1, and the slight differences in daily intake and feed efficiency were not significant. Gains were depressed in both treatments because of reduced feed intake due to high environmental temperature.

TABLE 1. INFLUENCE OF TWO PROTEIN LEVELS ON PERFORMANCE OF LAMBS FED DURING SUMMER

Number of lambs	Crude protein calculated	Protein level analyzed	Average daily gain	Average daily intake	Feed per pound gain
44	14	15.6	.39	2.77	7.40
58	18	19.2	.39	2.71	7.13

The data presented in Table 2 are the combined results of two experiments in which a wider range of protein levels was studied. These results show no difference between treatments and suggests there is not a growth response to increasing protein levels above 12 percent.

These results are somewhat surprising since animals fed at this level are actually consuming less protein than is commonly recommended in feeding standards. A possible explanation is that all of the lambs used in these experiments were older lambs (not early weaned lambs) and much of the weight gained was due to fat deposition. Other studies at this station tend to suggest that early weaned lambs, put on feed at a relatively light weight, respond favorably to an increased level of protein above 12 percent. Further work is in progress with early weaned and older lambs, in an effort to further clarify the desirable protein level.

SUMMARY

A series of experiments were conducted at the Livestock and Forage Research Center, McGregor, to determine the influence of protein level on performance of lambs fed high grain rations in drylot. The results indicate there is no advantage to increasing protein level above 12 percent when this type ration is fed to large frame lambs. Further studies are being carried out with lighter weight lambs.

TABLE 2. INFLUENCE OF THREE LEVELS OF PROTEIN ON PERFORMANCE OF LAMBS FED IN FALL AND EARLY WINTER

Number of lambs	Approximate protein level	Average daily gain	Average daily intake	Feed per pound gain
27	12	.49	2.90	5.92
74	16	.46	2.86	6.46
24	20	.48	2.85	6.06

Physical Factors Affecting Feedlot Production of Market Lambs

J. W. Menzies

THE PURPOSE OF THIS STUDY is to determine if certain physical improvements in lamb feedlots will improve productive performance. The following improvements are being tried in this study: night lighting systems, lamb shades, water trough shades and running water.

TEST 1. WATERING SYSTEMS

In August of 1964 and 1965, tests were conducted to duplicate commercial feeding situations during the hot summer months. Ewe lambs were randomly assigned to three groups. Group 1, Control Group, received normal feedlot treatment with no shade and a regular water trough. Group 2 received the same treatment as Group 1 with the exception of a shade over the water trough. Group 3 was treated the same as Group 1 but had a running-water system. All three groups received a high concentrate 70 percent milo ration. The test was duplicated in 1965.

Results

Table 3 shows the results of 2 years' work using 30-day feeding periods.

The data in Table 3 indicates there is an advantage in cost per pound of gain due to improvements in the watering system. However, a sufficient volume of data has not been collected to statistically substantiate this evidence.

TEST 2. NIGHT LIGHTING AND SHADES

This test was conducted during August, using ram lambs. The lambs were split into three groups at random. All three groups received the same high concentrate 70 percent milo ration. Group 1, Control Group, received regular feedlot treatment. Group 2 received the same treatment as Group 1 with the exception of 4 square feet of shade per lamb. Group 3 received the same treatment as Group 1 with the exception of four hours of light from 10:00 p.m. to 2:00 a.m. each night. This trial was duplicated in 1965.

Results

The results are presented in Table 4.

These data indicate no significant differences among treatments. However, the shaded lambs seemed to gain faster on less feed and were fatter at the end of the experiment than were the controls.

TEST 3. COMPARING EWE LAMBS TO RAM LAMBS

Table 5 compares the control group in Table 3 (ewe lambs) to the control group in Table 4 (ram

TABLE 3. 1964 AND 1965 RESULTS COMPARING THREE WATERING SYSTEMS FOR MARKET LAMBS

Treatment	Group	Average daily gain, pounds			Pounds of feed per pound of gain			Cost per pound of gain, dollars
		1964	1965	Mean	1964	1965	Mean	
Regular water	1	.33	.29	.31	8.63	8.50	8.56	.260
Shaded water	2	.30	.29	.29	8.13	7.40	7.76	.236
Running water	3	.43	.28	.35	6.62	8.10	7.36	.222

TABLE 4. EFFECT OF SHADE OR NIGHT LIGHTING ON LAMBS DURING THE SUMMER OF 1964-65

Treatment	Number of lambs	Average daily gain, pounds			Pounds of feed per pound of gain			Cost per pound of gain, $	Fat score 1 = fat 4 = thin
		1964	1965	Mean	1964	1965	Mean		
Control, regular pen	22	.63	.30	.47	5.6	10.3	7.9	.246	2.35
Group 2, shaded pen	23	.68	.36	.52	5.0	7.0	6.0	.187	2.17
Group 3, night lighting	22	.47	.43	.45	5.9	9.0	7.5	.234	2.05

lambs). Two years' experimental results indicate that ram lambs will outgain ewe lambs.

General Conclusions

The data indicate no significant difference among treatments due to improved watering systems, shades or lights. However, it must be remembered that the data have thus far, been collected only on a small number of lambs.

Ram lambs outgained ewe lambs in both 1964 and 1965, and did so on less feed per pound of gain.

TABLE 5. COMPARING EWE LAMBS TO RAM LAMBS

Treatments	Average daily gain, pounds 1964, 1965	Pounds of feed per pound of gain
Ewe lambs	.31	8.56
Ram lambs	.47	7.90

A Comparison of Some Quantitative Carcass Traits for Ram, Wether and Ewe Lambs

W. M. Oliver, Z. L. Carpenter, G. T. King and J. M. Shelton

THE PURPOSE OF THIS STUDY was to evaluate some of the quantitative differences in carcasses produced by wether, ram and ewe lambs. Most of the lambs slaughtered in this country today are either wether or ewe lambs. Some researchers in recent years have studied the rate of gain, feed efficiency, etc. of ram lambs. Menzies (1965) reported that ram lambs fed at the Ranch Experiment Station, Sonora gained an average of 0.30 pound per day more at a feed cost of 9.6 cents per pound of gain less than ewe lambs. At the close of the test, the ram lambs returned $3.42 more net profit per head than did ewe lambs. Such reports raise a question concerning the quantitative differences in carcasses produced by the three sexes.

EXPERIMENTAL MATERIALS AND PROCEDURE

Data collected by the Meats Laboratory of Texas A&M University over a period of 4 years were the basis for the study. The data included 337 lamb carcasses obtained from 90 wethers, 112 rams and 135 ewes. Average slaughter weights were 86.5, 93.1 and 87.9 pounds for the wethers, rams and ewes, respectively. Carcasses of Delaine, Rambouillet, Hampshire, Columbia and Southdown lambs, as well as crossbred lambs out of Rambouillet and Delaine ewes and sired by Hampshire, Dorset, Suffolk, Shropshire, and Columbia rams, were compared. Only carcasses grading choice or prime were included. The carcasses were uniformly cut into wholesale cuts and later into closely trimmed retail cuts following the normal retail fabrication procedure described in the Texas A&M-Safeway Stores study of 1962.

The averages for sexes shown in Table 6 that are underlined are *not* significantly different at the 95 percent level of probability.

The following statistical procedures were used in this study:

a. Carcass traits were adjusted for differences in carcass weight by regression of the weight or measurement on chilled carcass weight.

b. The constants for adjusting the averages for sex differences were determined by a least squares analysis of covariance.

c. The differences in the adjusted averages for each sex were tested for statistical significance following Duncan's Multiple Range Test as modified to consider unequal numbers of replications by Kramer (1956).

The carcass traits and measures of carcass merit shown in Table 6 were considered in the study. The carcass traits were statistically adjusted for differences in carcass weight so that the values for each sex could be meaningfully compared with one another. The differences in the trait averages for each sex were tested for statistical significance.

RESULTS AND DISCUSSION

The average values of the traits for each sex are shown in Table 6. The ewe lamb carcasses produced significantly lighter wholesale legs and retail legs, heavier kidney fat, a smaller loineye area and a thicker fat cover over the loineye area than did the wether and ram carcasses.

The hindsaddle from the ewe lamb carcasses was significantly heavier than the hindsaddle from the wether carcasses, while the hindsaddle from ram carcasses was significantly lighter than that from the wether carcasses. On the other hand, the wether carcasses produced streamlined hindsaddles that were significantly heavier than both ram and ewe carcasses. Streamlined hindsaddle is that portion of the hindsaddle remaining after the kidney, kidney fat and flank have been removed. The streamlined hindsaddle weights from ram and ewe carcasses were not significantly different. The significantly heavier kidney fat weight in the ewe lamb carcasses likely

TABLE 6. AVERAGE VALUES FOR THE TRAITS FOR EACH SEX

Measurement of carcass trait	Average adjusted for differences in carcass weight			
	All sexes	Wethers	Rams	Ewes
Wholesale leg, pounds	10.67	10.85	10.82	10.40
Retail leg, pounds	9.24	9.35	9.46	8.91
Hindsaddle, pounds	22.74	22.77	22.40	23.06
Streamlined hindsaddle, pounds	19.13	19.38	19.05	18.96
Loineye area, square inches	1.90	1.91	1.94	1.85
Kidney fat, pounds	0.93	0.80	0.75	1.25
Fat thickness at 12 rib, inches	0.20	0.18	0.18	0.23
Body wall thickness, inches	0.66	0.65	0.56	0.76
Measures of carcass merit				
Percent consumer cuts	87.36	88.31	88.25	86.0
Retail carcass value per cwt., dollars	55.30	56.26	55.52	54.48

explains the cause for their heavier hindsaddles but lighter streamlined hindsaddles when compared to the wethers. Nothing is evident in the traits included in this study to explain the fact that the ram lambs produced lighter hindsaddles and streamlined hindsaddles than did the wethers.

The body wall thickness measured 2 inches below the lower edge of the loineye muscle at the 12th rib was significantly thicker in ewe lamb carcasses than the thickness found in either ram or wether carcasses. The body wall thickness found in wether carcasses was significantly greater than that found in ram lamb carcasses.

When the two measures of carcass merit shown in the lower portion of Table 6 are considered, ewe lamb carcasses produced a significantly smaller percent of total consumer (retail) cuts and retail value per cwt. of carcass. There was no significant difference in these values for wether and ram lamb carcasses.

SUMMARY

Based on the sample of lamb carcasses in this study, ewe lamb carcasses are less muscular and carry more fat than do carcasses from either wether or ram lambs. There is essentially no difference in the muscling and amount of fat in carcasses from wether and ram lambs. Thus, from a quantitative standpoint, ram lamb carcasses are equal in value to wether carcasses and are more valuable than ewe lamb carcasses. This fact, taken together with a faster daily gain and a lower cost per pound of gain, indicates a definite advantage to the producer in growing and feeding ram lambs rather than wether lambs.

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Qualitative Characteristics of Ram, Wether and Ewe Lamb Carcasses

Z. L. Carpenter, G. T. King and J. M. Shelton

Several research workers have reported that ram carcasses are equal or superior to wether and ewe carcasses when considering the yield of preferred cuts and total yield of edible meat. It has also been reported that ram lambs gain faster and are equal or superior in efficiency of gain to the other sexes. The above results indicate the possibility that ram lamb production should be investigated. It seemed appropriate that the qualitative factors associated with the palatability of the meat should be studied. If carcasses from ram lambs are not unsatisfactory to the consumer, then the economics of production seem to favor ram lamb production.

The purpose of this study was to investigate the palatability and quality characteristics of ram, wether and ewe carcasses.

EXPERIMENTAL PROCEDURE

Ram, wether and ewe lambs of known history were the source of 259 carcasses for this study. Rib chops from the carcasses were evaluated for tenderness by use of the Warner-Bratzler shear. In addition, subjective evaluations of quality were completed on each carcass in accordance with USDA lamb carcass grading specifications. Rib chops were obtained opposite the 12th rib from each carcass. The chops from the opposite side of each carcass were completely boned, trimmed of subcutaneous fat and submitted for chemical analysis of ether extractable fat and dried for moisture content. Chops were cooked by three methods (oven-broil, deep-fat-fry and electronic cookery) to an internal temperature of 70° C. Cooking losses were recorded on each of the rib chops.

RESULTS AND DISCUSSION

The averages for the tenderness shear values, cooking loss and extractable fat content of the loineye muscles are presented in Table 7. The ram carcasses provided rib chops that were significantly less tender than those from wethers, with no difference existing between those from the ram and ewe carcasses. It is assumed that the value of 10.46 pounds shear value for the ram carcasses is within the consumer acceptability range. The shear value, as determined in previous work by several investigators on beef, is in the marginal range of acceptance or rejection. The same pattern existed for the percentage of cooking loss with the ram carcasses having a lower cooking loss than the wether carcasses. There were no differences between the ram and ewe carcasses or the ewe and wether carcasses for percentage of cooking loss. For ether extractable fat content, the ewe carcasses contained a significantly higher percentage of fat than the ram or wether carcasses.

TABLE 7. AVERAGES FOR CERTAIN QUALITY TRAITS OF LAMB

	Tenderness shear value,[a] pounds	Cooking loss, percent	Ether extractable fat in loineye, percent
Wethers	8.96	26.3	3.26
Rams	10.46	24.9	3.28
Ewes	9.72	25.7	4.25

[a]The higher values indicate less tender chops.

Simple correlations showing the associations of some of the quality traits with the Warner-Bratzler shear values are presented in Table 8. For the wether carcasses there was a significant association with the chronological age of the animals. However, this relationship was low and did not exist to a significant degree for the ram and ewe carcasses. Tenderness was not closely associated with chilled carcass weight per day of age. However, the physiological maturity, as determined by an evaluation of the bone structure and the color of the lean tissue, was significantly associated with the shear values. With an increase in maturity score, there was a significant decrease in tenderness. The color scores were not related to the tenderness values, with the exception of the ewe carcasses in which the darker colored chops were less tender than the lighter colored chops. Marbling

TABLE 8. SIMPLE CORRELATIONS OF WARNER-BRATZLER SHEAR VALUES WITH QUALITY TRAITS

	Warner-Bratzler shear values[a]		
	Wethers	Rams	Ewes
Age (days)	0.24[b]	— .04	0.16
Chilled car. wt./day of age	— .06	0.08	— .08
Maturity (USDA score)	— .41[c]	— .22[b]	— .29[c]
Color score	— .03	0.01	0.23[c]
Marbling score	0.06	— .03	— .14
Percent intramuscular fat	— .16	— .07	0.07

[a]Higher shear values indicate less tender chops.
[b]Significantly different at the 95 percent level of probability.
[c]Significantly different at the 99 percent level of probability.

scores and percentage of ether extractable fat content were not significantly related to the shear values. It is obvious from these observations that the various quality characteristics used in evaluating lamb carcasses are not, in fact, closely related to the tenderness values, with the possible exception of that of physiological age as determined by the maturity score. As the maturity score increased, there was a decrease in tenderness and in cooking loss with simple correlation coefficients of −.27 and −.17, respectively, for the entire population. Also, when considering the entire population, marbling score and percentage of extractable fat were not significantly related to the tenderness of the lamb rib chops with correlation coefficients of −.08 and −.07, respectively. The fresh muscle color score was related to the age, maturity and cooking loss of the carcasses. The relationships for the traits varied considerably due to differences among sex groups.

In summary, it is evident that low relationships exist for the current subjective measures of quality and tenderness of lamb carcasses. The rib chops from wether carcasses were significantly more tender than those from the ram carcasses, while the ewe carcasses provided less tender chops than the wethers. These data suggest that the average tenderness values for ram carcasses would be acceptable in tenderness to the consumer. Further studies concerning ram carcass palatability are needed. It appears that the physiological age of a carcass as determined by the maturity score is perhaps more indicative of the eating qualities of lamb carcasses than that of the chronological age.

Factors Affecting Cutability of Lamb Carcasses*

Z. L. Carpenter, G. T. King, D. F. Manns, D. K. Hallett, E. F. Kimbrell and W. E. Tyler

INCLUSION OF CARCASS MERIT in selection programs is difficult since simple and definitive measures of lamb carcass desirability have not been completely developed. Perhaps lamb carcass improvement through selection practices cannot be economically justified. However, before carcass improvement can be adequately studied, it is of paramount importance to examine methods for accurately and objectively measuring the carcass desirability. One measure of carcass desirability by the industry has been carcass grade. Most research groups have reported low associations of carcass grade with the yield of preferred retail cuts.

The purpose of this study was to determine the effects of carcass weight, fatness and conformation upon the yield of boneless, closely trimmed retail cuts and upon the yield of total edible meat from lamb carcasses.

EXPERIMENTAL PROCEDURE

Data were obtained on 141 wether lamb carcasses selected in commercial packing plants in Texas and Missouri. The carcasses were selected for each of four weight groups (30-39 pounds, 40-49 pounds, 50-59 pounds and 60-69 pounds). Within each weight group carcasses were selected on the basis of seven visual finish groups (1 — thin fat covering and 7 — excessive fat covering) and two conformation groups within each finish group.

The carcasses were fabricated into wholesale cuts, closely trimmed bone-in retail cuts and boneless, closely trimmed retail cuts according to standard cutting procedures. Rib chops were removed from each carcass for tenderness determinations on the Warner-Bratzler shear. Additional samples were analyzed for solvent extractable fat (a measure of intramuscular fat) and moisture content.

RESULTS AND DISCUSSION

Although these data have not been completely analyzed, certain average values for various carcass traits suggest trends in the effects of fatness, weight and conformation on these measures of carcass merit. Several groups of carcasses in the experimental design were not available. As would be expected, only one lightweight (30-39 pounds) carcass in the excessively fat visual finish group (group 7) was obtained for the study. Also, no carcasses were included in the study representing the 50-59 pounds weight group with extremely thin fat covering (group 1), or the 60-69 pounds carcasses with either the 1 or 2 finish groups.

TABLE 9. CHARACTERISTICS OF LAMB CARCASSES VARYING IN WEIGHT

	Carcass weight group			
	30-39#	40-49#	50-59#	60-69#
Edible portion, percent	65.7	65.9	65.3	64.7
Retail leg, loin, rack and shoulder, percent	63.5	63.0	62.1	60.9
Wholesale leg, percent	24.2	23.6	23.5	22.4
Retail leg, percent	19.7	19.4	19.0	18.3
Retail leg and loin, percent	34.0	33.5	32.8	32.1
Fat trim, percent	6.9	8.0	9.9	11.1
Fat thickness, inches	.14	.18	.24	.26
Loineye area, sq. inches	1.46	1.67	1.96	2.17
Loineye area/50 pounds carcass, sq. inches	2.06	1.87	1.82	1.69
Shear force, pounds	4.3	4.7	5.0	4.9

The average values of various carcass traits for carcasses in each of the weight groups are included in Table 9. It is interesting to note that significant differences in percentage of total edible meat did not exist between weight groups except for the lower value for the heavyweight group. It should be pointed out that the carcasses of widely different degrees of fatness were included in all weight groups; therefore, these results for each weight group could not be considered a random sampling of the population. Percentage edible meat ranged from 51.6 to 72.0 in this study. Therefore, a wide range existed in actual

TABLE 10. EFFECTS OF VISUAL FATNESS SCORE ON LAMB CARCASS CHARACTERISTICS

	Finish group*						
	1	2	3	4	5	6	7
Edible portion, percent	67.8	68.0	67.3	66.4	64.7	63.3	61.5
Retail leg, loin, rack and shoulder, percent	67.2	65.9	64.2	62.9	61.7	59.8	57.9
Wholesale leg, percent	25.9	24.9	24.3	23.5	22.8	22.5	21.8
Retail leg, percent	21.6	20.7	20.0	19.6	18.6	18.1	17.1
Retail leg and loin, percent	36.8	35.4	34.1	33.3	32.7	31.4	30.3
Fat trim, percent	3.2	4.6	6.6	8.3	9.9	12.1	14.1
Fat thickness, inches	.07	.11	.14	.20	.23	.27	.33
Loineye area, sq. inches	1.58	1.73	1.86	1.87	1.77	1.76	1.84
Loineye area/50 pounds carcass, sq. inches	2.21	2.04	1.95	1.86	1.76	1.76	1.69
Shear force, pounds	4.0	5.0	4.6	4.8	4.7	4.6	5.0

*Seven scores with 1 representing carcasses with a very thin fat covering.

*This study was a cooperative project with the Standardization Branch, Livestock Division, Consumer and Marketing Service, USDA.

cutability. There were significant differences in bone-in retail cut yields. There were decreases in these yields with increases in carcass weight. Loineye area increased with an increase in carcass weight, however, the ratio of area to carcass weight decreased with an increase in weight. Tenderness, as measured by the Warner-Bratzler shear, was not significantly affected by differences in carcass weight.

The effects of visual fatness upon the carcass characteristics are summarized in Table 10. These results agree with those previously reported by a number of research workers. Values for fat thickness and yield of trimmable fat indicate the visual finish scores rather equally divided the carcasses on the basis of these fat measures. Conformation scores indicated a slight advantage in total yield of edible meat and loineye area for the high conformation group (Table 11).

SUMMARY

In summary, these data re-emphasize the paramount importance of a trim fat covering for carcass desirability. These data are expected to provide information which can be used to significantly change present lamb carcass grading standards. The remainder of the data compiled at Texas A&M University is being analyzed by USDA personnel.

TABLE 11. CUTABILITY OF LAMB CARCASSES WITH DIFFERENT CONFORMATION GRADES

	Conformation group	
	Low*	High*
Edible portion, percent	65.0	65.9
Retail leg, loin, rack and shoulder, percent	62.4	62.4
Wholesale leg, percent	23.3	23.6
Retail leg, percent	19.0	19.3
Retail leg and loin, percent	33.0	33.3
Fat trim, percent	8.8	9.0
Fat thickness, inches	.20	.21
Loineye area, square inches	1.68	1.91
Loineye area/50 pounds carcass, sq. inches	1.76	1.99
Shear force, pounds	4.8	4.6

*Low conformation scores were below average choice while high scores were over average choice.

Relationships of Linear Measurements to Carcass Value of Lamb*

Z. L. Carpenter, N. L. Cunningham, G. T. King and J. M. Shelton

STANDARDIZED TECHNIQUES to measure differences in meat animals are difficult to obtain. With the trend toward leaner meat products, the sheep industry is becoming increasingly aware of the need for tools with which to select more desirable meat animals. Considerable effort has been devoted by some researchers to develop and perfect methods of predicting ultimate value of carcasses, thereby helping the producer realize maximum return from his commodity. There is a need for definitive and usable exterior live measurements for predicting value and cutability of lamb carcasses. If proven to be of value, these measurements would be of aid in selecting sires which might possibly transmit these particular desirable traits to their offspring and also provide the packer with a means, in addition to visual inspection, of selecting the more valuable animals. This in turn would encourage production of greater numbers at less cost, thereby reducing prices on the retail level and causing greater consumption of lamb products.

Previous work on the value of live measurements has been done largely with cattle. The few studies on use of live measurements for predicting carcass merit of lambs have not been encouraging.

The purpose of this study was to investigate the usefulness of live and carcass measurements in predicting merit of slaughter lambs and the effects of breed and sex on these measurements. It was also the purpose of this study to formulate a practical technique for use by the producer and packer, should any measurements prove to be of value.

EXPERIMENTAL PROCEDURE

Ninety-nine lambs, representing seven breeds and crosses and three sexes within these breeds were slaughtered and processed at the University Meat Laboratory. Before slaughter, 18 measurements were recorded for each lamb. After chilling for 48 hours, ten carcass measurements were taken.

Five days after slaughter, the carcasses were separated into retail cuts and fat was trimmed to ¼ inch over each cut. The yield of trimmed retail cuts was calculated as a percentage of carcass weight, and retail carcass value per unit of carcass weight was determined using average retail prices.

*Assistance provided by Safeway Stores, Inc., Dallas Division, is gratefully acknowledged.

Analyses were computed to determine the relationships between various combinations of measurements (both unadjusted and adjusted for breed, sex and weight) and retail value per unit of carcass weight, percent retail shoulder, rack, leg and loin and percent leg and loin.

RESULTS AND DISCUSSION

The means of live and carcass measurements for each sex are presented in Table 12. These means were not adjusted for breed or weight differences. It may be noted that ram lambs possessed a slightly longer body, a larger circumference of paunch and a longer rib cage than the wether and ewe lambs. The ewe lambs possessed smaller measurements in most cases. The carcass measurements were similar for the three sexes with small observed differences in loineye area and fat thickness.

Simple correlations for live measurements as related to carcass value and yield of closely trimmed preferred cuts were calculated. Correlations indicated circumference of thigh and pins to hock were low but significant in their association with retail value (0.27 and −.28, respectively). Since value per unit of carcass weight is dependent on the yield of pre-

TABLE 12. MEANS OF CERTAIN LIVE AND CARCASS MEASUREMENTS

Variable	Wethers	Rams	Ewes
Live measurements[a]			
Length of body[b]	18.87	19.46	18.76
Length of leg	23.14	23.02	22.54
Circumference of thigh	14.19	14.80	14.74
Circumference of heart girth	32.89	33.79	33.22
Circumference of paunch	35.72	37.01	35.64
Width of shoulders	7.50	7.78	7.20
Width of loin	4.98	5.06	5.05
Width of hips	6.08	6.35	6.20
Depth of body	10.37	10.48	10.14
Depth of twist	5.17	5.35	5.14
Length of rib cage	11.94	12.37	12.05
Carcass measurements[a]			
Length of body[b]	24.38	25.03	24.52
Width of leg	8.38	8.30	8.27
Circumference of thigh	13.42	13.66	13.50
Width of shoulders	7.72	7.41	7.23
Width at last rib	8.74	8.77	8.69
Depth of thorax	11.04	10.95	10.84
Loineye area, sq. inches	1.92	2.04	1.80
Average fat thickness	0.17	0.12	0.17

[a]Units = inches.
[b]Length on the live animal and carcass were not comparable measurements. Carcass length was measured from the first rib to the aitch bone. Length of body was measured from the hip to the point of the shoulders.

ferred cuts, of which retail leg is one, this partially supports the results previously reported in which measures of leg circumference were highly related to yield of primal cuts. The negative correlation coefficient for the pin to hock measurement possibly supports results by other workers who have found that an increase in length of limb bones did not result in an increase in weight of muscle, however, the present study did not include the specific measure of muscle weight. These data on primal yields disagree with the study by previous research which indicated that the smaller boned carcasses provided lower yields of the high priced cuts. It appears that an increase in bone diameter is related to an increased muscle development. Simple correlations of live measurements with percent retail shoulder, rack, leg and loin were low in magnitude.

Table 13 contains simple correlations of carcass measurements with percent of shoulder, rack, leg and loin. A significant relationship was found for carcass length and length of foreshank. Width of shoulders and average fat thickness were significantly related to the yield of preferred cuts (−.26 and −.35, respectively).

Analyses of various combinations of live measurements for predicting retail value and yield of preferred cuts were completed. No advantageous prediction equations could be perfected when using live measurements as dependent variables. Results indicated that some combinations of carcass measurements, when adjusted for effects of breed, sex and weight, may be useful for predicting percentage of the more valuable primal cuts. Carcass measurements of carcass length, circumference of thigh, fat thickness and width of shoulders accounted for more variation in percentage of primal cuts than combinations of other variables.

TABLE 13. SIMPLE CORRELATION COEFFICIENTS OF CARCASS MEASUREMENTS WITH PERCENT OF RETAIL SHOULDER, RACK, LEG AND LOIN

Variable	Simple correlation
Carcass length	0.20[a]
Width of legs	− .10
Circumference of thigh	0.14
Length of foreshank	− .21[a]
Width of shoulders	− .26[b]
Loineye area	0.04
Average fat thickness	− .35[b]

[a]Significant at the 95 percent level of probability.
[b]Significant at the 99 percent level of probability.

SUMMARY

In summary, it appears that visual evaluation of slaughter lambs remains as one of the most useful tools for predicting carcass merit, when compared to linear measurements performed in this study. Efforts will continue in the area of perfecting a procedure for objectively evaluating slaughter lambs for ultimate carcass merit.

Sheep Improvement Through the Use of Records and Performance Testing

J. W. Menzies

REPLACEMENT ANIMALS have been selected ever since animals were first domesticated. Selection has generally been made through visual observation. However, for the last two decades it has been thought that faster progress could be made by using production and performance records. This project was initiated to determine if, and to what degree, faster improvement can be made by using records as compared with visual selection.

PROCEDURE

In 1961, 180 head of Rambouillet ewes were split at random into three equal groups. Group 1 ewes were to be selected by visual means only. Group 2, the control group, had no selection program. Group 3 ewes were selected by production and performance records.

The ewes have been maintained as one flock so that differences occuring among them will be due to genetic differences.

The records used for selection in the performance group are weaning weight, wool weight, staple length, face cover, belly cover, skin folds and overall index scores. Ram lambs are performance tested each year, and ram selections are made from these records.

RESULTS

Table 14 shows the pounds of lamb produced per ewe bred. Even though the visually selected group produced 4.8 pounds more lamb per ewe at the beginning of the experiment, they have failed to out-produce the performance group since then.

Note: Comparisons should be made on a within year basis.

Table 15 shows the average number of pounds of grease wool produced per ewe. In 1965 the performance selected group out-produced the visually selected group by 0.5 pound and out-produced the control group by the same amount.

TABLE 14. POUNDS OF LAMB PRODUCED PER EWE BRED

Group	Before experiment 1960	1961	1962	1963	1964	1965
Control	75.8	60.2	76.7	43.3	38.3	56.1
Visual selection	75.3	56.1	64.3	37.5	49.0	59.4
Performance selection	70.5	64.0	75.6	50.5	57.2	63.3

TABLE 15. AVERAGE NUMBER OF POUNDS OF GREASE WOOL PRODUCED PER EWE

Group	Before experiment 1960	1961	1962	1963	1964	1965
Control	9.1	9.7	10.3	8.9	9.0	10.3
Visual selection	8.9	9.3	10.1	9.1	9.5	10.3
Performance selection	9.3	9.9	10.4	8.9	10.0	10.8

Table 16 compares some other economically important traits. Face cover, staple length and belly cover comparisons are very similar in the visually and performance selected groups. However, the clean wool data show an advantage of 0.27 pounds of clean wool for the performance group.

CONCLUSIONS

This report shows the progress made by the two different selection programs, visual and performance selection, over a 5-year period.

Progress thus far shows that the performance selected group has produced from 3.9 to 13.0 pounds more lamb and sheared 0.5 pound more wool than the visually selected group. At the same time, face cover scores have remained at 1.4 in both groups. The performance group produced 0.27 pounds more clean wool per head.

One rarely considered difference between visual and record selection is that it does not require years of experience or training to select from records.

TABLE 16. OTHER PRODUCTION FACTORS, 1965 EWES

Group	Face cover 1 open; 4 covered	Staple length	Belly cover 1 excellent; 4 bare	Clean wool*
Control	1.55	3.5	2.45	4.24
Visual selection	1.44	3.5	2.38	4.18
Performance selection	1.41	3.5	2.35	4.45

*Clean wool data is based on squeeze machine readings and should be used for comparative purposes only.

Ranch Selection Program Itinerary, Spring Lambing Program

Fall: 1. Prospective replacement ewe and ram lambs

A. Shear lambs

B. Weigh lambs and place each sex in separate pastures

C. Record weight and date weight was taken

D. Handle lambs normally but keep all on the same feed

2. Ewes fall breeding

A. If ewes are under the 3-group selection program, place best of yearling rams with best ewes. Second best with second best ewes.

B. Place replacements into flock

Spring: 1. Prospective replacement lambs

A. Measure staple length

B. Visually select, paying particular attention to:

a. Face cover

b. Wool quality

c. Belly cover

C. Weigh lambs, record weight. Weight increase ÷ days on test = average daily gain

D. Shear lambs, weigh fleece. Differences occurring among fleeces are real because all the lambs were sheared at the same time in the fall.

E. Obtain additional fleece information by visual observation, from the wool testing laboratory, squeeze machine or Extension Service personnel.

2. Ewe flock

A. Cull flock before shearing for face cover, belly cover, wool quality and general appearance.

B. Shear ewes, cull light shearers

C. Cull non-producers

Selection of Replacement Sheep at a Younger Age

J. W. Menzies

UNDER A FLOCK IMPROVEMENT PROGRAM where the breeder raises his own replacements, it is costly to hold ram lambs until a suitable age has been reached for selection, usually 5+ months of age. As a consequence, the cull end of the flock as ram lambs will sell for approximately $.06 per pound less than mutton lambs at feeder prices.

In 1964, a study was initiated to determine if ram lambs can be selected at a younger age and, if so, what criteria to use in selection.

PROCEDURE

A group of 180 Rambouillet ewes under a selection program were used. The ram lambs from these ewes are normally selected at 5 to 6 months of age. The selected ram lambs are placed on a ram performance test at 6 to 7 months of age and are bred as yearlings.

In 1964, data were collected on the ram lambs at birth, at 2.5 months of age and at 6 months of age.

DATA COLLECTED

1. At birth
   - A. Birth weight
   - B. Abnormalities
   - C. Width of head
   - D. Width of hips
   - E. Length of front leg
2. At an average of 2.5 months of age
   - A. Body weight
   - B. Skin fold score*
   - C. Face cover score**
   - D. Metacarpus bone diameter***
3. At 5 to 6 months of age (normal culling time)
   - A. Body weight (adjusted for age)
   - B. Belly cover
   - C. Skin fold score
   - D. Face cover score
   - E. Staple length (adjusted for age)
   - F. Index score = 0.75 X adjusted weaning weight + 2.0 X adjusted staple length — 8 X face — 6 X skin folds

*Skin fold score: 1 = smooth, 4 = heavy wrinkles
**Face cover score: 1 = open, 4 = closed
***Bone diameter was taken laterally on the metacarpus 2 inches below the carpus (kneejoint)

RESULTS

The data presented are from a group of 50 ram lambs born in the spring of 1964.

1. Birth data
   - A. Of the upper 50 percent according to birth weight, 80 percent were in the top half according to adjusted weaning weight at 6 months of age.
   - B. No lambs were culled at birth for visual abnormalities.
   - C. Width of head, width of hips and leg length were found to be less desirable in predicting future weight than birth weight.
2. Data at 2½ months of age
   - A. Skin fold culling: The lambs were scored for skin folds at 2.5 months of age. Any lamb with over a 3.0 score was marked as culled. Using the 3.0 skinfold score as a culling level, at 2.5 months of age 100 percent accuracy was achieved in predicting lambs having a 3.0 + skinfold score at 6 months of age.
   - B. Face cover culling: Face cover scores were taken at 2.5 months and 6 months of age. Using a 2.5 face cover score as a culling level, 65 percent of the lambs with over a 2.5 face at weaning time could have been culled at 2.5 months of age. In general, lambs tended to become more covered as they got older. Therefore, no lambs would have been culled at 2.5 months of age that would not have been culled at 6 months.
   - C. Of the top 50 percent at an average of 2.5 months of age according to body weight, 88 percent were in the upper half in adjusted weaning weight at 6 months of age.
   - D. Of the top 50 percent with the largest metacarpus bone diameter at 2.5 months of age, 86 percent were in the upper half according to adjusted weaning weight at 6 months of age.
   - E. Choosing lambs in the upper 50 percent in both body weight and metacarpus bone diameter resulted in 90 percent accuracy in predicting 6-month adjusted body weight.

The 2 percent increase in accuracy may not justify the use of bone measurements.

3. Ninety percent accuracy was achieved on this group of lambs in ranking them according to 6 months adjusted weaning weight. This was accomplished at 2.5 months of age by using a combination of the data previously mentioned.

A. First, cull all lambs with more than a 2.5 face cover score and eliminate from the flock.

B. Second, cull all lambs with more than a 3.0 belly cover score and eliminate them from the flock.

C. (1) Measure the metacarpus bone diameter (at 2.5 months of age) of the lambs and mark the upper 50 percent.
(2) Weigh the lambs (at 2.5 months of age average) and mark the upper 50 percent.

Select those lambs in the upper 50 percent in both metacarpus bone diameter and 2.5-month body weight.

SUMMARY

Lambs can be culled (at an average of 2.5 months of age) on both face cover and skin folds with reasonable accuracy.

The percent accuracy of certain data to predict 6-months adjusted weaning weight is given below:

	Criteria	Percent Accuracy
1.	Birth weight	80
2.	Body weight (2.5 month average)	88
3.	Metacarpus bone diameter (2.5 month average)	86
4.	Lambs in upper 50 percent in both body weight and metacarpus bone diameter	90

This information is a report of 1 year's data on one particular flock. No statistical analysis has been made.

Influence of Inbreeding on Productivity of Rambouillet Ewes

J. M. Shelton and J. W. Menzies

In 1954, a number of small inbred lines of Rambouillet sheep were initiated as a cooperative program with the Western Sheep Breeding Laboratory, Dubois, Idaho. The total number at the outset consisted of nine lines located at Sonora, College Station and McGregor. The number of ewes per line was variable ranging up to 15, with each line established from foundation animals obtained from different breeders over the state. In the years since 1954, the number of lines was reduced to six, all of which have been maintained at the Livestock and Forage Research Center at McGregor since 1961.

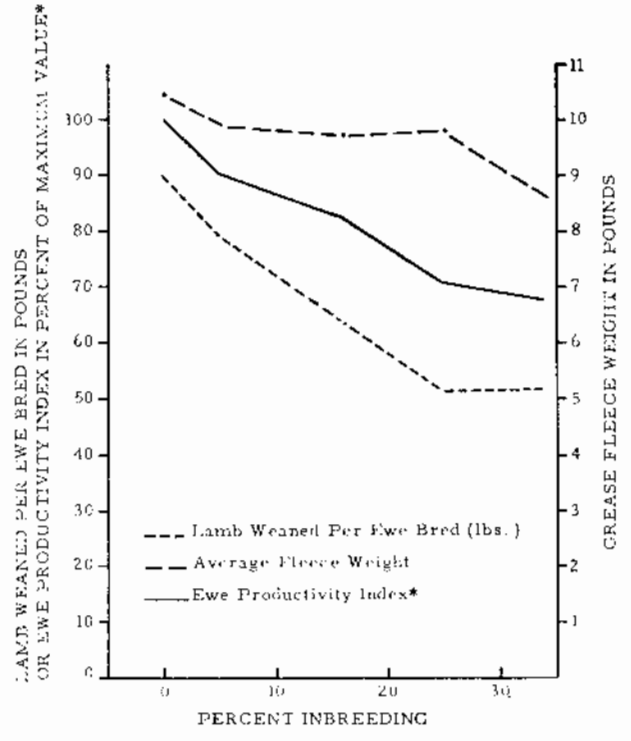
Research progress with large animal species since 1954 indicates very little likelihood that this line of work will result in superior breeding animals or breeding systems. Thus, it appears advisable to discontinue this work. The results obtained to date, however, should hold some interest. This report presents the effects of inbreeding on ewe performance. Only Sonora and McGregor data are included. All analyses were made on a within-station basis and were pooled for presentation. The relatively small numbers involved (287 matings) distributed over several lines at two locations complicates the analysis, but an effort has been made to consider these factors in the tabulations presented.

The ewes were grouped based on the amount of inbreeding as follows:

0.000	— percent inbreeding
0.001	— 0.10 percent inbreeding
0.101	— 0.20 percent inbreeding
0.201	— 0.30 percent inbreeding
0.301	+ percent inbreeding

The 0.0 group does not represent outbred controls, but the group contains ewes assigned to this program but not themselves inbred. A summary of the fertility data are shown in Table 17. The average fleece weight, pounds of lamb weaned per ewe bred and ewe productivity index are shown in Figure 1. The ewe productivity index represents an attempt to compare the groups in a manner which would reflect income per breeding ewe. The volume of data involved is inadequate to calculate reliable quantitative estimates of the effect of degree of inbreeding, but it does appear adequate to give some estimate of the trends involved. Inbreeding significantly affected or reduced performance in all the variables measured. This downward trend was most evident in fertility data and particularly in lamb survival. The effect was least consistent in average fleece weight and in weaning weight of lambs. This may have been, in part, a reflection of the fact that fewer lambs were raised, since neither fleece weight or weaning weight were adjusted for current or previous parity of the ewe.

A very marked location difference was noted in the survival of the inbred lambs. At the Ranch Experiment Station at Sonora the survival rate of inbred lambs was not significantly different from that of the controls, whereas, at the McGregor Center 34.6 percent of the inbred lambs were lost. This was approximately double that of the flock in general. This can apparently be explained by the difference in the management practices at the two stations. During the time these lines were present at Sonora, this flock was on a spring lambing schedule and were very intensively managed during the lambing season. By contrast, the flock at McGregor is a fall and winter lambing regime and is given only a minimal amount



*Ewe productivity index was calculated as two times fleece weight plus the pounds of lamb weaned per ewe bred and expressed as a percent of the value obtained for the non-inbred ewes.

Figure 1. Inbreeding influence on pounds of lamb weaned, fleece weight and productivity index.

of care at lambing. Higher mortality is generally observed among fall and winter lambs. No significant number of abnormal lambs were born in the inbred lines. The increased mortality appears to be largely attributable to weak lambs or to poor mothering of the ewe and thus, this loss could be partially overcome by more intense management. These data corroborate other reports indicating that inbreeding with large animal species leads to serious reduction in productive efficiency. The degree of this reduction appears to be largely proportional to the amount of inbreeding, although other work has indicated that a plateau effect may be reached after a period of time. The degree of this effect is sufficient to indicate that inbreeding should be carefully avoided in commercial programs. In this study the productivity index for ewes with 25 percent or more inbreeding was only approximately 70 percent that of non-inbred ewes. It should be pointed out that individual inbred animals occasionally had good performance records, but this is not true of the group as a whole. Thus, an occasional experience in which inbred matings are made without serious results should not lead a producer to become complacent about this practice.

TABLE 17. THE RELATION OF INBREEDING TO LAMBING PERFORMANCE OF RAMBOUILLET EWES

Range in inbreeding	Average inbreeding coefficient	Number matings	Percent ewes lambing	Percent lambs raised of ewes bred	Percent lambs raised of lambs born	Average weaning weight	Pounds lamb weaned per ewe bred
0.000	0.000	79	90.1	116.4	82.9	76.4	88.9
.000-.10	.047	37	88.1	114.3	84.9	69.7	79.7
.101-.20	.159	59	86.9	98.4	77.3	65.0	64.0
.201-.30	.251	71	69.3	71.8	71.7	71.7	51.5
.301 +	.334	41	77.6	73.3	64.3	70.6	51.7

Influence of Season on Reproductive Performance of Aged Rambouillet Ewes

J. M. Shelton

IT HAS LONG BEEN KNOWN that there is a seasonal trend in reproductive performance of sheep, but that the extent of this effect depends on factors such as age and breed. The general trend toward earlier lambing, along with some interest in multiple lambing, has placed a renewed interest in a more complete picture of the effect of season on overall reproductive efficiency. One of the environmental phenomena known to be associated with reproductive efficiency in sheep is the length of photoperiod, which varies with the season of the year. A total of 539 aged Rambouillet ewes were used to study this question over a 2 year period. These ewes had been purchased in two different lots from range flocks on the Edwards Plateau area. The ewes were mated in groups starting on March 21, June 21, September 21 and December 21. These represent the longest and shortest days of the year with the equinoctial points between. Representative groups of ewes were exposed to rams for a period of 6 weeks following these dates. The ewes were maintained in drylot for 60 days prior to and during the mating period. The same ration (80 percent sorghum hay, 10 percent alfalfa hay, 5 percent cottonseed meal and 5 percent sorghum grain) was fed during confinement in drylot. This was done to eliminate level of nutrition as a source of variation. The rams were marked with lamp black in oil, and matings were recorded daily. Half of each group of ewes was laparotomized (observation of the ovaries by means of abdominal surgery) 4 days after estrus or at the end of 6 weeks if no estrus was observed, and the ovulation rate was recorded. All surviving ewes were carried through lambing, but lambing data are reported on only those ewes not subjected to surgery. Results are shown in Table 18. These data show that essentially all the ewes were cycling at each of the four seasons. However, there

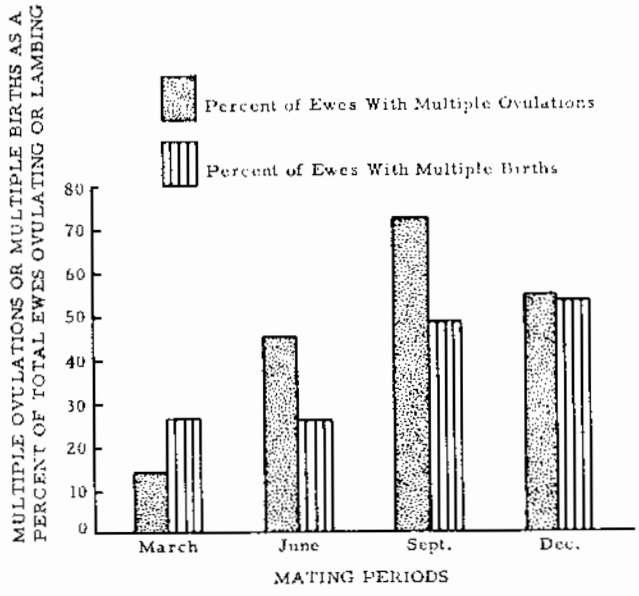


Figure 2. The relation of season of the year to the occurrence of multiple ovulations or multiple births.

appears to be a distinct tendency for some of the ewes not to show outward manifestation of estrus during the spring months. These data also show a large difference in the ovulation rate by seasons (see Figure 2) of the year. For instance, only 14 percent of the ewes laparotomized at the March mating period had multiple ovulations compared to approximately 75 percent during the September mating period. Ovulation rates at the other two dates are intermediate between these extremes. The percent ewes lambing is not high for any of the groups but tends to increase as the season advances. This appears to be a combined effect of both the photoperiodic response and temperature. Also interesting is the great difference between potential lamb production as

TABLE 18. INFLUENCE OF SEASON OF YEAR ON THE OCCURRENCE OF ESTRUS, OVULATION AND LAMB PRODUCTION OF AGED RAMBOUILLET EWES

Season	Total number of ewes	Percent showing estrus	Percent ovulating	Total ovulations as percent of ewes in group[a]	Percent ewes lambing[a]	Total lambs dropped[b]	
						Percent of ewes in group	Percent of ewes lambing
March	116	84.5	92.6	105.6	66.1	83.9	127.0
June	167	96.4	94.7	140.8	76.5	96.5	126.2
September	142	97.2	100.0	175.4	84.5	126.8	150.0
December	114	99.1	98.1	151.9	87.0	135.2	155.3

[a]Based on an observational laparotomy of half of the ewes in each group.
[b]Based on the lambing results from the half not laparotomized.

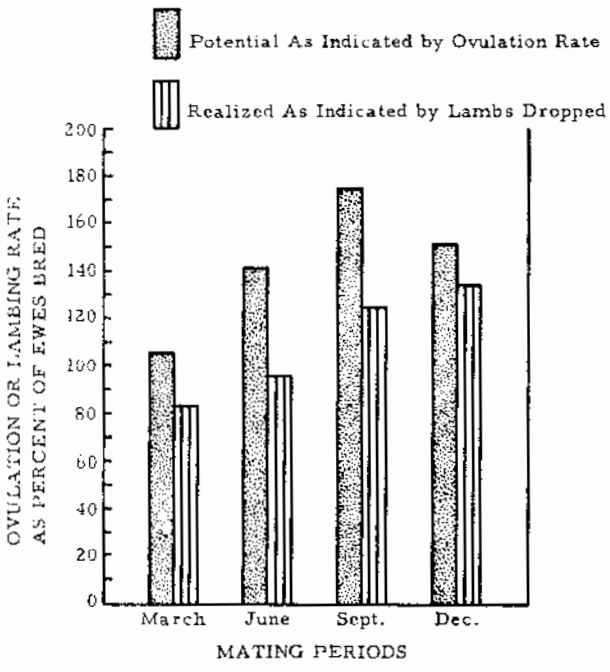


Figure 3. A comparison of ovulation and lambing rate by seasons of the year.

indicated by total ovulations and realized lamb crop dropped (see Figure 3). Although evident at all periods, this wastage appears to be greater at the June and September mating periods, and efforts should be made to ascertain the explanation for this loss.

In addition to the other factors enumerated, season of the year also affects the distribution or pattern of occurrence of estrus (see Figure 4). In September and December essentially all the ewes came into estrus in 16 days, the equivalent of one estrus cycle. This is as would be expected if all the ewes were cycling when the rams were placed with them. At the March and June mating periods the pattern of occurrence of estrus was more diffuse. The peak at around 22 days at the June mating period has a physiological explanation. Apparently many of the ewes were not cycling when the rams were placed with them, but were stimulated to do so by their presence. Since ewes first exhibit a silent or non-receptive heat before the first active one, the 22 days represent the sum of the approximately 6 days required for stimulation plus a 16-day cycle.

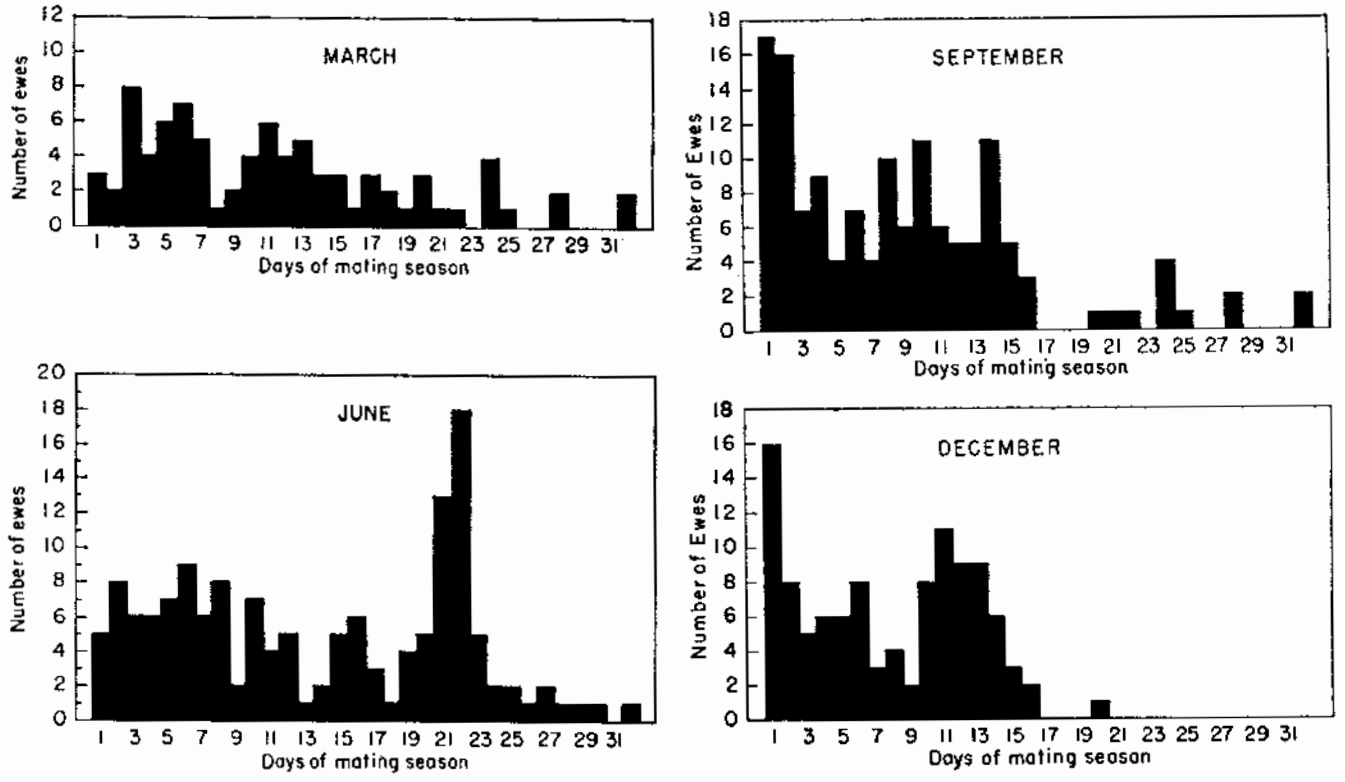


Figure 4. Distribution of occurrence of estrus by seasons.

Relation of the Polled Gene to the Occurrence of Cryptorchidism in Fine-wool Sheep

J. M. Shelton

MALES WITH RETAINED TESTICLES occasionally occur with most species of farm or ranch livestock. These animals are referred to as cryptorchids, ridglings, toruna, etc. It was early observed that polled sheep or those of polled breeding have a much higher incidence of this defect than those of horned breeding.

A research project involving polled Rambouillet sheep has been conducted at the Livestock and Forage Research Center at McGregor, Texas since it was established in 1918. The objectives of this project have been: to find a polled line not carrying the cryptorchid gene; to develop an improvement program with polled Rambouillet; and to determine if the poll gene has an effect on animal performance. At the present time, no single polled ram has been identified which, on extensive use, failed to sire at least one ridgling offspring. The difficulty experienced in accomplishing these objectives does not seem to be explained by the currently accepted theories concerning the inheritance of these two characters.

In this flock, the presence or absence of horns seems to be from a single pair of segregating genes with the polled condition dominant. When different breeds, such as Dorset, are involved the mode of inheritance is apparently not this simple. Thus, in this flock three different genotypes are possible as outlined. From this it will be seen that it is not possible to distinguish the two polled genotypes by appearance. Some inference can be made about the rams in that a ram with any significant horn tissue cannot be pure polled. However, it cannot be inferred that all clean headed rams are pure polled. The true genotype of the depression ewe or polled ram can sometimes be determined from pedigree on progeny testing. For instance, a polled ram or a depression ewe out of either a horned ram or a knobbed ewe cannot be other than a heterozygote.

		Phenotype (Visual appearance)	
Genotype	Symbol	Male	Female
Homozygous polled	PP	Without horn or scur development	Depressions
Heterozygous polled	Pp	Without horns, but may or may not have horn stubbs or scurs	Depressions
Homozygous horned	pp	Horns	Knobs

The relationship of type of mating to frequency of cryptorchidism is shown in Table 19. Although a total of 1,532 lambs is involved, the number in certain mating groups are small. However, significant differences in the frequency of ridglings between the various mating groups are evident. No ridglings were found among 855 offspring in which either or both parents were horned.

TABLE 19. RELATION OF TYPE OF MATING TO FREQUENCY OF RIDGLING OFFSPRING

Breeding and genotype of ram	Genotype of ewe	Number lambs		Number ridglings	Percent total males which are ridglings	Estimated frequency percent of pure polled lambs
		Total	Males			
Horned-Ramb.(pp)	knobbed (pp)	167	(87)	0	0.0	0.0
Heterozygote-Ramb.(Pp)	knobbed (pp)	229	(104)	0	0.0	0.0
Homozygous-Ramb.(PP)	knobbed (pp)	33	(16)	0	0.0	0.0
Homozygous-Medium wool (PP)	knobbed (pp)	233	(120)	0	0.0	0.0
Horned-Ramb. (pp)	depression (pp or Pp)	193	(100)	0	0.0	0.0
Heterozygous-Ramb. (Pp)	depression (pp or Pp)	466	(235)	25	10.6	10.4
Homozygous-Ramb. (PP)	depression (pp or Pp)	53	(21)	4	19.1	20.7
Homozygous-Medium wool (PP)	depression (pp or Pp)	203	(111)	5	4.5	20.7

Compared to this, 19.1 percent of the total number of males were ridglings when homozygous polled males were bred to depression females. Based on a rough estimate of the gene frequency in this flock, it is possible to calculate the approximate number of homozygous polled lambs to be expected among the offspring. When this is done, there is a very close agreement between the expected number of homozygous polled lambs and the observed frequency of ridglings among the lambs sired by Rambouillet rams. The numbers here are too small to place much confidence in this observation, but they should be of interest. This would possibly indicate that in this flock a large majority of the homozygous polled lambs are ridglings. These data also indicate that rams of the medium wool breeds (Hampshire, Suffolk and Columbia), though homozygous polled, sire fewer ridglings than Rambouillet rams with a similar genotype with respect to horns.

The relation of type of birth to the frequency of ridglings is shown in Table 20. A larger percentage of ridglings was observed among the twin births, but the difference was not significant when tested by the chi-square procedure. However, if this observation proves to be real, it would be of some interest in attempts to explain the inheritance of this defect.

TABLE 20. RELATION OF TYPE OF BIRTH TO FREQUENCY OF RIDGLINGS (INCLUDING ONLY THOSE MATINGS IN WHICH CRYPTORCHIDISM WOULD BE EXPECTED)

Type of birth	Number lambs	Number ridglings	Percent of total males recorded as ridglings
Singles	381	14	7.37
Twins	401	23	11.39

DISCUSSION

The occurrence of cryptorchidism in sheep has been described as being the recessive allele of a single pair of genes. The association of the polled condition and cryptorchidism has been reported as being due to close linkage on the chromesome with only approximately 5 percent crossover. In the present flock, and possibly fine wool sheep in general, it does not appear that this is a satisfactory or complete explanation, and an alternative or supplemental explanation is herein being proposed. To date, no data have been developed in this project that would prove or disprove either hypothesis.

In embryological development, the initiation of testicular development occurs inside the body cavity from the same primordial tissue as that of the ovaries. During the process of fetal growth and development, the testes migrate through the inguinal canal into the scrotum. When this process is not complete by birth or at the time of observation, the animal is described as a cryptorchid. The frequency of observation of this condition in many species would indicate that the process is liable to accidents or failures in development. It has been determined that the presence of endogenous testosterone or the male sex hormone plays a part in bringing this process to completion. Supplemental testosterone after birth will occasionally bring about the descent of retained testicles. Although not denying the presence of a specific gene causing retained testicles, the hypothesis produced here is that many cases of crytorchidism represent an additional effect of the polled gene (pleiotropy) in which there is a large increase in the frequency of accidental failure of development among polled animals. This might be explained by a qualitative or quantitative change in the male sex hormone. If the observed cases of retained testicles represent a pleiotropic effect of the polled gene, the variability of effect would be described as incomplete penetrance. The variability in frequency of expression of cryptorchidism from sires or breeds of the same genotype would be variation in degree of penetrance.

The acceptance of this hypothesis would explain the difficulty in obtaining polled rams, particularly those of homozygous genotype which do not sire cryptorchid lambs. It would also suggest a different procedure in which selection for reduced incidence would be practiced as contrasted to a search for individual animals which are completely free of this defect.

Influence of Level of Protein and Other Factors on the Performance of Yearling Billies Maintained in Drylot*

J. M. Shelton and J. E. Huston

RELATIVELY LITTLE WORK has been done on ration formulation for goats. Development of young billies is one area in which widespread feeding is practiced and thus where an immediate need for information may exist. In the spring and summer 1965, a group of 60 head of yearling billies were split into six lots and fed on various experimental rations. The primary treatments applied were three different protein levels, with additional lots for a comparison of pelleting versus non-pelleting, and the addition of fat and antibiotics to the ration. The basic ration fed was:

Ration	Percent
Cottonseed hulls	20
Alfalfa hay	40
Sorghum grain	10
Oats	13
Cottonseed meal	12
Molasses	3.5
Trace mineral salt	0.5
Bone meal	0.5
Potassium chloride	0.5

This ration was fed in the form of 3/8-inch pellets. The potassium chloride was included in the belief that this product is beneficial in the prevention of calculi formation. The protein level was varied by substitution of cottonseed meal for grain or vice versa.

The treatments imposed are:

Lot 1	Low protein
Lot 2	Medium protein
Lot 3	High protein
Lot 4	Ration #2 fed in non-pelleted form
Lot 5	Ration #2 with 3.5% animal feeding fat added
Lot 6	Ration #2 with mixed antibiotic added

The rations used in the first three lots were formulated to contain approximately 12, 15 and 18 percent crude protein, respectively. However, this was done utilizing estimated composition of the ration components. Later analysis indicated the protein range between the rations to be much wider than expected. The first three lots were fed for 156 days and fleece data were obtained. The last three lots were fed only 70 days and were terminated for reasons of economy. No fleece data were collected on these. Data on the short term treatments are shown in Table 21. Pelleting of the ration substantially improved animal weight gains primarily because of increased feed intake. The inclusion of 3.5 percent fat reduced rate of gain and feed intake but improved feed efficiency. The presence of fat in the ration caused a breakdown of the pellet and this may explain the reduced gain. The ration containing 3.5 percent fat did perform better than the non-pelleted ration. In this case, the presence of the mixed antibiotic in the ration did not improve animal performance. However, it should be pointed out that no particular illness occurred in these lots.

Comparative performance on the three protein levels are shown in Table 22. These data show a direct increase in rate of gain and fleece weight as protein level increases. The fiber diameter also increased with increases in protein level but perhaps not as great as might have been expected. Staple length does not appear to increase with level of protein. This leaves unexplained the observed increase in fleece weight since fiber diameter and staple length do not provide a satisfactory explanation. An increase in density is suggested. This work does not appear to bracket the maximum amount of protein to which a response could be expected and further work would appear to be indicated.

The rations used in this research are not being suggested as rations for developing billies, but were made up as experimental rations for study purposes.

TABLE 21. INFLUENCE OF PELLETING, ADDED FAT AND ANTIBIOTICS ON GAIN AND FEED CONSUMPTION OF YEARLING BILLIES

Lot number	Treatment	Daily Gain	Daily feed consumption	Feed per pound gain
2	Control (pelleted)	.548	5.07	9.25
4	Non-pelleted	.465	4.37	9.40
5	3.5 percent added fat	.523	4.64	8.87
6	Mixed antibiotic added[a]	.503	4.94	9.82

[a]The antibiotic used was 1.5 pounds per ton of Aureo SP 250. When fed at this level, it provided 15 mg. aureomycin, 15 mg. sulfamethiazine and 7.5 mg. penicillin per pound of feed.

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TABLE 22. THE INFLUENCE OF LEVEL OF PROTEIN ON THE PERFORMANCE OF YEARLING BILLIES

Lot number	Crude protein level		Total gain, pounds	Daily feed consumption, pounds	Fleece data-6 month basis				Pounds feed per pound hair
	Calculated Percent	Analyzed Percent			Grease weight, pounds	Clean weight, pounds	Staple, inches	Fiber diameter, microns	
1	11.8	9.7	46.3	4.34	9.35	7.33	6.45	35.8	83.6
2	15.3	16.7	56.1	4.51	11.53	8.41	5.86	36.9	70.4
3	18.3	21.3	59.2	4.57	13.73	10.20	6.17	38.0	59.9

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Influence of the Female Sex Hormones on the Performance of Angora Male Kids During the Rutting Season*

J. M. Shelton

ANGORA MALES, as well as the females, are distinct seasonal breeders. The males normally show a rutting season from approximately the first of September through January. At other times, the male tract contains live sperm, but the animal does not show libido (mating desire). Well developed male kids show a rutting season their first year, but they are seldom used for breeding at this age. Many breeders have expressed the belief that rutting adversely affects their performance and that benefit could be realized from preventing the rutting season. It should be possible to do this easily and economically by administration of one of the female sex hormones.

Experimental studies were conducted in the fall and winter of 1964-65 in which a form of estrogen (Diethylstilbestrol) and progesterone (6-methyl, 17 Acetoxyprogesterone, hereafter referred to as Provera**) were administered to billy kids along with appropriate control lots. The stilbestrol was administered in the form of a single 12 mg. implant and the progesterone in the form of a single 50 mg. injection. The treatments were initiated in late September. Duplicate tests were made with one group on feed in drylot and the second on the range. The results are shown in Tables 23 and 24. Some kids were already rutting at the time of treatment. Initially, stilbestrol actually accentuated rutting on the part of some animals, but after a short time both treatments effectively prevented or eliminated rutting. However, both treatments appeared to have an adverse effect instead of an improvement on animal performance. This was not unexpected, since the presence of the male sex hormone normally has a stimulating effect on growth rate during the developmental period, and the presence of the female sex hormones in the animals system tends to block the production of testosterone or the male sex hormone.

TABLE 23. RESULTS OF HORMONE TREATMENT OF BILLY KIDS ON RANGE

Treatment 9/24/64	Number of animals	Weight gain to 1/14/65, pounds	Fleece weight 3/16/65, pounds
Control	10	33.9	9.7
12 mg. Stilbestrol implant	9	29.7	9.3
50 mg. Provera injection	9	23.9	9.2

The relatively poor performance of the drylot group can, in part, be explained by the fact that they were cull animals to start with. They also appeared to be affected by a low level of disease, possibly coccidosis, throughout much of the test.

It is possible that with different ages or different treatment regimes, a response to these treatments could be shown, but these data do not lead one to be much encouraged.

TABLE 24. RESULTS OF HORMONE TREATMENT OF BILLY KIDS MAINTAINED IN DRY LOT

Treatment 9/21/64	Number of animals	Weight gain to 2/10/65, pounds	Fleece weight 2/10/65, pounds
Control	7	32.6	5.9
12 mg. Stilbestrol implant	7	27.7	4.2
50 mg. Provera injection	8	30.4	5.1

*The assistance of Walton Greenwade, Clifton, Texas, in providing some of the experimental animals used in this work is gratefully acknowledged.

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Observations on the Scrotal Division of Angora Males

J. M. Shelton

A PARTIAL DIVISION OR SEPARATION between the testicles is a common occurrence with Angora males. The degree varies from a minor indentation in the scrotum to a complete separation of the testes. Breeders have exercised some selection pressure against this defect, but the reason for doing so is not always clear. It is said that the indentation serves as a site of screwworm infestation due to irritation from various types of plants. Also, some breeders have expressed the belief that this characteristic in the males was related to deformed udder or teats in the case of does.

Some observations have been made on the goats at the Livestock and Forage Research Center in an attempt to determine the heritability of this characteristic and its relationship to udder and teat shape. An attempt was made to both measure and score[1] the indentation in the scrotum of the males and the teat size and udder division of the does. However, it should be pointed out that shape and/or size of udder and teats are extremely variable depending on age of doe, stage or level of lactation and disease history. Heritability estimates were made using half-sib analysis and by correlation between sire score or measures and the mean of their offspring. A total of 13 sires and 190 male offspring was involved. Possibly because of the small numbers of animals involved, the heritability estimates obtained were somewhat erratic.

Heritability estimate (half-sib method):

Scrotal division measure in centimeters ..... 46.80 percent

Scrotal division score ..... 15.28 percent

Heritability estimates could be calculated by doubling the values obtained for the correlation between the sire and the mean of his offspring; however, this would lead to values in excess of 100 percent. Those estimates obtained by the half-sib method were more realistic with a value of 46.8 percent for the measurements and 15.3 for the scores.

Correlation coefficient between sire and offspring mean values:

Scrotal division measure in centimeters ..... $r = 0.69$

Scrotal division score ..... $r = 0.60$

Several correlation values were calculated between measures or scores taken on the scrotum of males and udder shape of their dam. As shown in Table 25, none of these values were statistically significant or large enough to indicate any real relationship between these characteristics. Thus, in this case no association was found between shape of the scrotum and the shape or size of the teats or udder.

SUMMARY

These data seems to indicate that the characteristic of a divided scrotum is moderate to high in heritability. These data fail to show any significant relationship between shape of the udder and shape of the scrotum. This would seem logical as these two organs are not particularly associated in embryological development. It would appear that this characteristic is undesirable, but should rate only very minor emphasis in a selection program and might be completely ignored in commercial programs where males are not to be kept for breeding purposes.

TABLE 25. CORRELATION COEFFICIENT BETWEEN CERTAIN SCROTUM AND UDDER MEASURES AND SCORES (n = 151)

Characters	Correlation coefficient	
	Gross	Pooled within year
Teat size and scrotal division score	.094	.091
Teat size and scrotal division measure	−.127	−.101
Udder division score and scrotal division score	.022	.003
Total division (teats and udder) and scrotal division score	.002	.016

[1]The assistance of J. D. Naler, technical assistant, in making most of these observations is gratefully acknowledged.

Changes in Mohair Fleece Characteristics as Influenced by Age and Season

J. W. Bassett

ANGORA GOATS ARE SHEARED twice a year at approximately 6-month intervals under normal management practices. The 6-month interval is only an approximation and may range from a 5 to 7-month interval or more depending on management considerations such as weather conditions, kidding dates, range conditions and other environmental factors. Spring and fall are considered to be the shearing "seasons" although shearing may start as early as January and July for the respective season. The fall clip will generally be the finer of the two clips with respect to fiber diameter, since this is the clip that will contain the 6-month-old kids being shorn for the first time and the yearling or 18-month mohair. The spring clip will produce the 12-month kid hair of a coarser fiber diameter, and the mohair from 2-year-old goats will be included with the "adult" mohair. Basing market quality on chronological age is not always a satisfactory or desirable practice for either the buyer or seller.

A direct comparison of age and seasonal influences on fleece characteristics is available from data being collected from mohair producers in the state and this is to report some of these comparisons.

PROCEDURE

Individual fleeces were obtained from four age groups from five different Angora goat producers in the fall of 1964. The goats were individually identified and the fleeces will be obtained at each shearing for the next five shearings. Grease fleece weights are obtained at shearing and physical measurements of fiber diameter, staple length and clean yield were obtained by the Wool and Mohair Laboratory of the Department of Animal Science. This report will use data from the first two shearings in the fall 1964 and spring 1965.

RESULTS AND DISCUSSION

The number of goats involved in the study and their approximate age at each shearing are shown in Table 26.

The number of goats within each age group will not remain constant since there will be some death losses and there will be no attempt to make substitutions.

Table 27 gives the results from successive shearings approximately 6 months apart. The data were adjusted to 6 months growth for grease fleece weight and staple length.

Average grease fleece weights were consistently lighter at the spring shearing than in the fall with Group I the lone exception of age. Group I goats all produced heavier amounts of grease mohair at yearling age as compared to 6 months of age. Percent yield was lower, but the yield of clean mohair per fleece exceeded the fall averages. Staple length was shorter and fiber diameter was coarser. Average fiber diameters increased by 3.5 to 6.6 microns, or from a 40s spinning count to a 28s or 32s. Body weights are given in Table 28 and these show that in most instances goats in Group I produced more pounds of fiber than pounds of increased body weight.

The older age groups are not consistent between producers in comparing grease fleece weights at the two seasons of the year. In general the grease fleece weights are lower, yields are lower and consequently the average clean fleece weights are also lower. Staple lengths are shorter in every case. This compares with wool in that wool fiber growth is less during the fall and winter than in the spring and summer period. However, wool fiber growth slows in both length and diameter while the mohair fiber tended to increase

TABLE 26. NUMBER AND AGE OF ANGORA DOES AT SHEARING

Age group	Age, years		Grower designation	Number of goats	
	Fall, 1964	Spring, 1965		Fall, 1965	Spring, 1965
I	½	1	A	10	10
			B	10	10
			C	10	7
			D	10	10
			E	12	12
			Total	52	49
II	1½	2	A	10	10
			B	10	10
			C	10	9
			D	10	10
			E	12	12
			Total	52	51
III	2½	3	A	10	10
			B	10	10
			C	10	10
			D	10	10
			E	12	12
			Total	52	52
IV	3½	4	A	10	10
			B	3	3
			C	10	8
			D	10	10
			E	12	12
			Total	45	43

TABLE 27. AVERAGE FLEECE MEASUREMENTS, FALL, 1964 AND SPRING, 1965

Age group	Grower	Fleece Weights: Grease, pounds F	Grease, pounds S	Clean, pounds F	Clean, pounds S	Yield, percent F	Yield, percent S	Staple length, inches F	Staple length, inches S	Fiber Diameter: microns F	microns S	Spinning count F	Spinning count S
I	A	2.9	4.9	2.2	3.5	76.1	71.1	5.2	4.8	24.8	28.6	40s	32s
	B	3.2	7.2	2.3	5.0	72.9	69.6	5.5	4.6	23.6	29.6	40s	28s
	C	2.6	4.3	2.0	3.4	79.8	77.9	5.6	4.8	24.6	28.1	40s	32s
	D	3.1	5.5	2.4	4.2	76.9	76.9	5.8	4.7	23.5	28.7	40s	32s
	E	1.7	3.9	1.4	3.0	83.2	78.5	5.5	6.0	21.6	28.2	40s	32s
	Average	2.68	5.2	2.07	3.8	77.8	78.1	5.5	5.0	23.6	28.6	40s	32s
II	A	8.1	5.7	6.4	4.3	78.9	75.5	5.5	3.9	34.5	34.3	24s	24s
	B	6.8	7.7	5.4	5.9	78.5	77.0	5.8	4.2	30.9	34.9	28s	24s
	C	6.1	5.9	4.6	4.6	76.3	78.1	5.3	3.9	31.0	33.1	28s	24s
	D	5.3	5.3	4.2	4.2	79.2	79.2	5.6	4.3	29.0	32.3	32s	24s
	E	4.8	3.7	3.9	3.0	81.9	81.4	5.5	4.6	29.6	31.2	28s	28s
	Average	6.2	5.7	4.9	4.4	78.9	77.2	5.6	4.2	31.0	33.2	28s	28s
III	A	8.2	6.8	6.1	4.9	74.3	71.5	4.8	3.9	37.1	36.2	20s	20s
	B	6.0	6.2	4.8	4.7	79.2	76.6	3.5	4.0	32.2	34.6	24s	24s
	C	6.2	6.8	4.7	5.2	75.7	77.4	5.3	4.2	32.1	34.7	24s	24s
	D	6.4	5.8	4.8	4.7	75.7	80.8	5.1	4.1	32.6	35.7	24s	20s
	E	4.4	4.0	3.6	3.2	82.2	80.8	5.0	4.4	29.2	33.2	28s	24s
	Average	6.2	5.9	4.8	4.5	77.5	76.3	5.2	4.1	32.6	34.9	24s	24s
IV	A	7.2	6.5	5.5	4.8	75.7	73.8	4.6	4.0	38.0	35.8	20s	20s
	B	5.5	6.9	4.4	5.3	79.8	76.2	5.6	5.1	31.5	34.3	28s	24s
	C	5.9	6.7	4.4	4.1	74.3	61.2	5.6	4.2	36.7	37.7	20s	20s
	D	7.1	5.8	5.6	4.7	78.3	80.5	5.4	4.2	36.2	36.0	20s	20s
	E	5.0	4.5	4.2	3.6	82.7	78.8	5.1	4.2	32.8	36.5	24s	20s
	Average	6.2	6.1	4.8	4.5	78.2	73.8	5.2	4.3	35.0	36.1	24s	20s

in diameter in the fleeces represented in this study. The increase in fiber diameter in this case is probably associated with the increase in age rather than indicating a seasonal effect.

Age differences in fiber diameter are apparent at each age represented in this study and at both seasons. Body weight averages increase with age but age appears to have little influence on mohair fleece weights or staple length within the weight ranges reported here.

The additional data being obtained from the Angora goats in this study should show a clearer picture of the influence of age and season on the fleece characteristics of economic importance.

TABLE 28. AVERAGE BODY WEIGHT MEASUREMENTS, FALL, 1964, AND SPRING, 1965

Age group	I		II		III		IV	
Shearing	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Grower								
A	[a]	42.8	[a]	70.5	[a]	91.8	[a]	83.2
B	37.8	46.9	52.0	61.1	53.6	55.5	63.0	66.3
C	30.4	31.0	47.8	53.1	56.2	59.3	61.2	67.4
D	40.0	43.2	48.6	53.0	67.2	73.1	70.7	76.2
E	30.5	35.2	47.3	48.5	50.9	49.7	58.3	57.9
Average	34.5	39.1[b]	48.8	53.9[b]	56.7	59.4[b]	63.1	66.9[b]

[a]Weight not available.
[b]Weights from Grower A not included in average.