STUDIES WITH BEEF CATTLE, SHEEP AND SWINE

REPORTED AT

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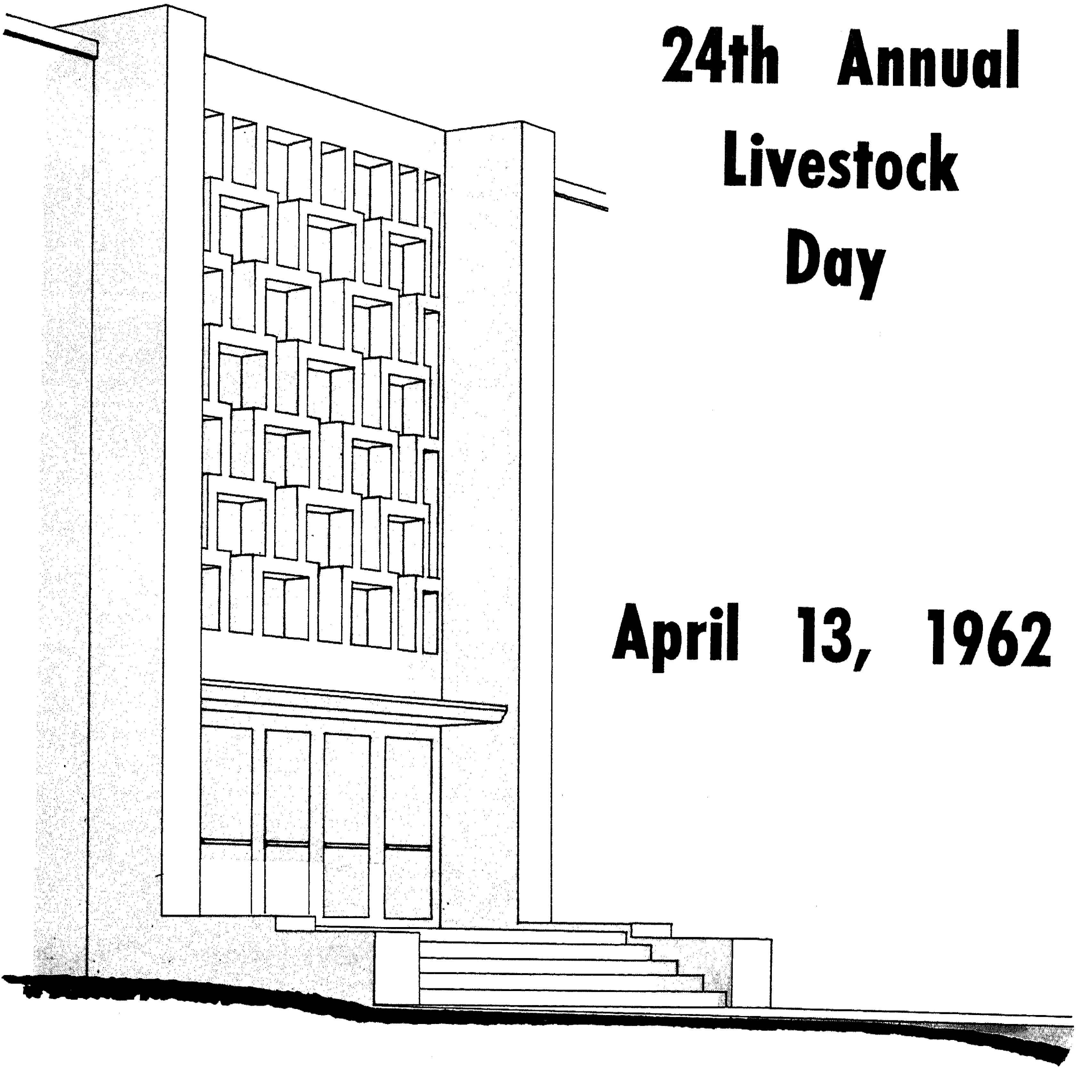

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PROJECT 237.

WINTER FEEDING FOR QUALITY BEEF

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Summary

Four winter rations for beef calves were evaluated using feed lot performance, carcass grades, and cut-out value as criteria. Following the winter period, all steers were fattened on a standard fattening ration and slaughtered after each made a total gain of 550 pounds. The best carcasses as well as the most efficient gains were produced by a winter ration containing adequate protein (1.6 lbs. crude protein) and sufficient energy (9.0 lbs. total digestible nutrients) to produce approximately 2 pounds average daily gain during the winter phase. Steers implanted (36 mg diethylstilbestrol) during the fattening phase produced carcasses with less fat trim and a higher retail yield than un-implanted steers. Gain response to diethylstilbestrol (DES) implants ranged from 16 to 28 percent and were greater for steers previously fed adequate protein in winter rations.

Production costs were lowest for the liberal winter feeding systems (Full Feed - Adequate Protein and Adequate Energy - Adequate Protein). This was due to lower total digestible nutrients (TDN) required per unit gain during the winter phase and for the combined winter and fattening phases as well as fewer days required to produce 550 pounds gain.

Description of Tests

Previous feeding trials with beef steers have shown that extremely low winter gains result in wasty, low quality carcasses after fattening. In tests reported last year, both protein and energy levels of winter rations were shown to affect the carcasses produced after subsequent fattening. Gain responses to implants of diethylstilbestrol (DES) in both the wintering and fattening phases were influenced by the protein level fed during the winter.

The low and adequate protein levels and the low and adequate energy levels used in the 1959-1960 test were repeated in the 1960-1961 test. In addition, one group of steers was full fed a high energy, adequate protein ration. Beef calves weighting 420 pounds were started on test in December, 1960. The four rations fed provided the following amounts of crude protein (CP) and energy (Total Digestible Nutrients - TDN) per head daily.

Rations	TDN (lbs.)	CP (lbs.)
1. Adequate energy, low protein (AE-LP)	9.0	1.0
2. Full fed, adequate protein (FF-AP)	10-12	1.6
3. Adequate energy, adequate protein (AEAP)	9.0	1.6
4. Low energy, low protein (LE-LP)	7.0	1.0

Typical rations that would provide these levels of TDN and CP are as follows:

AE-LP		FF-AP	
corn silage	12.0 pounds	corn silage	12.0 pounds
shelled corn	5.0 pounds	shelled corn	full fed
soybean meal	0.5 pounds	soybean meal	1.5 pounds

AE-AP		LE-LP	
corn silage	12.0 pounds	corn silage	25.0 pounds
shelled corn	5.0 pounds	soybean meal	0.7 pounds
soybean meal	1.5 pounds		

Fattening Phase

Following the winter feeding phase, all steers were fattened on the same standard fattening ration. Ground ear corn was full fed with one and one-half pounds of soybean meal and one to two pounds of grass hay per head daily. This ration was similar to the full fed winter ration in energy and protein. An equal mixture of salt and bone meal was provided free choice during both the wintering and fattening phases. All rations fed during both phases were fortified with Vitamin A supplement. (Approximately 15,000 USP units per head daily). At the start of the fattening phase half of the steers fed each of the four rations during the winter phase were implanted with 36 milligrams of diethylstilbestrol. Each steer was slaughtered after the combined winter and fattening gain totaled approximately 550 pounds.

Carcass Evaluation

All steers were slaughtered at the University of Missouri meats laboratory for detailed carcass evaluation. Carcasses were graded according to USDA carcass grade standards. Half of each carcass was cut into retail cuts and fat in excess of 3/8 inch was removed to determine retail yield.

Summary of Results

Winter Phase, December 3, 1960 to April 28, 1961 (157 Days)

	Ration			
	AE-LP	FF-AP	AE-AP	LE-LP
Number of Steers	12	12	12	12
Initial Weight lbs.	418	418	418	418
Gain per Steer lbs.	194	338	284	114
Average Daily Gain lbs.	1.32	2.29	1.93	0.77
Daily Ration lbs.				
Corn Silage	10.2	11.8	12.2	27.3
Gr. Shelled Corn	7.9	9.6	7.0	1.5
Soybean Meal	0.4	1.5	1.7	0.7
Feed per 100 lbs. Gain				
Corn Silage	850	514	632	3,521
Gr. Shelled Corn	657	421	361	194
Soybean Meal	32.9	65.0	88.1	91.0
TDN per Pound Gain	7.07	4.81	4.72	8.70

Summary of Results - Fattening Phase

Treatment During Winter Phase	AE-LP			FF-AP			AE-AP			LE-LP		
DES Implant 36 mg.	+	combined	-	+	combined	-	+	combined	-	+	combined	-
Number of Steers	5	10	5	6	12	6	6	12	6	5	12	6
Initial Weight Lbs.	597	606	616	756	757	758	702	702	702	531	532	533
Ending Weight Lbs.	939	954	960	1001	983	965	968	962	956	953	954	955
Gain per Steer Lbs.	342	348	354	245	226	207	266	260	254	422	422	422
Average Daily Gain Lbs.	2.51	2.33	2.16	2.25	2.0	1.75	2.46	2.23	2.01	2.62	2.36	2.15
Number of Days Fed	139	153	167	109	113	118	108	118	127	162	180	196
Gain Response to DES %		+16.2			+28.5			+22.3			+21.8	
Daily Ration												
Gr. Ear Corn Lbs.		18.0			17.3			18.2			17.3	
Soybean Meal Lbs.		1.5			1.5			1.5			1.5	
Hay-Orchard Grass Lbs.		1.1			1.2			1.3			1.0	
Total Feed Lbs.		20.6			20.0			21.0			19.8	
Feed per 100 Lbs. Gain												
Gr. Ear Corn Lbs.		793			869			822			741	
Soybean Meal Lbs.		65.5			74.6			67.0			65.1	
Hay-Grass Lbs.		50.0			60.5			57.9			41.9	
Total		908			1004			947			848	
TDN per Pound Gain		6.52			7.37			6.78			6.10	
Combined Winter and Fattening Phases												
TDN per Pound Gain		6.72			5.84			5.70			6.70	
Gain per Steer	536	542	548	583	564	545	550	544	538	536	536	536
Day on Feed	296	310	324	266	270	275	265	274	284	319	337	353

Summary of Results - Carcass Evaluation

Treatment During Winter Phase	AE-LP			FF-AP			AE-AP			LE-LP		
DES Implant 36 mg.	+	com-bined	-	+	com-bined	-	+	com-bined	-	+	com-bined	-
Number of Carcasses	5	10	5	6	12	6	6	12	6	5	11	6
Chilled Carcass Wt.	533	547	560	574	567	560	560	558	555	527	540	551
Dressing Percent	58.7	59.6	60.5	60.6	60.1	59.7	59.6	59.6	59.7	58.4	59.1	59.3
Marbling Score[1]	4.2	5.1	6.0	5.8	5.8	5.8	5.2	5.5	5.8	4.0	4.4	4.7
Conformation Score[2]	6.0	6.6	7.2	6.8	6.6	6.5	6.5	6.8	7.0	6.8	6.5	6.2
Carcass Grade[2]	4.2	5.6	7.0	6.5	6.4	6.2	5.8	6.2	6.6	4.8	5.6	6.3
Rib Eye Area Sq. In.	10.2	10.2	10.1	10.1	10.0	9.9	10.1	10.3	10.4	9.36	9.78	10.1
Rib Eye Area per 100 lbs. Carcass Wt.	1.91	1.85	1.79	1.75	1.76	1.77	1.81	1.85	1.89	1.78	1.81	1.83
Rib Fat Cover mm	17.8	18.2	18.5	21.2	20.5	19.8	18.0	18.6	19.0	16.2	18.9	21.1
Percent Fat Trim of Carcass Weight	12.6	14.5	16.4	13.7	14.1	14.6	12.4	13.7	15.1	14.8	16.7	18.3
Percent Retail Yield Carcass Weight	70.9	68.8	66.6	69.5	68.9	68.4	71.2	69.9	68.6	68.9	67.6	66.5

[1] Marbling scores: Traces 3, slight 4, small 5, modest 6, moderate 7.

[2] Conformation Scores and Carcass Grade: Low good 4, Average good 5, High good 6, Low choice 7, Average choice 8, High choice 9.

Conclusions

1. Steer calves fed winter rations containing adequate protein and sufficient energy to produce two pounds daily gain (AE-AP) produced the best carcasses and made the most efficient gains (TDN required per unit gain) of the four winter rations evaluated.

2. Feeding low level protein winter rations (AE-LP and LE-LP) produced the lowest quality carcasses with the greatest fat trim and slower and less efficient gains.

3. Full feeding corn with adequate protein (FF-AP) increased gains during the winter period and produced the highest grading carcasses after a subsequent fattening phase; however, gains were less efficient and fat trim greater than with a slightly less liberal winter ration (AE-AP).

4. Steers implanted (36 mg DES) during the fattening phase gained faster (16 to 28 percent) than those not implanted and produced carcasses with less fat trim and higher retail yields.

5. Gain responses to implants were greater for steers previously fed winter rations containing adequate protein.

6. Implanting (36 mg DES) during the fattening phase did not affect marbling scores or carcass grades of steers previously fed the more liberal winter rations containing adequate protein (FF-AP and AE-AP).

7. Carcass grades and marbling scores of steers fed low protein winter rations were lower for steers implanted during the fattening phase than for those not implanted, regardless of the winter energy level.

PROJECT 397.

RELATIONSHIP BETWEEN RIBEYE AREA, FAT THICKNESS AND CARCASS WEIGHT OF BEEF CATTLE

H. B. Hedrick

Beef carcasses were studied for relationship between ribeye area, fat thickness at the 12th rib, and carcass weight. Data were obtained from 695 beef carcasses. Table 1 shows the average values by 50 pound weight intervals. Ribeye area per hundred pounds carcass weight decreased and fat thickness increased as carcass weight increased. When carcass weight exceeded 500 pounds, ribeye area was less than two square inches per hundred. However, carcasses of less than 500 pounds had more than two square inches ribeye per hundred. These data indicate the importance of considering carcass weight or live weight when comparing measurements of one carcass or animal to another.

Table 1--Average Ribeye Area, Fat Thickness, and Grade of Beef

Carcass Weight	Number Animals	Ribeye Area/100 Lbs.	Fat Thickness (in./100 Lbs.)	Grade
350-399	5	2.30	.09	Good
400-449	9	2.14	.100	Good
450-499	47	2.05	.122	Good+
500-549	52	1.87	.114	Good+
550-599	105	1.84	.131	Choice-
600-649	104	1.76	.140	Choice
650-699	132	1.67	.137	Choice
700-749	131	1.63	.134	Choice+
750-799	68	1.57	.132	Choice
800-849	33	1.60	.108	Choice
850 & Up	11	1.43	.129	Choice+

PROJECT 198.

SCORES AND MEASUREMENTS IN THE LIVE BEEF ANIMAL AND IN THE CARCASS AS RELATED TO GAINS, HEAD SHAPE, HAIR COLOR AND HAIR TEXTURE

B. J. Greiman, J. F. Lasley and J. E. Comfort

Summary and Conclusions

Fast growing animals tended to have larger bone development at a standard weight than those which grew at a slower rate. This was true of scores and measurements in both the live animal before slaughter and in the carcass. Fast growing animals also tended to be rangier in type. Thus, the fast growing animals possessed the ability to grow more muscle and bone at the standard slaughter weight, compared to those which grew more slowly. They also had a lower carcass grade.

Wider and longer headed individuals were more desirable from the standpoint of performance and meatiness. It appears that head length and width may be indicators of greater bone and muscle development up to the weight limits within which this study was made. These preliminary results suggest that head size and shape are of considerable importance and there seems to be justification for gathering further information on this subject.

Variations in hair coat color in Herefords showed little relationship to performance, body scores and measurements, and carcass quality. In this study, however, there seemed to be some relationship between hair texture score and

some other traits. Animals with a coarser hair score had greater bone development, were rangier in type, and grew at a faster rate than those with a finer hair score. The results suggest that there is a relationship between hair size and bone size and length.

Description of Study

Do fast growing animals differ from slow growing animals in their body proportions? Are length and width of the head and color or texture of the hair related to conformation, growth, or meatiness? These are questions often raised but not many experimental results are available to answer them.

Twenty-one heifers and 26 steers born in the fall and weaned in the spring were full-fed from shortly after weaning until the heifers reached a shrunk weight of 800 pounds and the steers 900 pounds. A total of 67 scores and measurements were taken on each animal just before slaughter and in the carcass. Correlations between all scores and measurements were determined by means of an electronic computer.

Results and Discussion

The coefficients of correlation given here are only those which are statistically significant. For purposes of interpretation, a perfect correlation would be 1.00 and the closer the coefficient is to the number one the greater the relationship between two characteristics. This is true regardless of whether the coefficient of correlation is positive or negative.

Scores and Measurements Related to Daily Gains. Table 1 summarizes the coefficients of correlation between daily gains and body measurements. These data show that the faster growing animals had greater bone development than those which made slower gains even though they were all slaughtered at approximately the same weight within each sex. This is shown by the positive correlations between daily gains and certain body measurements.

Measurements made in the carcass and summarized in Table 2 agree with the relationship between rate of gain and various body measurements made in the live animal. Faster gaining animals also had heavier hides and a larger rib-eye area. They also tended to be wider in the shoulder.

Carcass scores also indicated that fast growing animals were more rangy in type and scored lower in carcass grade. This may have been due to less finish which could have been associated with a tendency to grow muscle and bone rather than to fatten.

Scores and Measurements Related to Head Length and Width. The length of the head was measured with calipers from the tip of the nose to the top of the poll on the head. The width of the head was measured at the eyes from one side of the head to the other. The coefficients of correlation for this portion of the study are summarized in Table 3.

Table 1--Measurements in the Live Animal at Slaughter Which Were Related to Average Daily Gains in the Feed Lot

Measurements	Coefficients of Correlation
Width through shoulders	.78**
Circumference of rear flank	.66**
Width of chest	.65**
Width of round	.64**
Circumference of heart	.64**
Width of pin bones	.59**
Circumference of fore leg muscle	.53**
Depth of Heart	.52**
Circumference of fore shank	.45**
Width of loin	.44**
Depth of twist	.42**
Width at hook bones	.42**
Length from shoulder to hook bone	.41**
Length of rump	.41**
Total length of body	.39**
Width of quarter	.33**
Width of crops	.30**

** Probability of the coefficient of correlation being this large due to chance was less than 1 out of 100.

Table 2--Scores and Measurements in the Carcass That Were Related to Average Daily Gains in the Feed Lot

Measurements	Coefficients of Correlation
Length of body	.74**
Length of body and leg	.73**
Width of shoulder	.67**
Circumference of round	.62**
Hide weight	.54**
Carcass weight	.53**
Length of leg	.49**
Length of loin	.48**
Area of rib eye	.45**
Percent trimmed chuck	.38**
Width of round	.35*
Percent untrimmed chuck	.32*
Percent untrimmed loin	-.33*
Percent trimmed ribs	-.32*
Score for compactness	-.43**
Score for marbling	-.36*
Actual carcass grade	-.29*

* Probability of the coefficient of correlation being this large due to chance less than 5 out of 100.

** 1 out of 100.

Table 3--Length and Width of Head as Related to Scores and Measurements in the Live Animal and in the Carcass

Scores and Measurements	Coefficients of Correlations	
	Head length	Head width
Measurements in the live animal:		
Width through shoulders	.50**	.40**
Depth of chest	.50**	.32*
Width of chest	.50**	N. S.
Circumference of fore shank	.49**	.33*
Width of pin bones	.47**	.46**
Width of round	.46**	N. S.
Height at withers	.41**	N. S.
Circumference of fore leg muscle	.40**	.35*
Width of quarter	.36*	.29*
Circumference of heart	.34*	N. S.
Total length of body	.34*	.31*
Scores in the live animal:		
Size of bone	.43**	.53**
Compactness	-.47**	-.41**
Symmetry	-.38**	-.37**
Slaughter grade	-.32*	-.41**
Marbling score	N. S.	-.30*
Measurements in the carcass:		
Hide weight	.57**	.41**
Length of body and leg	.52**	.40**
Length of leg	.48**	.37*
Length of body	.47**	N. S.
Length of loin	.43**	.37*
Width of shoulder	.43**	N. S.
Tenderness of top round	.41**	N. S.
Depth of body	.36**	N. S.
Circumference of round	.32*	N. S.
Width of round	.29*	N. S.
% total trimmable fat	-.37*	-.33*
Rate of gain	.48**	.41**
Age when slaughtered	.31*	N. S.

* Probability of the coefficient of correlation being this large due to chance is less than 5 out of 100.

** 1 out of 100.

Animals with longer heads also had wider heads, although the correlation was not extremely high. Animals with longer and wider heads were wider, deeper, and longer in body proportions, as determined by measurements in both the live animal and in the carcass. This was also true of scores for bone size in the live animal made by visual appraisal.

The data show that the small headed animal (less width and length) was likely to be smaller and not as thick (smaller all over), whereas the larger animals were longer and wider in the head but later maturing with less finish or condition at the slaughter weights in this experiment. They also grew at a more rapid rate.

Animals with longer and wider heads graded lower just before slaughter. Apparently they grew rather than fattened since they also produced a lower percentage of trimmable fat in the carcass. These animals, however, were less symmetrical and had less balance due to a somewhat rangier conformation. They were also younger at the standard slaughter weight because they had made more rapid gains from birth. This may be responsible for the observation that they had a more tender top round steak, compared to those with shorter and narrower heads.

Scores and Measures Related to Hair Color and Hair Texture. Each of the animals was scored for hair color on a scale from 1 to 6 with the smaller number for light yellow and the larger for dark red color. The same judges also scored the same animals for hair texture on a scale from 1 to 6 with the smaller number being a coarse texture and the larger a fine texture.

Hair color scores showed little correlation with any of the scores and measurements studied. Yellow animals tended to be slightly wider at the crops and had a smaller percentage of untrimmed ribs. They also had a larger percentage of bone at the 6-7-8th ribs, and the top round was less tender. All of these correlations, though statistically significant, were low, the highest being -.39 between color score and percentage of bone at the 6-7-8th ribs.

Hair texture score was related to many more traits in the live animal and in the carcass than was hair color score. The coefficients of correlation are summarized in Table 4. Cattle whose hair was coarser gained faster and were larger, structurally, indicating a relationship between coarser hair and more bone growth. Correlations with carcass measurements followed the same trends as those made in the live animal with coarser hair being related to greater length of body and leg and greater width through the shoulder. The more compact individuals had finer hair texture scores in this study. Animals with coarser hair also had less tender lean in the rib-eye at the 12th rib as determined by the Warner-Bratzler shear technique.

Table 4--Relationship Between Hair Texture Score and Scores and Measurements in the Live Animal and in the Carcass

Measurements	Correlation coefficients
MEASUREMENTS IN LIVE ANIMAL:	
Daily rate of gain	-.43**
Depth of heart	-.40**
Circumference of heart girth	-.39**
Width of chest	-.36*
Shrunk weight	-.34*
Width at hook bones	-.33*
Width of loin	-.32*
SCORES IN THE LIVE ANIMAL:	
Hide thickness	.52**
Type of marbling	.31*
Size of bone	-.45**
Area of rib-eye	-.32*
MEASUREMENTS IN THE CARCASS:	
Width of shoulder	-.48**
Tenderness-12th rib-lateral (W. B. shear)	
Length of body and leg	-.33*
Carcass weight	-.31*
Length of body	-.31*
SCORES IN THE CARCASS:	
Compactness	.35*

* Probability of the coefficient of correlation being this large due to chance is less than 5 out of 100.

** 1 out of 100.

PROJECT 198.

BREEDING EFFICIENCY IN BEEF CATTLE

J. F. Lasley and J. E. Comfort

Summary

Records were studied on a total of 262 different grade Hereford cows during the period from 1951 to 1960. Eleven different purebred Hereford bulls were mated to these cows during the 10-year period. Pasture mating was practiced and cows were allowed to remain in the herd as long as they were productive.

The percentage calf crop born for the 10-year period was 98.6 percent and the calf crop weaned was 93.4 percent. One reason for the high calving percentage was that nearly all cows which failed to settle during the breeding season were sold in the fall of that season. As a result they were not in the herd during the calving season the next year.

A complete record was kept of the reasons for selling the cows. The most important reason was cows becoming too old to be productive. This age varied from 8 to 13 years with an average age at disposal of 10.64 years. Other important reasons for selling cows were that they produced lighter than average calves or they failed to settle during the breeding season.

Death losses amounted to less than one percent per year during the 10-year period. In some instances the cause of death was not determined and in others death was due to unavoidable accidents or to calving injuries. The overall replacement rate due to death losses and culling ranged between 10 and 15 percent per year in this herd.

About 90 percent of the calving intervals were less than 400 days in length and the modal group (class including the largest number) was that which ranged between 331 and 340 days. Thirty-five cows had calving intervals of 461 or more days but this group included mostly those that calved late when they were introduced into the herd; they were not bred during their first season so they could be allowed to catch up with their early calving date the next year. The average calving interval, excluding those of definite abnormal length, was 356.3 days with a standard deviation of 31.3 days. Thus, 356.3 plus or minus 31.3 days should include about two-thirds of all intervals.

A study was made of several factors that might have an influence on the length of the calving interval. The year of breeding and the bull to which the cows were exposed both had a highly significant (probability of error less than 5%) effect on the length of the calving interval. The sex of the calf suckled and the age of the cows were not significant sources of variation in this trait.

Description of Study

The percentage calf crop weaned is one of the most important factors affecting the efficiency of beef production. The United States average is between 65 and 75 percent. It is probably similar in the state of Missouri. In some herds it may be 90 to 95 percent--in others less than 60 percent.

The data reported here were obtained from a herd in which breeding efficiency was very high over a period of 10 years. The records were studied in detail because it was thought that some of the findings might be beneficial to other cattle producers who desire to improve the percentage calf crop weaned in their herds.

The records used in this study were obtained from the herd of Morris DeWitt of Newburg. Newburg is in the Ozarks south and west of St. Louis. The ranch consists of approximately 3,000 acres, much of which is covered with timber, although there are many open areas where grass is grown. Available pastures are of high quality because of heavy fertilization and an improved pasture program.

Detailed records have been kept on the herd since 1951. Records for this study were for the years 1951 to 1960, inclusive, and included those on a total of 262 grade Hereford cows. Eleven different purebred Hereford bulls have been used in the herd. Some have been used for many years--others for only a few years. Pasture mating has been practiced with certain cows assigned to a particular bull each year.

Results and Discussion

The number of cow years involved in the study was 1,073 with an average of 4.10 per cow. Some cows produced from 1 to 3 calves whereas others produced 9 to 10. The percentage calf crop born was 98.6 and the percentage weaned was 93.4. One reason for this high calf crop was that cows were usually sold if they were open in the fall of the year at the end of the breeding season. In a few instances, cows which failed to calve through no fault of their own were not exposed to the bull until the next breeding season. Most of these cows were those thich calved late when purchased, and their dry period was only a few days longer than average.

Death losses between birth and weaning averaged only 5.2 percent. This is about half of the death loss usually encountered. No doubt close supervision and observation at calving, together with strict culling of cows which did not raise calves, were responsible for the low losses.

Reasons for Selling Cows

One hundred and sixty cows were sold from the herd during the 10-year period. They ranged in age from 2 to 13 years with an average age at the time of their sale of 6.61 years. Advanced age was the main reason for selling cows and those listed in this category ranged from 8 to 13 years of age with an average age of 10.64 years. The second most important reason for disposing of cows was that they produced light calves. Since cows in this group ranged from 2 to 9 years in age and averaged 4.68 years, some of them must have weaned light calves because of their advanced age. However, many of the cows sold for this reason were young and had not yet reached their most productive age.

A third important reason for selling cows was that they failed to conceive during the breeding season. Many of these were heifers but some were older cows that had been productive for many years.

Causes of Death Losses in Cows

Nineteen cows (7.25%) died during the 10-year period. This was less than 1 percent per year. Only four cows died because of calving difficulty which is further evidence of superior management.

Table 1--Reasons for Selling Cows and Age When Sold

Reason Sold	No. Sold	Range in Age When Sold	Avg. Age When Sold	% of Total
Cows too old	39	8 to 13	10.64	24.38
Produced light calves	38	2 to 9	4.68	23.75
Didn't breed	26	2 to 10	5.19	16.25
Bad udder or mastitis	14	2 to 9	7.86	8.75
Sickness	13	2 to 9	5.31	8.13
Injuries	9	3 to 9	6.89	5.62
Abortion	8	2 to 9	5.00	5.00
Cow undesirable	4	2 to 6	3.50	2.50
Produced late calf	4	2 to 3	2.33	2.50
Produced no milk	3	2 to 3	2.67	1.87
Cows were wild	2	5 to 12	8.50	1.25
Total & average	160	2 to 13	6.61	100.00

Table 2--Death Losses in Cows in the Herd in a 10-Year Period

Reason for Death	No. Cows Died	Range in Age	Avg. Age at Death
Cause unknown	7	2 to 10	7.86
Killed by lightening	2	4 to 5	4.50
Died from calving	4	2 to 4	2.50
Disease	2	6 to 12	9.00
Choked by neck chain	1		12.00
Cut by barbed wire	1		8.00
Shot by deer hunter	1		8.00
Killed on railroad	1		2.00
Total & average	19	2 to 10	6.42

Death losses and the number of cows sold during the 10-year period amounted to a replacement rate of 18 cows per year. This would represent a 10 to 15 percent replacement rate in a herd of 100 to 125 cows.

The Calving Interval

A study of the data on 827 calving intervals showed that 90 percent of the cows had less than 400 days between calves. Thirty-five cows had calving intervals of 461 days or more. This group included mostly cows that calved late one year and were not bred until the next year so an earlier calving date could be established. When the abnormal intervals were eliminated, the average interval between calves was 356.3 days.

Some Causes of Variations in Calving Intervals

Several factors affecting the length of the interval between calves by the same cow were studied.

Yearly variation. A highly significant difference (probability of error less than 5%) between calving intervals in different years was noted. The longest average interval of 371.6 days was observed in 1951; the shortest, 339.3 days, occurred in 1954. Several factors may be responsible for this year to year variation although it was not possible to study them in detail. Variations in the feed supply due to drouth or wet years or the time in the year that the cows were turned with the bull could be important.

Sex of calf suckled. Bull calves usually weigh from 30 to 40 pounds more than heifer calves at weaning. It is not known if this is because they are more efficient or because they cause the cows to give more milk. If cows nursing male calves give more milk, it may be that they would have a longer interval between calves. In this study the average interval between calves for cows nursing heifer calves was 355.7, compared to 356.9 for those nursing steer calves. This difference was not statistically significant.

Age of cow. The average interval between calves varied from a low of 354.2 days in 8-year old cows to a high of 373.0 days in cows that were 13 years of age. This difference due to age was not statistically significant.

Bull to which cow was exposed. The calving interval varied from a low of 340.7 for cows exposed to one bull to a high of 376.9 for cows exposed to another. The calving intervals varied twice as much in length for cows exposed to the latter bull, indicating that he failed to settle many of the cows that he bred. A statistical analysis of the data showed that the bulls to which the cows were exposed were a highly significant source of variation (probability of error less than 5%) in the calving intervals of the cows during the 10-year period.

PROJECT 397 and 400.

MISSOURI BEEF CATTLE TESTING STATION

R. K. Leavitt, H. B. Hedrick and W. E. Meyer

The Missouri Beef Cattle Testing Station is in its second year of operation. Only 36 bulls and 32 steers of several different breeds have been tested to date. Because of the small number of animals tested, it is difficult to make many conclusions.

Most cattle breeders are aware of variation that exists within individual herds in type and performance. To date there has been evidence of a wide variation in performance and carcass characteristics of cattle tested at the station. The most efficient animal required 562 lbs. of feed for 100 lbs. of gain and the least efficient animal required 968 lbs. of feed. The range in daily gain was from a low of 1.84 lbs. per day to 3.25 lbs. per day. Variation also existed in conformation scores at weaning and at the end of the test in both bulls and steers. There was also considerable variation in carcass characteristics of the steers slaughtered. Table 1 summarizes the more important carcass characteristics studied.

From an economic standpoint it is important to identify strains of cattle within the various breeds that will grow fast and efficiently and produce a desirable carcass. The central testing station along with on-the-farm testing can provide the breeder with information which will enable him to select the most desirable animals. Factors that can be measured in a Production Testing program, although variable in degree of heritability, can be useful in a breeding program designed for improvement of beef cattle in Missouri.

Table 1--Carcass Data of Steers from Beef Cattle Testing Station

	Average	Range Low-High
Carcass weight (pounds)	493.9	370.6 - 582.4
Percent 5 primal cuts[a]	62.19	58.36 - 65.52
Percent fat trim	11.26	6.74 - 16.45
Fat thickness 12th rib (mm.)	15.22	5.67 - 22.50
Rib-eye area (sq. in.)	10.52	8.49 - 12.78
Marbling score	Small$^-$	Practically devoid-moderate
Carcass grade	Good$^+$	Standard$^+$ - Choice$^+$

a Includes chuck with neck removed, rib, loin, rump, and round with shank removed. Fat in excess of 3/8 inch was removed.

PROJECT 3.

PROGRESS THROUGH SELECTION FOR THINNER BACKFAT

K. O. Zoellner, J. F. Lasley, B. N. Day, and L. F. Tribble

The main objectives of this study were to investigate the effectiveness of selection for thinner backfat, to gain information on the genetic associations between traits, and to determine if pigs with similar genetic backgrounds respond the same under different environmental conditions. Also being investigated are the possible physiological changes which may occur in swine as backfat thickness is reduced.

The project was initiated in 1958 by selecting females from a Poland China inbred line that had been maintained at the University of Missouri for several years. The females were mated to four purebred Poland China boars purchased from breeders in Missouri and Illinois. The spring 1959 litters were produced from these matings and insofar as possible the same matings were made for fall, 1959, farrowings. Descendants from these matings were then maintained as closed spring and fall lines. Attempts were made to select approximately 40 gilts and 6 boars from each generation to provide 30 litters for the next generation.

Replacement gilts and boars with least backfat were selected as parent stock for the next generation on the basis of their adjusted backfat probes (backfat adjusted to a weight of 175 pounds). Selection of replacements was made entirely on thinness of backfat, with the exception that animals showing abnormalities such as hernia, atresia ani, whorls, or seriously defective feet and legs were not used.

The expected progress in any selection program is dependent on two factors: (1) the average difference between the selected animals and the entire population from which they were selected (selection differential) and (2) the percent of the observed variation of a trait that is due to heredity (heritability estimate). The product of these gives the expected progress through selection.

In this study the selection differential has averaged 0.19 inches for the boars and 0.09 for the gilts, for an average selection differential of 0.14 inches.

Heritability estimates that have been reported for backfat thickness have indicated it to be about 46 percent heritable.

On the basis of heritability of backfat being 46 percent and selection differential 0.14 inches, the expected reduction of backfat would be (.46 x .14) or 0.06 inches per generation. However, the average reduction for boars was 0.08 inches and 0.12 inches for the gilts or an average reduction of 0.10 inches of backfat per generation or 0.04 inches more than expected.

Table 1 lists the adjusted backfat probes of pigs produced, by generation, season, and sex.

Analysis of the data from the base generation and first generation of offspring from selected parents indicates that litter size, weaning weights, and feed efficiency have not been affected by the reduction of backfat. Conformation subjective scores have significantly improved as backfat has been reduced. The analyses indicate that rate of gain decreased slightly when backfat was reduced.

Table 1--Adjusted 200 Lbs. Probes (Inches)

	Unselected Population				Selected for Breeders			
	Boars		Gilts		Boars		Gilts	
	No.	BF	No.	BF	No.	BF	No.	BF
<u>Spring Line</u>								
Foundation Stock	80	1.18	88	1.29	7	1.03	30	1.18
First Generation	73	1.07	82	1.15	7	.90	26	1.08
Second Generation	49	1.02	55	1.08	6	.87	26	1.05
<u>Fall Line</u>								
Foundation Stock	83	1.16	84	1.24	6	.92	28	1.14
First Generation	93	1.07	84	1.10	6	.88	27	1.02

Project 3 in cooperation with the USDA Regional Swine Breeding Laboratory

PROJECT 355.

LEVEL OF PROTEIN FOR BROOD SOWS DURING GESTATION

L. F. Tribble

Three trials involving 34 sows and gilts have been completed. Sows have been used in two trials and gilts in one trial. A protein supplement was fed at the rate of 1/2 lb. per head per day to the animals in one lot and at 1 1/4 lbs. to those in another lot. The supplement was composed of 62.5% soybean oil meal, 31% meat and bone scraps, 1% limestone, 2% salt, 2% bonemeal and 1.5% vitamin supplements. Corn was fed with the supplement to make a total of 4 to 5 pounds for a feeding.

The results have been variable and no consistent trend has been indicated. These results would indicate that for number of pigs farrowed and weaned, 1/2 lb. of a protein supplement is as satisfactory for sows and gilts during gestation as 1 1/4 lb. Birth weights were greater for pigs farrowed by sows and gilts fed the larger amount of supplement. Heavy birth weights are desirable and the lighter weights of the pigs from sows fed 1/2 lb. of supplement may be an indication that a level slightly higher than 1/2 lbs. but less than 1 1/4 lbs. would be the optimum level to feed.

PROJECT 355.

THE EFFECTS OF HIGH LEVELS OF ANTIBIOTICS AT BREEDING ON SOW PERFORMANCE

L. F. Tribble

In four previous trials, sows fed approximately 1/2 gram of a tetracycline antibiotic per head per day for 10 to 21 days at breeding farrowed 18.8 percent larger litters than sows not fed antibiotics.

Two trials were completed during the past year. The average results of these two trials did not show beneficial effect from the antibiotics for number of pigs farrowed or weaned per litter. Two sows out of 14 that were not fed antibiotics failed to settle and were not included in the farrowing and weaning results. All sows fed antibiotics settled on first service. Field tests with antibiotics have indicated an increased settling percentage; perhaps the antibiotics were of value in these tests in increasing the settling percentage.

PROJECT 141.

VALUE OF ADDING LYSINE TO DIFFERENT LEVELS OF PROTEIN FOR GROWING-FINISHING HOGS

L. F. Tribble

Quality of protein must be considered in evaluating proteins for hogs. The quality factor in protein is the quantity and balance of the essential amino acids. This research is concerned with an attempt to improve protein quality by adding amino acids to practical rations for growing-finishing hogs.

Six lots of 10 hogs each were fed in concrete lots from 50 to 200 lbs. The pigs were fed according to the following plan:

Lot 1	16% protein 50 to 125 lbs. and 12% from 125 to 200 lbs.
Lot 2	16% protein 50 to 200 lbs.
Lot 3	12% protein 50 to 200 lbs.
Lot 4	same as 1 + 0.1% lysine.
Lot 5	same as 2 + 0.1% lysine.
Lot 6	same as 3 + 0.1% lysine.

Results are shown in Table 1. Lysine was of no value when added to any of the levels of proteins. There was a difference in the performance of the pigs between protein levels. Pigs fed 16% protein from 50 to 125 lbs. gained faster

Table 1--Value of Adding Lysine to Different Levels of Protein For Growing-Finishing Swine

Lot	1	2	3	4	5	6
Level of Protein %	16-12	16	12	16-12	16	12
Lysine added %	0	0	0	0	0.1	0.1
			(50 to 125 lbs.)			
Avg. Daily Gain	1.51	1.51	1.23	1.51	1.46	1.07
Feed/lb. Gain	2.92	2.92	3.46	2.85	2.96	3.53
			(125 to 200 lbs.)			
Avg. Daily Gain	1.87	1.60	1.89	1.81	1.67	1.84
Feed/lb. Gain	3.66	4.12	3.41	3.72	3.94	3.72

and more efficiently than pigs fed 12% protein. During the period from 125 to 225 lbs., pigs fed 12% protein made faster and more efficient gains than pigs fed 16% protein. For the entire experiment pigs started on 16% protein and changed to 12% at 125 pounds, made the fastest and most efficient gains.

Results of this test and others in the past form the basis for the recommendation that growing-finishing pigs be fed 16% protein from weaning to 125 pounds and then changed to 12% for the remainder of the feeding period.

PROJECT 365.

MISSOURI SWINE EVALUATION STATION

R. K. Leavitt

The central testing station has become an important tool to many purebred swine breeders in Missouri. It supplements other testing programs such as Production Registry and meat hog certification. It supplies the breeders with accurate information on feed efficiency, daily gain, backfat probes and more detailed carcass data than are available otherwise. During the past year high frequency sound has been used to estimate the loin eye area on boars. This estimate is on a volunteer basis as requested by breeders. During the year about 250 boars have been sonorayed.

Breeders use the data in their selection and breeding program to make improvement in their herds.

Purebred breeders are not the only ones benefiting from the testing program. Commercial producers are purchasing tested boars from the Testing Station sales or from purebred breeders who are doing production testing to secure improvement in feed efficiency, growth rate, litter size and carcass quality.

In the 3 1/2 years that the station has been in operation approximately 1500 boars and barrows have been tested. Only about 75% of these have met the standards of the station. Of 1500, about 450 were barrows and 1050 boars. In 12 public auction sales about 675 boars have been sold. Approximately 100 boars have been taken home by consignors. The remainder that failed to meet station standards were sent to market for slaughter.

Producers are becoming aware of the fact that wide differences exist between individual animals. This is illustrated by the wide range of variation in the production factors checked. Feed efficiencies have ranged from a low of 255 lbs. to more than 350 lbs., daily gain from a high of 2.88 lbs. per day to less than 1 lb. per day, adjusted backfat probes from a low of 0.8 inches to over 2 inches.

Wide variation also exists in carcass measurements. Loin-eye areas have varied from less than 3 sq. inches to almost 6 sq. inches and the percentages of 4 lean cuts from a low of 45% to a high of 55%.

PROJECT 397.

ANATOMICAL CHANGES IN SOFT TISSUE DURING THE GROWTH AND FATTENING OF SWINE

W. G. Moody, M. Alexander, R. K. Leavitt

This experiment was undertaken to study in detail the anatomical changes in soft tissue and bone in live hogs at various stages of growth and/or fattening. Due to the number of measuring periods and the time needed to take each measurements, it was decided to use only ten pigs. The pigs were of similar breeding, age, and weight in this study.

Management and feeding ~~conditions~~ were standardized for all hogs throughout the experiment. Hogs were initially weighed and measured when they attained an average of 77 pounds. This selected weight was arbitrarily chosen since previous experience had shown that hogs between 70 and 100 lbs. were more conveniently restrained while making the ultrasonic measurements than hogs of lighter weights.

High frequency sound (HFS), ruler probe, tape and calipers were the basic instruments used to make the live animal measurements. The HFS instrument was used to measure both the fat thickness over the back (shoulder, loin, and rump) and the depth of seam or pocket fat in the ham. This instrument was especially useful in determining also the boundry and/or the size of the longissimus dorsi muscle at the various stages of growth. Table 1 presents the average estimated loin eye areas and their ranges at the various intervals. From this data it appeared that the loin eye muscle increased in size on the average about 0.02 of a square inch per day during the 70 day testing period. Growth of the loin muscle did not slow down as fattening progressed. However, only a drastic change of this type would have been easily detectable. This was obviously not the case since these animals continued to grow and fatten simultaneously.

Table 1--Average Estimated Loin Eye Area at Various Intervals of Growth

Measuring Intervals (Days)	Average Live Weight (lbs.)	Average Loin Area 10th Rib (Sq. In.)	Range Loin Area (Sq. In.)
0	76.4	1.93	1.41 - 2.56
14	104.3	2.20	1.44 - 2.94
28	129.9	2.37	1.52 - 3.20
42	156.8	2.57	1.96 - 3.23
56	186.3	2.77	2.00 - 3.33
70	208.6	3.12	2.27 - 3.74

The ruler probe was used in comparison with HFS to determine backfat thickness at similar locations along the back. A comparison of the average backfat thickness using these instruments is presented in Table 2. As backfat increased up to and beyond an inch (130 lbs. and up) the two measuring methods gave practically the same results. However, hogs at lighter weights (130 lbs. and down) with less than an inch of backfat gave more variation between the two methods.

HFS was used to detect the seam fat on the lateral (outside) side of the ham while the animals were restrained in the crate. Difficulty was encountered here since several muscle interfaces were observed on the oscilloscope and it was hard for the operator to distinguish the peaks derived from the muscles from those of fat. The peaks which were finally selected, however, were very similar in depth to those obtained at the 10th rib.

Duplicate loin eye tracings were made from every loin measurement during each of the 2-week measuring intervals. This procedure was performed to check the repeatability of two or more people (technicians) working independently "drawing in" the loin eye muscle while interpreting identical interface peaks. Also, two separate operators were used to operate the HFS instrument and record the selected interface peaks. This practice was followed on the same and different days by the same two operators.

Table 2--Average Live Hog Fat Determinations Made With Ruler Probe and High Frequency Sound (HFS)

Measuring Intervals (Days)	Average Live Weight	PROBE: 10th Rib 2" off Midline	PROBE: Ave. of 3 Sites (Sh., Loin, Rump)	HFS: 10th Rib 2" off Midline	HFS: Ham Pocket of Seam Fat
0	75.4	.56	.59	.77	.82
14	104.3	.81	.74	.90	1.13
28	129.9	.99	.99	1.10	1.01
40	156.8	1.09	1.13	1.12	1.00
50	186.3	1.27	1.33	1.28	1.12
70	208.6	1.50	1.53	1.58	1.30

Results of the repeatability study between two technicians and two operators are presented in Table 3. Here it may be observed that technician "A", and operator "A" are the same. In this example not only does each technician duplicate himself but he also cross-checks the work of the other technician. The major portion of the difference in size of the loin area drawn by each technician between testing periods (two week interval) is attributed to the increase in growth from one period to the next.

Table 3--Repeatability Study Between Technicians and Operators at the Same and Different Times

Technicians	Operators (Measured the Same Day): A	Operators (Measured the Same Day): B
A	2.52	2.48
B	2.57	2.63
	Two Week Intervals	
A	2.75	2.69
B	2.82	2.89

Carcass cut-out data were compared to the live animal measurements whenever applicable. The backfat thicknesses were: carcass, 1.55; HFS, 1.58; Probe, 1.53. Also the ham fat thickness was the same as the ham pocket fat determined by HFS on the live hog, although these measurements were not taken at the same location. Loin eye area in the carcass was 0.23 of an inch larger than estimated by HFS. The other carcass measurements could not be directly compared to the live measurements since they were taken differently.

It appears from a limited analysis of this data that carcass and live animal measurements can be closely associated. Also the repeatability between different technicians and operators can and should be determined to eliminate as much human error as possible. This is essential to obtain more valid information from the actual changes occurring in the animal during the various stages of growth and fattening. Work of this nature should provide a better understanding of growth and development which will enable us to more closely associate live animal characteristics with those in the carcass.

PROJECT 384.

USE OF HIGH FREQUENCY SOUND TO DETERMINE MEATINESS OF TEST STATION BOARS

W. G. Moody, M. Alexander, R. K. Leavitt

Several years of preliminary research have shown that HFS can be employed as a reliable method for determining both the backfat thickness and, most important, the loin eye area on live animals. Hence, the purpose of this study was to make practical use of HFS as an accurate method of determining meatiness in the live animal.

Boars from the University Swine Testing Station were selected for this study since they were to be sold and used as breeding sires throughout the state. Consequently, the information gathered from this work served as a valuable aid in evaluating individual meatiness characteristics of these boars.

One hundred and twenty-eight boars representing six breeds were measured with High Frequency Sound (HFS) whenever they individually attained 200 $\pm$ 10 pounds.

The boars were measured while restrained in a modified bleeding crate. The right side was clipped and 12 carefully selected angles of sound intercept were used to outline the loin eye muscle. To avoid obvious errors and to eliminate individual bias, a procedure was incorporated to include the judgment of two technicians working independently in estimating the loin eye area of each boar. The average of these final interpretations from the HFS measurements was used as the final loin eye area estimation. A correlation coefficient of 0.88 between these technicians indicated a highly significant relationship (probability of error less than .1%) between two persons estimating the size of the loin muscle from the same images.

A comparison was also made on 128 hogs between live probe and HFS backfat measurements taken at each of three sites on the back (shoulder, loin and rump). These data indicated no significant difference between the probe and HFS measurements.

Comparisons were made between live boar HFS measurements and littermate barrow carcass cut-out data. Table 1 presents averages from these comparisons. According to this information the boars and barrows had approximately the same size of loin eye muscle in contrast with previous work reported at this station in which littermate boars had loin eye muscles about 0.2 to 0.3 square inches larger than littermate barrows.

Table 1--High Frequency Sound Live Boar Loin Eye Measurements vs. Littermate Barrow Carcass Cut-Out

	Boars	Barrows
Loin Eye Area	3.99	4.03
Back Fat (10th Rib)	1.11	1.45

With this knowledge it was assumed that the HFS loin measurements were on the average underestimated approximately 0.25 of an inch. This assumption was further substantiated with previous carcass cut-out work in which the HFS loin eye was compared to the actual carcass tracing taken at the same location. The average HFS loin area in this case was also approximately 0.3 of an inch smaller than the actual area.

One of the reasons for this underestimation of the HFS loin area is the inability on the part of the operator to "trace in" the medial and lateral boundary of the loin muscle. Another very probable possibility attributing to this difference in size of loin area is the change in the shape and size of the muscle during the slaughtering, cooling and/or hanging process.

The fat measurements, however, between the two tested measuring methods, agreed closely with other work in that the barrows had about 0.3 of an inch more fat than littermate boars. Also HFS fat measurements and ruler probe measurements gave almost identical results when comparing fat thickness on the same animal.

This experiment was one of the first of its type and magnitude to employ High Frequency Sound on a practical basis for selecting superior breeding boars. From the highly favorable results and the popular acceptance of this work it is anticipated many similar projects will be conducted in the future.

PROJECT 142.

WINTERING EWES ON PASTURE AND CORN SILAGE A SUMMARY OF FIVE YEARS EXPERIMENTAL WORK

C. V. Ross and A. J. Dyer

The primary aim of all our tests with feeding pregnant ewes is to reduce cost of production. Since 1946, the research has been pointed toward maximum use of pastures and roughages. During the last five years studies have been made of methods of wintering ewes using a combination of winter pasture and corn silage. Pasture has been practically the sole source of nutrients until the first part of January, then supplemented corn silage has furnished nutrients until ewes and lambs could be turned to pasture in the spring.

The seven experiments conducted were designed to obtain information on the kind and amount of protein rich feeds required to supplement corn silage for pregnant ewes.

In each case, ewes were pastured on bluegrass and fescue from breeding dates, beginning in most cases in mid-October, until the first part of January. Then they were divided into uniform groups for the comparison of supplements fed in addition to corn silage free choice.

A flock of 60 three-year old Northwest ewes were used in the tests during 1957-58 inclusive. Then 100 large smooth-skin Texas ewes were added. Comparisons made are outlined below:

Years	Comparison
1956-1957	0.33 lb. soybean oilmeal vs. 15 lb. soybean oilmeal per ewe daily.
1957-1958	Switched groups of ewes on treatment and repeated the test.
1958-1959	0.35 lb. soybean oilmeal vs. .89 lb. ground alfalfa hay and .35 lb. ground corn per ewe daily. (Protein supplement allowances per ewe daily were equal in protein and energy).
1959-1960	(A) The experiment of 1958-1959 was repeated.
	(B) Compared were: 0.42 lb. soybean oilmeal, 0.24 lb. soybean oilmeal plus 0.18 lb. ground corn, and 0.05 lb. soybean oilmeal plus 0.37 lb. ground corn per ewe daily.
1960-1961	A. Experiment A was repeated but baled alfalfa hay was used instead of ground hay. Experiment B was repeated using three levels of dehydrated alfalfa meal plus corn

instead of soybean oilmeal plus corn. Levels tested were: 0.99 lb. dehydrated alfalfa meal, 0.59 lb. dehydrated alfalfa meal plus 0.24 lb. corn, and 0.12 lb. dehydrated alfalfa meal plus 0.51 lb. corn per ewe daily.

RESULTS:

In every test, the ewes on all treatments produced strong healthy lambs and appeared to suckle them satisfactorily, even though in some instances the protein content of rations were as low as 6.93 percent. There were no cases of pregnancy disease in any of the ewes, which confirms other work indicating that there has never been a case of pregnancy disease diagnosed among ewes which have been wintered on excellent bluegrass of fescue pasture.

In spite of the fact that strength and growth of lambs were not apparently affected by levels of protein as low as 9.2 percent, there was some evidence that it was below optimum levels. These indications were:

(a) Reduced feed consumption.
(b) Reduced fleece weight.
(c) Slipping of wool.
(d) Slightly reduced birth weights.

The effect of the lower protein levels was most noticeable in yearling ewes and much reduced for the same ewes with their second lamb crop.

Source of protein evidently has no effect on ewes since alfalfa was quite evidently equal to soybean oilmeal in each of three tests.

The observation made in an early investigation that pregnant ewes could not consume adequate quantities of corn silage to meet their needs appears to be incorrect.

The system of management which includes the use of a good growth of permanent pastures such as bluegrass or fescue followed by corn silage free choice plus 0.33 lb. soybean oilmeal (44% crude protein) appears to be a practical and economical way of wintering ewes. Replacing the soybean oilmeal with the equivalent in protein and energy furnished by alfalfa hay and corn may even be less expensive and is just as satisfactory.

CURRENT PROJECTS IN ANIMAL HUSBANDRY

Beef Cattle

- Improvement of Beef Cattle Through Breeding
- Rations for Fattening Cattle
- Production of Feeder Calves
- Beef Cattle Testing Station

Swine

- Performance Testing of Swine
- Method of Selection and Breeding for Swine Improvement
- Protein Nutrition of Swine
- Factors Affecting Sow Performance
- Evaluation of Some Economic Traits of Swine

Sheep

- Some Factors Affecting Productivity of Ewes
- Reproduction of Sheep
- Lamb Fattening

Nutrition

- Ruminant Digestion
- Mineral Balance
- Roughage Changes

Breeding

- Endocrine Secretions in Reproductive Physiology of Farm Animals
- Anatomy of Reproduction

Meats

- Meat Tenderness
- Tolerances of Meat Storage
- Meat Acceptability
- Improving the Objective Identification of Swine,
- Economic and Technological Problems in Marketing Pork and Beef
- Objective Indices of Meatiness
- Meat Quality

AVAILABLE PUBLICATIONS

B618	Improving Livestock Through Breeding
B627	Fattening Two Year Old Steers
B628	Winter Rations for Feeder Calves
B641	Corn Substitutes for Fattening Cattle
B646	Fattening Comparisons - Steers vs. Heifers
B703	Water Livestock the Automatic Way
B708	Learn to Live With Nitrates
B753	Management Plans for Finishing Yearlings
B756	How Swine Reproduce
B757	Learn to Predict Inheritance in Breeding Herds
C523	All Weather Stock Tank
C665	Grass Silage
C667	Good Fences for Your Farm
C673	Farmstead Re-arrangements
C731	Profitable Pork Production in Missouri
Folder 9	Livestock Pasture Farming
Folder 19	Concrete Barnyard Pavement and Feeding Floors
Folder 24	Here's Help for You on Grain Storage
Folder 33	Restoring Drought Pastures
Folder 36	Housing for Calves
C248	The Value of Manure
Memo:	Feeding, Processing and Handling for Beef Cattle
C703	Missouri System for Early Lambs
C704	Missouri System for Late Lambs
Folder 46	Probing - An Aid in Production of Meat Hogs
Folder 84	Standard Measurements for Pork Carcasses
RP119	Principles of Record of Performance in Beef Cattle
B750	Managing Missouri Pastures