1966-67 Livestock Research Report

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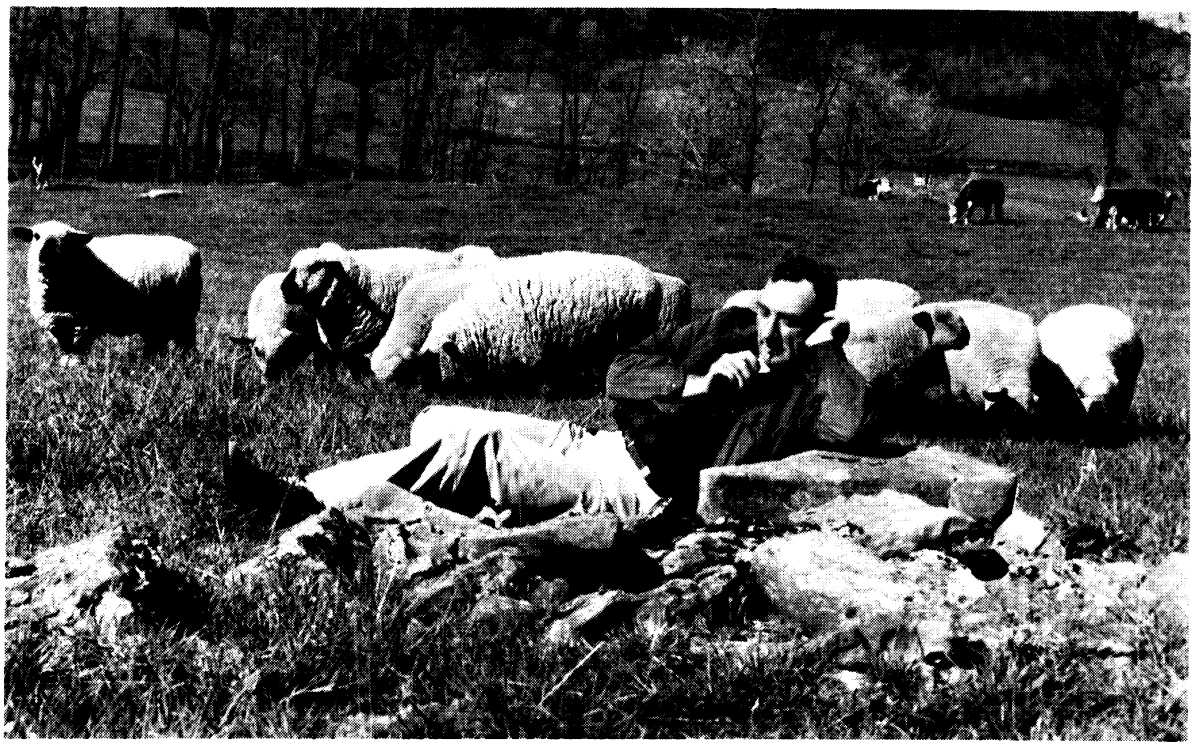
Dedication

A MOMENT OF RESPECT
by
G. W. Litton



Joseph Stafford Moss, one of the great stockmen of our time, expired February 1, 1967. But time can hardly dim his influence in livestock fields. His spirit of accomplishment will live in every improved Hampshire sheep, with all the steers on bluegrass pasture, and as long as there are some of us who love the land.

Frances, Mrs. Moss, spent her time between home and the hospital for about a year before Joe's death, and apparently she didn't like the separation, because she departed this life only 52 days after Joe.

The character, integrity, love, and friendship of these 2 fine people was best exhibited through their regard for their family. The oldest son, Bob, was the subject of much pride and many compliments at every meeting, and is now managing the family enterprise in Burkes Garden. Their daughter Anne, Mrs. Lloyd Davies of Richmond, hung up Joe's sun every morning, and was the cause of a forlorn look on her parents' faces when she "left the nest" to marry Lloyd. Then there is Joe Moss, Jr., who inherited a love and ability for football, and is enjoying a highly successful profession as a coach at V.P.I., previously having coached a prep school team, and at the University of Kentucky.

Joe's father, Mr. R. S. Moss, signed my diploma from V.P.I., as he did for about half of the ones who have graduated from here. He was Rector of the V.P.I. Board of Visitors for many years.

Joe and Frances were both elders in the Presbyterian Church. Joe was a director of the Farmers Bank of Tazewell County and served as its land appraiser. He was a life-long director in the Tazewell Farm Bureau, and past president of the Tazewell Branch of the Southern States Cooperative. He was a past president of Burkes Garden Ruritan Club and was chairman of the Wool Selling Committee for Burkes Garden for 20 years. He was chairman of the Tazewell County Road Committee for Service Clubs. He was a director in the Abingdon Production Credit Association, and a member of the Virginia Livestock Council. He was a great supporter of the Southwest Virginia Experiment Station where he gathered ideas for feeding cattle grain on grass. He continuously used his farm and facilities for educational benefits to the state and nation, for he helped train 4-H and college judging teams, and was host to literally scores of tours, field days and demonstrations.

Joe Moss was best known for his superior ability as a breeder of Hampshire sheep. The Lawson and Moss flock was started in 1896 by the late R. M. Lawson and under Joe's hand this flock helped bring the title to Burkes Garden of "Hampshire Sheep Throne of America". He was in the group enroute to the Buck and Doe Farm when the idea was born to establish the now famous Eastern Stud Ram Sale at Staunton, Virginia, and he served on the committee from 1942 until 1962. He put 18 Hampshire ewes and 3 rams in the first sale, and was a consignor for some 20 years. In that time, he produced more champions than any other flock in America. This flock was in the top 10 of the country in terms of genetic contribution to Hampshires, according to a study published by R. C. Carter in the Journal of Heredity, Vol. 56, 1965.

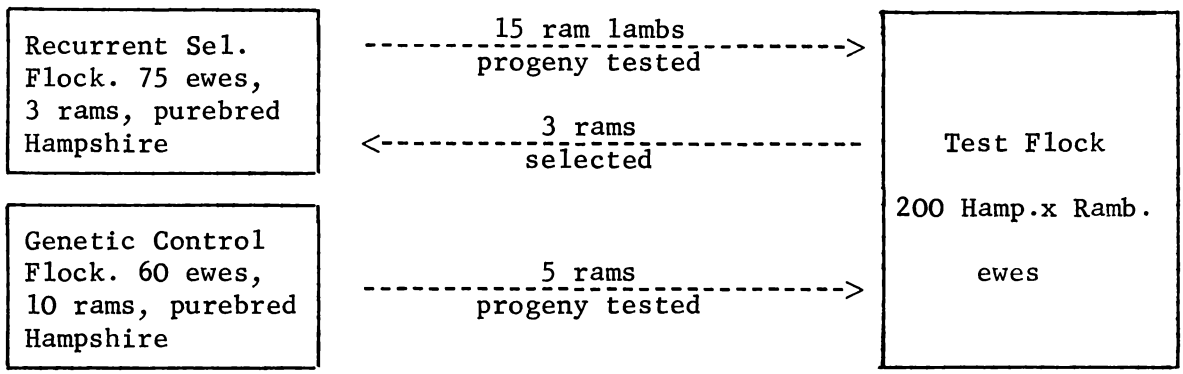
We respectfully dedicate our 1967 Animal Science Research Report to this great contributor to Animal Agriculture and the betterment of the world in which he lived, our beloved friend Joe Moss.

RECURRENT SELECTION AS A BREEDING METHOD FOR IMPROVING GROWTH RATE IN SHEEP

R. C. Carter, W. H. McClure, J. S. Copenhaver and F. S. McClaugherty
(Contributing to Southern Regional Project S-29)

An experiment to evaluate the effectiveness of Recurrent Selection as a method for improvement of the breeding value for growth rate in Hampshire rams, has been underway since 1956. A flock of purebred Hampshires was assembled that year by purchases from a number of breeders, with as wide a range of geographic diversity as possible. Ewes and rams were obtained from flocks in California, Oregon, as well as from the Eastern United States, including a flock established on recent imports from England, and from already established flocks of the V.P.I. Animal Science Department. This flock, known as the recurrent selection flock, consists of 60 to 75 ewes and three rams.

Each year 15 ram lambs from the recurrent selection flock are progeny tested by breeding each to 10 ewes in a test flock of 200 Hampshire x Rambouillet crossbred ewes. These 15 rams are evaluated according to the average growth rate of their lambs from birth to market or weaning weight. The three rams whose progeny have the highest average growth rate are selected to go into the recurrent selection flock each year, replacing the three rams used the previous year. The diagram below shows the breeding scheme.



A genetic control flock, based on the same foundation stock as the recurrent selection flock is maintained without selection, as a base from which to measure progress made by recurrent selection. Each year five rams, produced in the genetic control flock, are also progeny tested along with the 15 recurrent selection rams. Comparison of the average growth rate of the lambs sired by the two groups of rams provides a measure of genetic improvement made in the selection flock.

Results

Progeny test comparisons were made between rams from the recurrent selection and genetic control flocks in 1963, 1965 and 1966. (No progeny test was carried out in 1964 due to replacing the test flock with a group of young ewes from the same source as the original test flock). The progeny averages and ranks of the individual rams is shown in the table.

In 1963, two genetic control rams were tested along with 12 rams from the recurrent selection flock. The genetic control rams ranked 6th and 13th out of the 14 tested. Average progeny daily gain from birth to market or weaning was .61 lb. for the progenies of the 12 recurrent selection rams vs. .59 lb. for the genetic control. In 1965 five genetic control rams were progeny tested. The rank of their progenies in growth rate was 5th, 9th, 17th, 19th and 20th out of the 20 rams tested. The average daily gain was .52 lb. for the progenies of the 15 recurrent selection rams vs. .48 lb. for the 5 genetic control sires. In 1966 the ranks were 10th, 15th, 16th, 18th and 19th, out of 20 for the genetic control rams. Progeny average daily gain was .64 lb. for the recurrent selection and .59 lb. for the genetic control rams.

These results are encouraging and indicate that real genetic progress is being made in the breeding value of the recurrent selection rams for transmitting rapid growth rate to their lambs.

AVERAGE DAILY GAINS[1] AND RANK OF PROGENIES
RECURRENT SELECTION AND GENETIC CONTROL RAMS

1963				1965				1966			
Recurrent Selection		Genetic Control		Recurrent Selection		Genetic Control		Recurrent Selection		Genetic Control	
Rank	Prog. ADG	Rank	Prog. ADG	Rank	Prog. ADG	Rank	Prog. ADG	Rank	Prog. ADG	Rank	Prog. ADG
1st	.665			1st	.562			1st	.709		
2	.643			2	.556			2	.704		
3	.632			3	.550			3	.669		
4	.625			4	.546			4	.667		
5	.622					5th	.538	5	.666		
		6th	.619	6	.533			6	.663		
7	.616			7	.518			7	.654		
8	.604			8	.515			8	.643		
9	.600					9th	.515	9	.642		
10	.595			10	.511					10th	.626
11	.592			11	.510			11	.625		
12	.590			12	.509			12	.621		
		13th	.562	13	.507			13	.617		
14th	.556			14	.506			14th	.611		
				15	.492					15th	.603
				16	.470					16th	.598
						17th	.463	17th	.596		
				18th	.462					18th	.592
						19th	.456			19th	.549
						20th	.425	20th	.534		
Av.	.62		.59		.52		.48		.64		.59

[1] 1963 and 1966 adjusted to single wether lamb, 1965 adjusted to twin ewe lamb.

PERFORMANCE OF EWES OF DIFFERENT BREEDING UNDER TWO ENVIRONMENTS

(Cooperative with Canada Department of Agriculture)

R. C. Carter and F. S. McClaugherty, V.P.I. Research Division
G. M. Carman, Canada Dept. of Agriculture

An experiment to compare the performance of ewes of different breeding under two different environments was carried out in cooperation with the Canada Department of Agriculture from 1959 through 1965. Two groups of ewes of rather widely different breeding and geographic origin were used. One was a group of 3/4 Hampshire - 1/4 Rambouillet backcross ewes produced in Virginia; the other was North Country Cheviot x Leicester crossbreds produced in Quebec. Sixty ewes of each cross were used. A random sample of 30 ewe lambs of each breed cross group was transferred to each of the two locations, the Southwest Virginia Station at Glade Spring, Virginia; and the Central Experimental Farm, Ottawa, Ontario, in December, 1959.

The ewes were bred as yearlings in the fall of 1960. Three Suffolk rams were used each year and the rams replaced annually. Rams were obtained in Canada or the U.S. in alternate years. Due to a difference in customary breeding at the two locations, August 1 to September 30 at Glade Spring and November 1 to December 15 at Ottawa, the same rams could be used at both locations in the same year.

Five lamb crops were produced, 1961 through 1965. The ewes and lambs were handled according to customary good husbandry at each location. Lambs were grazed with their mothers on permanent pasture, without supplemental grain feeding, until they reached market weight or were weaned. Lambs not heavy enough for marketing or slaughter (85-110 lbs.) when weaned were finished with grain feed on pasture or in dry lot. A sample of each crop of lambs was slaughtered each year and detailed carcass observations recorded.

Results and Discussion

Results averaged over the 5 years are shown in tables 1, 2 and 3. Table 1 is concerned with ewe productivity, table 2 with lamb weights, growth rates and grades, and table 3 with carcass traits.

The greatest indication of a differential response of the two groups of ewes to the environments was in reproductive performance. In Virginia 92% of the Hampshire ewes lambed but only 77% of the Cheviot-Leicester crosses. In Ontario there was only a little difference between the two groups in lambing percentage, 93.4 and 92.1%, respectively. The Hampshire cross ewes averaged 3 weeks earlier in lambing date in Virginia but one day later in Ontario. The Cheviot-Leicester ewes were more prolific at each location, averaging 0.2 more lambs per ewe lambing than the Hampshires,

the difference being essentially the same at both locations. Fleece weights were slightly heavier in the Virginia group with the Cheviot-Leicester fleeces averaging 1/3 to 1/2 lb. heavier at both locations.

TABLE 1. EWE PRODUCTIVITY. TOTAL OR AVERAGE FOR 5 YEARS 1961-65

	Virginia		Ontario	
	HxHR	NCCxL	HxHR	NCCxL
No. ewes bred	122	123	122	114
No. ewes lambing	112	95	114	105
Lambs born	179	171	187	191
Lambs born alive	163	163	174	186
Lambs weaned	149	149	171	173
Ewes lambing of ewes bred	91.8%	77.2%	93.4%	92.1%
Lambs born per ewe bred	1.47	1.41	1.53	1.68
Lambs born alive per ewe bred	1.33	1.33	1.43	1.63
Lambs weaned per ewe bred	1.22	1.21	1.34	1.52
Lambs born per ewe lambing	1.60	1.82	1.64	1.82
Lambs born alive per ewe lambing	1.46	1.72	1.53	1.77
Lambs weaned per ewe lambing	1.33	1.57	1.44	1.65
Lbs. lamb weaned per ewe bred	117	112	100	117
Lbs. lamb weaned per ewe lambing	128	145	107	127
Average lambing date	15 Jan.	6 Feb.	16 Apr.	15 Apr.
Fleece weight	6.31	6.85	6.10	6.48
Fleece grade or count	56's	46's	58's	48's
Body weight of ewes (fall)	151	149	130	138

Average performance of lambs from the two groups of ewes at the two locations is shown in table 2. These values are adjusted (least squares) means with the effects of year, sex and twinning removed. Lambs from the Hampshire cross ewes were 0.5 lb. heavier at birth in Virginia but 0.4 lb. lighter in Ontario than the Cheviot-Leicester crosses. Lambs from the Cheviot-Leicester ewes had faster growth rate from birth to weaning at both locations, the difference amounting to about 0.03 lb./day. There were similar but somewhat wider differences in adjusted 120-day weight amounting to from 2 to 5 lbs. in favor of lambs from the Cheviot-Leicester ewes.

Live and carcass grades are hard to compare between the two locations. In Virginia most of the lambs were sold alive with live slaughter grades being taken on each lamb by a committee of three graders. In Ontario all lambs were slaughtered and graded in the carcass. The lambs from the Hampshire cross ewes graded about 1/5 of a grade higher (alive) in Virginia while the reverse was true of the carcass grades in Canada.

TABLE 2. GROWTH RATES, WEIGHTS AND GRADES OF LAMBS
1961-65

(Least Squares Means)

Station	Virginia		Ontario	
Breed Cross of Ewe	HxHR	NCCxL	HxHR	NCCxL
Birth weight	10.2	9.7	9.4	9.8
120-day weight	81.0	82.2	74.8	80.0
Average daily gain to weaning	0.55	0.57	0.54	0.58
Slaughter (live) grade[1]	13.2	12.6		
Carcass grade[2]			1.38	1.22

[1]Only live slaughter grade available on most of the Virginia lambs.
grade code: 13 = U.S. Choice, 10 = U.S. Good.

[2]Only carcass grades available on Canadian lambs.
grade code: 1 = first grade (equivalent to U.S. Choice)
2 = second grade (equivalent to U.S. Good)
3 = third grade (equivalent to U.S. Utility)

(note for carcass grade on Canadian scoring system, the lower numerical value indicates the higher grades).

Adjusted means for carcass traits of the lambs slaughtered for detailed carcass study are shown in table 3. Carcass weights and yields were essentially the same for both groups in Virginia but those from the Cheviot-Leicester ewes were heavier and had a higher dressing percentage in Ontario. Lambs from Hampshire ewes graded higher in Virginia but lower in Ontario. Area of the loin eye muscle, adjusted to 50 lb. carcass weight, were substantially larger in Ontario than Virginia but there were only slight differences between the two kinds of ewes. Similar differences were found in fat thickness at the 12th rib.

Weight of the legs, loin and rack and the percentage these cuts were of total carcass weight were higher in Canada for both kinds of ewes, but differences between lambs from the two kinds of ewes were small at either location. The reverse was true of weight and percentage of shoulder, neck and breast. This suggests some systematic difference in cutting or measuring between the two locations.

TABLE 3. CARCASS CHARACTERISTICS OF LAMBS
(Least Squares Means)
1961-65

	Virginia		Ontario	
	Hamp.	NCL	Hamp.	NCL
Carcass weight, lbs.	45.9	45.4	43.4	46.8
Carcass yield, %	48.6	48.5	43.2	47.8
Carcass grade[1]	1.10	1.30	1.20	1.12
Eye of loin (sq.in./50 lb.car.wt.)	2.02	1.97	2.51	2.42
Fat thickness, in.	.211	.209	.239	.247
Weight leg, loin, rack	22.98	22.52	25.93	25.73
Percent	50.45	49.95	55.15	55.07
Weight shoulders, neck, breast	20.98	20.88	18.30	19.47
Percent	40.80	40.86	39.53	39.45

[1]Carcass grades 1 = Choice, 2 = Good (U.S. equivalent).

The principal objective of the experiment was to determine if important genotype x environment interactions were likely to exist in sheep. On statistical analysis of the data, the following significant interactions were found:

Characteristic	Probability Level
Pounds lamb weaned per ewe mated	<.05
Average lambing date	<.001
Fleece weight	<.05
Ewes lambing of ewes mated	0.1>P>.05
Birth weight	<.01
120-day weight	<.01
Average daily gain	<.05
Carcass weight	<.001
Carcass yield	<.001
Weight leg, loin, rack	<.01
Weight shoulder, neck, breast	<.01

It seems evident, both from the levels of significance shown above and from the mean values in table 1, that there were important genotype x environment interactions in reproductive performance of the ewes. They simply did not perform the same relative to each other at the two locations. This emphasizes the importance of local adaptation of ewe breeds.

In the lamb performance traits, significant interaction between breed cross of ewe and location were shown for birth weight, daily gain and 120-day weight of the lambs. While statistically significant the actual magnitudes of the differences involved in the interaction was of the order of 0.4 lb. birth weight, .01 lb. daily gain and 2.0 lb. weight at 120 days, not large enough to be of great economic importance.

The significant breed cross x location interactions in carcass weight, carcass yield and carcass grade are interpreted as reflecting similar interaction in growth rate and 120-day weight. All are probably a measure of the same phenomenon. The significant interaction for weight of leg, loin and rack, and shoulder, neck and breast, might reflect differences in slaughtering and cutting procedure between the two locations rather than a true interaction. Since there was no indication of interaction when these two values were transformed to percentages of carcass weight, this suggestion is strengthened.

PERFORMANCE TESTING RAMS

W. H. McClure, G. A. Allen, Jr. and R. C. Carter

Farm production testing of purebred sheep was started in Virginia purebred sheep flocks in 1955 with five flocks participating. By 1961, the number of purebred flocks participating had grown to 35 and the program was generally popular with the purebred sheep breeders.

In 1961, the Virginia Purebred Sheep Breeders contacted the Virginia Agricultural Experiment Station and Extension Service requesting their help in setting up and carrying out such a ram feeding program. The Experiment Station agreed to conduct the trial on an actual cost basis. Thus a uniform feeding test to evaluate ram gain and potential breeding value was initiated at the Shenandoah Valley Research Station in 1962.

For the 1962 test, an inspection committee selected the rams on the farm, with preference being given to high gaining rams from purebred flocks on the production testing program.

For the 1963, 1964 and 1965 test, only rams from performance tested flocks were eligible for nomination to the test. To qualify for the test, the lamb index or adjusted 120-day weight of the ram was required to rank within the top 25% of the ram lambs in his individual flock. In other words, no ram was accepted for the trial unless his 120-day weight was within the top 1/4 of his flock.

During the four years that the test was conducted, a total of 339 yearling rams, 217 Hampshire, 47 Southdown, 46 Suffolk, 25 Dorset, and 4 Cheviot were fed. Sixty of the Hampshire rams were consigned by the Experiment Station from the Recurrent Selection project.

In late January of each year, rams eligible for the test were delivered to the Experiment Station. Before being accepted for the test, each ram was subjected to a stern inspection by a committee of breeders and Extension service representatives for desirable type qualities. In addition, each ram was thoroughly checked by an Extension Veterinarian for unsoundnesses such as bad mouths, malformed testicles, footrot, bad feet or pasterns. Only healthy, well grown and physically sound rams were accepted.

Prior to the beginning of the feed test, a three-week adjustment period was used during which time the rams were sheared, vaccinated and treated several times for internal parasites. In February of each year, the rams were placed on the official 91-day feeding test. The rams were penned according to breed and weight, and self-fed a ground ration consisting of 50% ground ear corn, 25% alfalfa hay, 18% peanut hulls and 7% soybean meal. The rams were weighed at two-week intervals during the test and treatments for internal parasites were given at intervals as the need was indicated by fecal tests.

The feeding tests ended in May, at which time the ration was reduced and the rams were vigorously exercised daily. The rams were sheared again about two weeks prior to the annual sale. Prior to the sale, the rams were again thoroughly checked by the breeders committee and the veterinarian, and a semen check was run on each ram.

To be eligible for the sale, each ram was required to pass the type, physical soundness and semen checks. In addition, each ram was required to have an average daily gain on test or a 16-month adjusted weight that was within 25% of the average of his respective breed.

Just prior to the sale, each ram was graded by a committee consisting of representatives of the Market Grading Service of the Virginia Department of Agriculture, Extension Service, Experiment Station and the Purebred Breeders Association. Grading was done on a basis of AA, Fancy; AA-, Fancy minus; A+, Choice plus; A, Choice; A-, Choice minus; and G+, Good plus.

The rams remained the property of the individual breeders until they were sold at a sale sponsored by the breeders in late June or early July each year. In making up a sale order for the rams, equal emphasis was placed on grade and test gain. The sales have been extremely popular with purebred and commercial sheep breeders, and the averaged selling price has grown from slightly over $80 per head in 1962 to $104 per head in 1965.

The average daily gain for each breed for the four years is shown in Table 1. With the exception of Southdowns, there was a trend toward faster gains each year. Part of this is due to refinements in feeding and management techniques, and certainly part of it reflects the efforts on the part of the sheep breeders to produce faster growing sheep. In each case the average daily gain in 1965 was greater than the mean of the four years.

TABLE 1. AVERAGE DAILY GAIN

	Dorset	Hampshire	Southdown	Suffolk
1962	.53	.60	.48	.74
1963	.52	.60	.47	.75
1964	.60	.68	.44	.88
1965	.57	.72	.52	.87
Mean	.56	.65	.47	.82

The feed conversion figures are shown in Table 2. The Suffolks required the least amount of feed per pound of gain, and made the fastest gains.

TABLE 2. FEED PER POUND OF GAIN

	Dorset	Hampshire	Southdown	Suffolk
1962	10.82	10.95	10.44	9.50
1963	10.67	10.46	10.36	8.99
1964	9.88	10.34	11.86	9.08
1965	11.22	10.74	11.88	10.04
Mean	10.62	10.60	11.22	9.52

Table 3 shows the ram weights at the beginning and end of the test each year. Again with the exception of Southdowns, the rams tended to be heavier at the beginning and end of the test during each progressive year.

TABLE 3. RAM WEIGHTS - BEGINNING AND END OF FEED TEST

	Dorset		Hampshire		Southdown		Suffolk	
1962	136	181	148	199	112	153	137	201
1963	127	174	148	202	108	150	130	198
1964	147	191	171	221	123	157	160	225
1965	150	202	161	227	111	158	171	250

Since numbers were greatest in the Hampshire breed, Table 4 shows the relationship between grade and price in a four-year summary for the Hampshires that were sold.

The AA grade indicates a type and quality excellent enough to qualify a ram for stud use in top purebred flocks. AA- rams would be of stud caliber for most purebred flocks and A+ rams for some purebred flocks and for top commercial flocks. The A or choice grade was considered to represent a top commercial ram, and the Good plus generally represented our average commercial rams.

TABLE 4. RELATION BETWEEN GRADE AND PRICE

Hampshires - 4 Yr. Summary

Grade	Number	A.D.G.	Price
AA	3	.80	$203
AA-	8	.62	148
A+	38	.68	112
A	51	.63	89
A-	33	.64	78
G+	12	.66	71
G	2	.66	72

Considerable emphasis was placed by the buyers on grade or type, but the Hampshires gaining .65 or over sold for an average of $104, and the rams gaining below the average of the breed sold for $86.00 each. It seems that the buyers generally placed about equal emphasis on grade and performance in purchasing the rams.

In order to study the relationship of a ram's growth potential or gain at different age periods to the growth rate of the lambs he sires, a more complete study has been conducted on Hampshire rams consigned by the Experiment Station to this feed test. These rams are placed on a post-weaning feed trial immediately after weaning, then bred to 10 commercial ewes each to affect a progeny test, and then placed on the yearling feeding test. Thus the pre-weaning, post-weaning, yearling gain and mature or 16-month weight of these rams may be correlated to the growth rate of the lambs sired by them.

In summary, it is evident that the practice of selling unfitted, closely shorn rams with growth records on a grade and gain basis has become a sound management procedure in Virginia, and is popular with both the breeder and the potential ram buyers. As a matter of fact, the purebred sheep breeders are now selling yearling and ewe lambs with growth records, shorn, graded and unfitted in conjunction with the performance tested rams.

On the basis of information available at the present time, there are indications that the 16-month weight is the best indicator of a ram's ability to sire fast gaining lambs.

The success of the ram feeding tests may be best measured by the fact that the Virginia Purebred Sheep Breeders Association has now completely taken over this project, and is conducting a very successful annual feed test and sale on private premises.

INTENSIVE LAMB PRODUCTION METHODS

Research on management methods that will permit the carrying of much larger numbers of sheep on the average farm, than is now practical, has been carried out for several years at both the Glade Spring and the Blacksburg stations. Results of this work at both stations for 1963 through 1966 is presented below.

The principal hazard to concentration of large numbers of sheep on a restricted acreage is the increased level of disease and parasite infection that usually results from grazing too many sheep on too few acres. It has frequently been said that "a sheep's worst enemy is another sheep." Mature ewes develop a resistance to worms and can be concentrated fairly heavily on pastures. In fact there is some evidence to indicate that level of worm burden is lower where pastures are grazed heavily, than where grazed at moderate or light rates. Lambs, however, become severely infected with worms during the late spring and summer, when grazed with their mothers at moderate to heavy stocking rates.

If intensified sheep production is to be successful, some method to avoid the infection of lambs by internal parasites must be found. This really means breaking the chain of infection from the ewe to the lamb. Two systems have been studied for a number of years and show promise of success. These are (1) early weaning and rearing the lamb away from its mother, and (2) grazing ewes and lambs (not weaned) on separate pastures.

Early Weaning of Lambs

R. C. Carter and J. S. Copenhaver

Early weaning of lambs, and rearing them to market weight away from their mothers, is an effective procedure to reduce internal parasite infection in the lamb. Lambs have been weaned successfully at various ages from a few days to several weeks. Usually, however, early weaning implies weaning at 8 to 12 weeks of age. The milk production of the ewe falls off rapidly after 10 to 12 weeks of lactation so that there is no large loss in nutrition of the lamb from weaning at this age.

In the experiments reviewed here lambs were weaned at two dates: (1) at the beginning of the grazing seasons, usually about April 20; and (2) after the ewes and lambs had grazed together on permanent pastures for 4 to 6 weeks, or in late May or early June. The latter cannot be called early weaning.

It has been found that lambs born in the winter (January to early March), as is the common practice in most of Virginia, have a very low level of internal parasite infection by the beginning of the grazing season in mid-April. When turned to pasture with their mothers the buildup of worm load is fairly slow during April and May but increases rapidly after the first of June.

Experiments with early and late weaning of lambs have been conducted at Blacksburg over the four years, 1963 through 1966. Lambs are weaned at two dates: (1) at the beginning of the grazing season (about April 20), and (2) at the time the first draft of lambs were marketed (late May-early June). The weaned lambs are grown out to market weight under two feeding-management systems: (a) in dry lot; and (b) on pasture with supplemental grain, self-fed. Both groups were fed a pelleted complete ration, those in dry lot received a limited amount of high quality alfalfa hay. The pastures were permanent bluegrass-white clover, and were grazed continuously (not rotated). The composition of the pelleted ration is shown below.

V.P.I. Lamb Ration No. 1

Dehydrated alfalfa meal (17% Protein)	35.0%
Ground yellow corn	5.0
Soybean oil meal (44% Protein)	10.0
Cane molasses	5.0
Vitamin D premix	*

* To give 1700 I.U. Vitamin D per lb. feed

The lambs were from grade and crossbred ewes. In 1963 and 1964 they were sired by Shropshire rams; in 1965 by Hampshire x Southdown crossbred rams; and in 1966 by Hampshire rams. The lambs were marketed at intervals of about three weeks, at minimum weights of 85 to 90 lbs. (average about 95 lbs.). Each lamb was graded when marketed or removed from the test by a committee of three working independently, one of whom was the official state grader at the local auction market.

Experimental Treatments

Treatment 1. Control Ewes and lambs were grazed together on permanent bluegrass-white clover pastures with lambs given the pelleted ration in a creep feeder. The stocking rate was about 2 ewes and 3 lambs per acre.

Treatment 2. Lambs were weaned at the beginning of the grazing season (average date April 22) and turned on bluegrass pasture with access to the pelleted ration in a self feeder. Stocking rate was approximately 12 lambs per acre of pasture.

Treatment 3. Lambs weaned at the beginning of the pasture season (same dates as for Treatment 2) and placed in open sheds, with pelleted ration self-fed with a limited feed of high quality alfalfa or alfalfa-grass hay.

Treatment 4. Lambs and ewes were turned to pasture at the beginning of the grazing season (same dates as lambs in Treatments 2 and 3 were weaned) without creep feeding. All lambs heavy enough by late May or early June (average date June 10) were marketed, the remaining weaned. Those not of market weight were turned on pasture with the pelleted ration self-fed as in Treatment 2. This treatment was used only in three of the four years (1963, '64 and '65).

Treatment 5. Lambs and ewes were turned to pasture at same dates as Treatment 4, (average date April 22); lambs of market weight marketed by June 10, and remaining lambs weaned. The weaned lambs were finished to market weight in dry lot the same as Treatment 3.

All treatments extended over the four-year period except Treatment 4 which was used only in the first three years, 1963 to 1965.

Results

The results for the four years (three years for Lot 4) are shown in Tables 2, 3 and 4. Weights, gains and live grades are shown in Table 2, and feed consumption in Table 4. Table 3 shows the performance of lambs, in the Control group (Lot 1) by wet years and dry years, which were significantly different.

TABLE 2. LAMB PERFORMANCE, EARLY AND LATE WEANED AND CONTROL LAMBS, BLACKSBURG 1963-66

(Unweighted Averages of Year Means)

Treatment Lot	No. Lambs	No. Ewes	Av. Initial Wt.	Av. Market Wt.	Av. Daily Gain	Av. Slaughter Grade
1. Control, Ewes & Lambs grazed together with creep feed	88	17	57.5	94.5	.56	14.4 (C+)
2. Early Weaned, Lambs finished on pasture	87		55.0	94.5	.51	13.9 (C+)
3. Early Weaned, Lambs finished in dry lot	89		50.2	94.3	.61	14.4 (C+)
4. Late Weaned, Lambs* finished on pasture	72		54.3	94.7	.45	13.3 (C)
5. Late Weaned, Lambs finished on dry lot	85		53.5	95.0	.51	14.3 (C+)

* Three years' observation only for Lot 4, all other treatments include 4 years.
Grade Code: 13 = Av. Choice; 14 = Choice +; 15 = Prime minus

1. Lambs in the Control Lot, grazed with their mothers, with the pelleted ration, did quite well during 1963, 1964 and 1966, which were abnormally dry for this location. During these three years their average daily gain was excellent, 0.64 lb. per day, and their average slaughter grade Prime minus, both of which exceeded any other treatment for three years. In 1965, however, a year with rather heavy rainfall, the lambs did

poorly, averaging only 0.39 lb. daily gain and average Choice in grade. Parasite levels were much higher in 1965 than in the dry years, as indicated by external symptoms. Two lambs died before weaning in 1965; none in the other years. The average consumption of the creep ration was 85 lbs. per lamb during the dry years, and 78 lbs. in 1965; the daily consumption per lamb was substantially higher, 1.28 lbs., than in 1965, 0.82 lb.

2. In Treatment 2, with early weaned lambs finished on pasture with the pelleted ration self-fed, the average daily gain was 0.51 lb. and average slaughter grade Choice plus. The average feed consumption per lamb was 125 lbs. of the pelleted ration at the rate of 1.9 lbs. per lamb per day. In each of the years some or all of the lambs in this treatment had digestive disorders, 2 to 4 weeks after weaning, usually after rains. Two lambs died in 1963, one in 1965 and none in 1964 or 1966. Post-mortem diagnosis of cause of death was pneumonia.

3. Early weaned lambs, finished in the dry lot had the fastest daily gains, averaging 0.61 lb./day, for the four years, and equalled any other treatment in average market grade (Choice plus). They did not equal the lambs in the control lot during these dry years however. Total feed costs, not including pasture, were highest in this group, however. No lambs were lost following weaning.

4. Lambs in Lot 4, late weaned and finished on pasture had the lowest daily gain, 0.45, and slaughter grade, average Choice, of any of the treatment groups. These growth rates and grades were not considered satisfactory, and the treatment discontinued after three years. Total feed cost was lowest for this group however.

5. Lambs weaned late and finished in dry lot made satisfactory gains, 0.51 lbs., and grades, Choice plus. Their feed consumption was moderate, approximately half that of the early weaned lambs finished in dry lot.

It should be pointed out that the average feed per lamb, and average feed cost was calculated only on those lambs that were weaned and finished either on pasture or in dry lot. If the lambs that were marketed had been included, the average cost per head would have been substantially lower. In 1963, six of 45 lambs in these two groups were marketed on May 30; in 1964, 18 of 56 were sold on June 18; in 1965, 5 of 46 were ready by June 17; and in 1966, 18 of 25 by June 10.

TABLE 3. LAMB PERFORMANCE; LOT 1, CONTROL GROUP ONLY

By Wet and Dry Years

Years		Av. Daily Gain	Slaughter Grade	Feed Consumption (Pellets) Per lamb	Per lamb/day
Dry years	1963, '64, '66	.62	14.7 (P-)	84.7 lb.	1.43
Wet year	1965	.39	13.4 (C)	78.0	.82

TABLE 4. FEED CONSUMPTION, AV. OF 4 YEARS EXCEPT LOT 4, AV. 3 YRS. ONLY

Treatment Lot	Total Per Lamb		Av. Per Lamb/Day		Cost Per Lamb
	Pellets	Hay	Pellets	Hay	
1. Control	83 lbs.		1.3		$3.11
2. Early Weaned, Pasture	125		1.9		4.69
3. Early Weaned, Dry Lot	177	46	2.6	0.5	7.56
4. Late Weaned, Pasture*	53		1.5		1.99
5. Late Weaned, Dry Lot*	93	16	2.2	0.4	3.81

Feed Values: Pelleted Ration No. 1 $75.00/ton; Alfalfa Hay $40.00/ton.
*Feed consumption and cost based only on lambs weaned and finished on pasture or in dry lot.

Discussion and Conclusion

Some definite conclusions and recommendations for on the farm application seem fortified from the results. Certainly adoption of some of these practices would permit increases from four to ten times the numbers of sheep now carried on the average Virginia farm.

1. The results from the control group, in which the ewes and lambs were grazed together with the lambs given the pelleted ration in a creep, were surprising, particularly in the dry years. The stocking rate of 2 ewes and 3 lambs per acre was too low, even in the dry years, and gross understocking in 1965, the year of rather heavy rainfall. Certainly 3 ewes and their lambs could have been carried per acre during the dry seasons and 6 to 8 ewes during the wet season. During seasons of normal to heavy rainfall, however, one should expect fairly heavy levels of parasite infection at the heavier stocking and it would probably be necessary to wean a good proportion of the lambs by early June, to be finished in dry lot.

2. Early weaning of lambs, 60-75 days of age and around 50 lbs. in weight, shows much promise for really large increases in sheep numbers on the average sheep farm. Dry ewes, following weaning can, and no doubt should, be concentrated on poorer pastures, or at heavy stocking rates, say 10 to 12 per acre on good pastures, until 2 to 3 weeks before breeding time. Finishing the weaned lambs in dry lot seems to be the preferred practice, even though the total feed cost is higher than for those finished on pasture. However, earlier work at the Virginia station indicates that if really excellent pasture, say near pure stands of ladino clover, is available, the early weaned lambs do quite well on pasture. Unfortunately, such pastures are difficult to establish and maintain on uplands and in dry seasons. This system could be combined with feeding the lambs green chop if desired.

3. The practice of turning ewes and lambs together on pasture for the first 6 weeks of the grazing season, then marketing the heavier lambs and weaning the remainder, permits considerable increase in numbers carried, with less outlay for feed and building space than required under early weaning. From 2 to 3 ewes and their lambs can be carried per acre of pasture until the lambs are weaned or marketed. After weaning the ewes would be crowded on a small acreage, or carried on sparse pasture until 2 to 3 weeks before breeding time. This system would work particularly well with a cattle grazing operation. The ewes and lambs would utilize the surplus pasture in the spring and early summer leaving most of the available grazing to the cattle during the summer, where pastures are least productive.

We have observed that dry ewes, crowded on a limited acreage of grazing, actually have a lower parasite level than if given a lower acreage. Presumably by keeping the pasture quite short, the larvae, hatching from the worm eggs, are much more exposed to the sun, and the ewes do not become reinfected at so high a rate.

Grazing Ewes and Lambs on Separate Pastures

F. S. McClaugherty and R. C. Carter

The spread of worms from ewes to the lamb may be greatly reduced, if not eliminated, by grazing ewes and lambs on separate pastures. The lambs are not weaned and are allowed to nurse their mothers in a barn or dry lot for part of each day. This system will permit stocking rates of 3 to 4 ewes and their lambs per acre of good bluegrass pasture.

Research on separate pasture grazing of ewes and lambs has been conducted for four years (1963-66) at the Glade Spring Station. The lambs are not weaned but are together with their mothers in well ventilated barns (Burly tobacco curing barns) from about 8:00 A.M. to about 4:00 P.M. During the remainder of the 24-hour period they are grazed on separate pastures from their mothers.

Three groups of ewes and lambs were used in this experiment as follows:

1. Conventional Control:

   Ewes and lambs were grazed together on the same pasture, without creep feed.

2. Grazed Separately, With Creep Feed:

   Ewes and lambs grazed on separate pastures but were together, in a barn for about 8 hours per day. Lambs had access to creep feed while in the barn. In the first two years (1963-64), the creep feed was coarsely ground shelled yellow corn. In 1965 and '66 however, the creep feed was a pelleted ration (See Ration I below).

3. Grazed Separately, No Creep Feed:

Ewes and lambs were handled the same as in treatment 2 above, except the lambs had no creep feed.

All pastures were permanent bluegrass-white clover sods. The trials were started at the beginning of the grazing season, about April 20, each year. Lambs were weaned and removed from the experiment at intervals of about three weeks at minimum weights of 90 lbs. The experiment was closed about July 15 each year with any remaining lambs weighed, graded as live slaughter lambs, and weaned.

Results

The results are shown in Table 1, separately for each of the four years as well as the 4-year average. The 1963 and 1966 grazing seasons were near normal so far as rainfall was concerned. There was a severe drought in 1964 and pastures in the latter part of the season were short and dry. In 1965 rainfall was above normal.

In three of the four years lambs grazed separately from their mothers made somewhat faster gains than the control group, with the overall average advantage of 0.04 lb. gain per day. They also averaged slightly higher in slaughter grade at weaning. Lambs grazed separately from their mothers and fed coarsely ground shelled corn in a creep (1963 and 1964 only) gained an average of 0.46 lb. per day, slightly less than those in Lot 3 (0.48 lbs./ day) grazed separately but with no creep feed. The creep fed lambs graded slightly higher however. In the last two years (1965-1966) the creep fed lambs received a pelleted complete ration gained an average of 0.62 lbs. daily compared to 0.36 for those handled similarly but with no creep feed. They averaged top choice in grade compared with choice minus for the non-creep fed lambs in Lot 3 for those two years. The average daily consumption of the pelleted ration was 2 1/4 times as high as that of the cracked corn, indicating that it was much more palatable.

TABLE 1. GRAZING EWES AND LAMBS ON SEPARATE PASTURES

Glade Spring, 1963-66

Treatment Lot:		Year	No. Lambs	Av.Daily Gain	Slaughter Grade	Feed Per Lamb/Day
1. Control: Ewes & Lambs grazed together; no creep feed		1963	23	0.49	11.9	
		1964	19	0.35	10.1	
		1965	24	0.32	10.6	
		1966	22	0.39	13.2	
	Total or Av.		88	0.39	11.9	
2. Ewes In & Out; lambs creep fed	corn	1963	26	.53	13.1	.93
		1964	18	.39	12.7	.81
	Av.	(63-64)		.46	12.9	.87
	pellets	1965	26	.63	13.6	2.12
		1966	21	.62	14.2	1.77
	Av.	(65-66)		.62	13.9	1.95
	Total or Av.	(4 yrs.)	91	.54	13.4	1.41
3. Ewes In & Out; no creep feed		1963	27	.54	12.9	
		1964	19	.41	12.0	
		1965	26	.34	10.9	
		1966	22	.38	13.9	
	Total or Av.		94	.42	12.4	

Grade Code: 11=Good Plus; 12=Choice Minus; 13=Average Choice; 14=Choice Plus

VERY EARLY WEANING - MULTIPLE LAMBING

J. S. Copenhaver and R. C. Carter

Weaning lambs at 30 to 40 days of age, rearing them to market weight in confinement on slotted floors, and immediately rebreeding the ewes to raise more than one lamb crop in a 12-month period, has been very successfully accomplished by Dr. D. F. Watson of the Veterinary Science Department on a laboratory scale, and by Copenhaver and Carter of the Animal Science Department with small numbers in a pilot test. In 1964 research on this method of intensive lamb production was expanded to a farm-sized operation with some 225 ewes involved.

The objectives were:

1. To test the method of early weaning and multiple lambing with lambs reared on slotted floors, on a larger scale, approaching a farm sized operation, in comparison with conventional management of ewes and lambs.

2. To investigate continuous confinement of ewes in dry lot or barns, under multiple lambing and early weaning.

3. To compare various breeds and breed crosses of ewes for suitability under intensive production systems.

Experimental Procedure

Ewes of four breeds or breed crosses were compared: Purebred Dorset, Dorset x Rambouillet crosses, high grade Rambouillet, and Suffolk x Rambouillet crosses. Forty purebred Dorset ewes were taken from the V.P.I. Animal Science Department flock. The Rambouillet ewes (50 head) were purchased from a rancher near San Angelo, Texas, and the Dorset x Rambouillet crosses (50 head) were purchased from several producers in the vicinity of El Reno, Oklahoma. Seventy-seven Suffolk x Rambouillet crossbreds were purchased from a dealer in Virginia and were reported to have originated in the vicinity of Alpine, Texas. The Dorset ewes were of mixed ages but were mostly yearling to three years old at the beginning of the experiment. The Rambouillet and Dorset x Rambouillet crosses were fall born lambs and were purchased at weaning in the spring of 1964. The Suffolk x Rambouillet crosses were spring born lambs and were purchased as yearlings in early summer, 1964. Obviously, the Dorsets and Suffolk x Rambouillet crosses had some age advantage over the Dorset x Rambouillet crosses and Rambouillets.

Management Methods

Three management methods were compared.

1. Early weaning - Multiple lambing.

Following lambing, ewes and lambs were kept on slotted floors in open sheds for 30-40 days with lambs having access to creep feed. Lambs were weaned at about 5 weeks and continued on slotted floored pens with a ground

hay-grain ration self fed. The ewes were immediately turned with rams on pasture, following weaning, for rebreeding. Approximately 40 ewes of each of the four breeds or crosses were used in this treatment. They were divided into two breeding groups of 80 each, 20 of each of the four kinds. One of these groups of 80 was bred to lamb in January and February and again in July and August. The second group was bred to lamb in April-May and October-November.

2. Complete Confinement of Ewes.

Ewes were confined in barns or dry lots at all times except for 30-40 days following lambing when they were in slotted floor pens with their lambs. Ewes were fed 2 lbs. of mixed hay per day until 4 weeks before lambing when they were given 3/4 lbs. of additional grain. When nursing lambs they were fed 1 1/2 lbs. of grain and 2 1/2 lbs. of hay or 1 1/2 lbs. of grain and 4 lbs. of corn silage (when available). Only Suffolk x Rambouillet ewes were used with this method. They were bred for January-February and July-August lambing.

3. Conventional Control.

Ewes were bred to lamb once per year for January to March lambing and nursed their lambs to slaughter weights. Lambs and ewes were handled conventionally being grazed on permanent pasture and lambs creep fed. Ten ewes of Dorset x Rambouillet, Rambouillet and Suffolk x Rambouillet groups were included in the conventional control test.

Results and Discussion

The results of a two-year comparison of early weaning and multiple lambing, where lambs were weaned at approximately 5 weeks of age and were reared on slotted floors, with conventional management of ewes and lambs, where ewes lambed once a year and nursed their lambs to market weight, are shown in table 1. The conventional ewes had more lambs per mating than the ewes that were in the early weaning-multiple lambing treatment. This difference may be due to management differences. The conventional ewes were bred in August and September when ewes are normally cycling whereas the other ewes were divided into two groups, one being bred to lamb in January, February and March and rebred for July, August and September lambs, while the second group was bred to lamb in April, May and June and rebred for October, November and December lambs. A number of these ewes did not lamb because they were exposed to the ram during the season (March, April, May and June) in which very few of them normally come in heat. Another reason is that a portion of the ewes that were expected to lamb in January and February, lambed in late February and March and didn't have a chance to get rebred to lamb in July, August and September. The ewes that were bred for April, May and June lambed in April but didn't perform very well in October, November and December because they don't normally cycle in April, May and June.

The early weaned-multiple lambing ewes raised .38 lamb more per year than the controls because they lambed twice in a year.

The Control lambs reached slaughter weight 15 days earlier than the early weaned lambs which can be partially explained by an outbreak of coccidiosis in the early weaned lambs during the summer of 1966. This outbreak slowed up gains and caused these lambs to reach market weights at older ages.

TABLE 1. EARLY WEANING - MULTIPLE LAMBING VS. CONVENTIONAL MANAGEMENT (CONTROLS)
Suffolk x Rambouillet, Rambouillet, and Dorset x Rambouillet Ewes
2 years, 1965-66

	Early Weaned Multiple Lambing	Conventional Control
No. ewe years	225	60
Total matings	443	60
Total lambings	237	49
Lambs born	335	71
Lambs raised	306	59
Lambs born/mating	.76	1.18
Lambs born/ewe lambing	1.41	1.45
Lambs born/ewe year	1.49	1.18
Lambs raised/mating	.69	.98
Lambs raised/ewe lambing	1.29	1.20
Lambs raised/ewe year	1.36	.98
Av. birth weight	10.7	9.35
Av. daily gain, birth-market	.53	.58
Av. slaughter weight	93.3	93.0
Av. slaughter age	163	148
Av. slaughter grade	14.4 (Ch +)	14.0 (Ch +)

The results of the comparison of lambing season under early weaning-multiple lambing are shown in table 2. The ewes lambing in April, May, and June and in October, November and December performed better than the ewes lambing in January, February and March and again in July, August and September. They had .12 lamb more per ewe mated, .24 lamb more per ewe lambing, and .22 lamb more per ewe year; and they raised .13 lamb more per ewe mated, .26 lamb more per ewe lambing, and .24 lamb more per ewe year. These differences are due to the higher percentages of twin lambs dropped by the ewes lambing in April.

TABLE 2. COMPARISON OF LAMBING SEASON UNDER EARLY WEANING - MULTIPLE LAMBING SYSTEM
Suffolk x Rambouillet, Rambouillet, and Dorset x Rambouillet Ewes
2 years, 1965-66

System	Early Weaning, Multiple Lambing	
Lambing Season	Jan.-July	Apr.-Oct.
No. ewe years	113	112
Total matings	223	218
Total lambings	126	121
Lambs born	156	179
Lambs raised	140	166
Lambs born/ewe mated	.70	.82
Lambs born/ewes lambing	1.24	1.48
Lambs born/ewe year	1.38	1.60
Lambs raised/ewe mated	.63	.76
Lambs raised/ewe lambing	1.11	1.37
Lambs raised/ewe year	1.24	1.48

The results of the comparisons of breed or breed crosses of ewes under early weaning-multiple lambing are shown in table 3. The performances of the Dorset and Dorset x Rambouillet ewes are quite similar. The Dorset ewes had a few more twins while a slightly higher percentage of the Dorset x Rambouillet ewes lambed. The Dorsets raised .06 lamb more per ewe year than the Dorset x Rambouillets. Both groups raised 86% of lambs dropped, gained at the same rate and showed almost the same slaughter grades.

The Rambouillet ewes did not perform as well as the other kinds of ewes. Only 39% of those mated produced lambs and only 29% of those lambing had twins. Death losses in this group were slightly lower than in the other groups, but this was probably due to fewer twin lambs being born.

The Suffolk x Rambouillet ewes excelled the other kinds of ewes. Ninety-one percent of these ewes lambed, 63% of those lambing had twins and 94% of the lambs were raised. Lambs from these ewes gained .02 pound per day faster than lambs from the other kinds of ewes.

These ewes were about 6 months older at the start of the experiment than the Dorset x Rambouillet, Rambouillet and 1/2 of the Dorset ewes. This age difference might account for some of the differences in performance of these ewes.

TABLE 3. BREED OR BREED CROSS OF EWES UNDER EARLY WEANING - MULTIPLE LAMBING
2 years, 1965-66

Breed or Cross	Dorset	Dor.x Ramb.	Ramb.	Suf.x Ramb.
No. ewe years	70	74	75	76
Total matings	131	144	150	149
Total lambings	82	96	58	83
Lambs born	127	129	71	135
Lambs raised	109	111	68	127
Ewes lambing/ewes mated	.62	.67	.39	.91
Lambs born/ewe mated	.97	.90	.47	.91
Lambs born/ewe lambing	1.55	1.34	1.22	1.63
Lambs born/ewe year	1.81	1.74	.95	1.78
Lambs raised/ewe mated	.83	.77	.45	.85
Lambs raised/ewe lambing	1.33	1.16	1.17	1.53
Lambs raised/ewe year	1.56	1.50	.91	1.67
Lambs raised/lamb born	.86	.86	.96	.94
Av. birth weight	10.8	9.4	10.4	10.4
Av. daily gain				
birth-weaning	.53	.56	.54	.61
wean-market	.49	.46	.50	.51
birth-market	.50	.50	.51	.52
Slaughter grade	15.4 (P-)	14.8 (P-)	14.2 (Ch+)	14.6 (P-)

The results of comparisons of ewes in confinement with ewes on pasture in an early weaning-multiple lambing system are shown in table 4. The ewes in confinement excelled the ewes on pasture when lambed in January, February and March but didn't do as well as those on pasture when lambed in July, August and September. Some of the difference in number of ewes lambing is due to a sterile ram that was mated to the confined ewes that were to lamb in July, August and September of 1966. Seventeen percent more of the confined ewes lambed in January, February and March and they had 6% more twins than the ewes that were run on pasture. In July the pasture ewes had .19 lamb more, and raised .24 lamb more per ewe lambing than the confined ewes.

TABLE 4. EWES IN CONFINEMENT VS. EWES ON PASTURE IN EARLY WEANING - MULTIPLE LAMBING SYSTEM
Suffolk x Rambouillet Ewes
2 years, 1965-66

	Jan. Lambing		July Lambing	
	Confined	Pasture	Confined	Pasture
Ewes mated	52	37	51	36
Ewes lambing	48	28	14*	21
Lambs born	73	41	14	25
Lambs raised	71	38	12	23
Lambs born/ewe mated	1.40	1.11	.27	.69
Lambs born/ewe lambing	1.52	1.46	1.00	1.19
Lambs raised/ewe mated	1.37	1.03	.24	.64
Lambs raised/ewe lambing	1.48	1.36	.86	1.10
Av. birth weight	9.6	10.2	12.6	11.2
Av. daily gain, birth-wean.	.57	.60	.62	.56
Av. weaning weight	30.6	31.8	37.6	33.6
Av. weaning age, days	37.1	36.3	41.9	35.4

* Sterile ram in July, 1966 confinement group, only 3 of 25 ewes lambed.

The average number of pounds of feed per pound of gain and the total pounds of feed eaten per lamb by seasons is shown in table 5.

The composition of the ration fed is shown below:

35% ground alfalfa x orchardgrass hay
50% ground yellow shelled corn
10% soybean oil meal
5% molasses

This ration was fed as a ground ration except for the group of lambs born in July, August and September of 1965 when it was pelleted and Vit. A and D were added. Vit. A and D were added to the ration fed the lambs born in April, July, August and September of 1966.

The total fed per lamb varies from a low of 259 lbs. eaten by lambs born in April of 1965 to a high of 374 lbs. eaten by the lambs born in January, February and March of 1965. In June of 1966 lambs born in January, February, March and April were found to be heavily infected with coccidiosis which may explain some of the differences in feed requirements of the April lambs of 1965 and the April lambs of 1966 but does not help to explain why the January, February and March lambs of 1965 required 66 lbs. more feed than those born in January, February and March of 1966. More work is needed to explain these differences.

TABLE 5. AVERAGE FEED CONSUMPTION OF LAMBS, GROUND HAY-GRAIN RATION, INCLUDING CREEP FEED BEFORE WEANING BUT NOT EWES' FEED

Year	Season	Lb. Feed/ Lb. Gain	Total Feed Per Lamb
1965	January	4.57	374 lb.
	April	3.16	259
	July	4.27	350
	Oct.	3.19	261
1966	January	3.78	308
	April	4.03	330
	July	4.34	356

HIGH SILAGE RATIONS FOR FATTENING LAMBS

W. H. McClure and J. P. Fontenot

Results of recent research at the Virginia Forage Research Station indicated that yearling cattle could be fattened to a desirable slaughter grade on a ration of high quality corn silage and a protein supplement. In view of the success obtained from feeding corn silage for fattening beef cattle, a trial was conducted in 1965-66 to study the value of corn silage and the relative value of two levels of grain supplementation for fattening low-grade native feeder lambs.

Experimental Procedure

Eighty native feeder lambs weighing approximately 70 lb. initially were used in a feeding trial conducted at the Shenandoah Valley Station. The lambs were utility grade feeders purchased from a local livestock auction market. Prior to the start of the trial the lambs were shorn, vaccinated against enterotoxemia and treated for internal parasites. The lambs were allotted into eight lots according to breed, sex and weight which were fed the following rations:

Lots 1 and 5 - Corn silage, full fed and 0.40 lb. soybean meal daily.
Lots 2 and 6 - Corn silage, full fed, 0.40 lb. soybean meal daily, plus limited shelled corn.
Lots 3 and 7 - Corn silage, full fed, 0.40 lb. soybean meal daily, plus a high level of shelled corn.
Lots 4 and 8 - Self-fed a conventional 40:60 ground hay and concentrate ration.

The corn silage used in the test was of rather low grain content because of drought conditions during the growing season. The silage tested 39% dry matter. Limited ground shelled corn was fed to Lots 2 and 6 at a level of approximately 0.75% of bodyweight daily. Ground shelled corn was fed to Lots 3 and 7 at the rate of approximately 1.5% of bodyweight per lamb per day. The hay and concentrate ration fed to Lots 4 and 8 contained 40% ground alfalfa hay, 55% ground shelled corn and 5% molasses.

Vitamins A and D were added to the soybean meal for Lots 1, 5, 2, 6, 3 and 7 at a level of 2500 I.U. of vitamin A and 625 I.U. of vitamin D per pound. The hay and grain ration contained 250 I.U. vitamin A and 65 I.U. vitamin D per pound of complete ration. A mineral supplement containing 2 parts trace mineral salt, 1 part defluorinated phosphate and 1 part ground limestone was fed free choice.

At the beginning of the trial the lambs receiving silage were full-fed once daily. A change to twice daily feeding increased consumption and reduced wastage. Soybean meal and corn were fed on top of the silage. The troughs were cleaned out each morning before feeding. The consumption figures in table 1 reflect the total amount of silage given to the lambs, with no allowance being made for silage wasted or refused. The lambs receiving the hay and grain ration were self-fed.

The lambs were slaughtered in January, 1966 after a 78-day feeding test.

Results

The results of the trial are given in table 1. Silage consumption decreased as the level of corn fed increased. Lambs fed only corn silage and soybean meal gained 0.26 lb. per day. The gain increased with level of grain supplementation. Average daily gain of lambs fed corn silage and supplement, plus corn at the highest level (Lots 3 and 7) was the same as for the lambs self-fed the conventional hay-concentrate ration (Lots 4 and 8). Feed efficiencies were good for the silage-fed lambs. Using current feed prices, the feed cost per pound of gain would be substantially less for the silage-fed lambs than for those fed the conventional hay-concentrate ration (Lots 4 and 8). Among the silage-fed lambs, feed cost per pound of gain would increase with grain level.

Average carcass grade for the lambs fed no supplemental grain (Lots 1 and 5) was between low and average choice. The grade for the lambs fed the other three rations averaged between average and high choice. Dressing percentage was very good for the lambs fed all rations.

TABLE 1. HIGH SILAGE RATIONS FOR FATTENING LAMBS

	Corn silage			Hay-grain
Grain level	none	low	high	
Lots	1 & 5	2 & 6	3 & 7	4 & 8
Initial wt., lb.	72.0	69.6	69.8	69.0
Final wt., lb.	90.3	94.1	100.8	100.6
Daily gain, lb.	0.26	0.31	0.40	0.40
Daily ration, lb.				
Corn silage	5.68	5.07	3.88	
Soybean meal	0.40	0.40	0.40	
Corn		0.62	1.23	
Mixed ration				3.34
Feed per lb. gain, lb.				
Corn silage	21.8	16.4	9.7	
Corn		2.00	3.08	
Soybean meal	1.54	1.29	1.00	
Mixed ration				8.35
Carcass grade[a]	12.6	13.6	13.8	13.6
Dressing %	53.2	54.1	54.2	53.6

[a]Code: 12 = low choice; 13 = av. choice; etc.

FLOTATION AS A MEANS OF ARTIFICIALLY CONTROLLING THE SEX RATIO IN RABBITS

G. J. More O'Ferrall, T. N. Meacham and W. E. Foreman

It is known that in mammals the male produces two types of sperm, one carrying a Y-chromosome, which is male determining, the other carrying an X-chromosome, which is female determining. These sperm fertilize the ova, carrying an X-chromosome, produced by the female to give male (XY) or female (XX) zygotes. Thus, in order to control the sex ratio in mammals, the two types of sperm would have to be separated prior to artificial insemination. Should a successful method be found, it would be of great economic importance to the livestock industry throughout the world.

Recent experiments by various research workers using electrophoresis, centrifugation and sedimentation techniques have indicated that a successful method may be found in the not too far distant future.

The present report describes the attempts to separate rabbit sperm into two fractions by means of froth flotation and the results obtained when the two separate sperm fractions were used to artificially inseminate female rabbits. The method of froth flotation has been used successfully for many years in the mining industry for separating different minerals and has recently been used to separate different types of microorganisms.

Experimental Procedure

Seven male and twenty-seven female rabbits of the New Zealand White breed produced a total of 78 litters from 177 inseminations over a nine-month period from August 1966 to April 1967.

Semen was collected from the males by means of an artificial vagina. On collection, the volume, motility, sperm concentration per cc and pH of the semen were determined. Provided the semen was of good quality, it was diluted 1:10 with Ringers solution (pH 8.1) and two-thirds was then put into the flotation cell, to which a controlled amount of air was supplied by means of a pressure vacuum dyno pump. A separation of the semen into two approximately equal sperm fractions was usually obtained in less than one minute. These sperm fractions were designated "Float" (F) and "Sink" (S) depending on whether the sperm was carried over in the flotation froth or remained in the flotation cell. The remaining one-third of the diluted semen was retained for control inseminations.

A series of eight experiments (lots of inseminations) were carried out, in which the female rabbits were randomly divided into three approximately equal groups for insemination with the control, float and sink sperm fractions, respectively. For the first three experiments, the flotation procedure was similar to that described above. In the following three experiments only the

top or first float fraction (TF) was collected for the float inseminations. The flotation was then run beyond the usual end point and this middle sperm fraction was discarded. The sperm remaining in the bottom of the cell (BS) was used for sink inseminations. In the remaining two experiments, the seminal plasma was removed from the sperm prior to flotation. The sperm was then separated into the two fractions and reconstituted with the seminal plasma prior to insemination.

Results

There were no differences in the sex ratio of the offspring of any of the seven male rabbits used in the study, so the data were grouped according to the different series of experiments, as shown in table 1. There was no difference between the sex ratio of the rabbits born from the float or sink sperm fractions and the controls nor was there any differences between the different groups of experiments. It can be seen that the conception rate increased as the series of experiments progressed. This may be due to a seasonal effect as it is more difficult to breed rabbits in the autumn months than in the spring. The first experiments were begun in August, while the last two were carried out in March. It is also possible that this increased conception may be due to the time of injection to cause ovulation. As in the earlier experiments, does were injected with 35 I.U.'s HCG, at the time of insemination, while in the later experiments they were injected two hours prior to insemination.

TABLE 1. NUMBER OF RABBITS BORN AND SEX RATIO FOR THE DIFFERENT GROUPS OF EXPERIMENTS BY SPERM FRACTION INSEMINATED

	Sperm fraction[1]	No. females inseminated	No. pregnancies	Total no. born	Sex ratio M:F	Sex ratio % males
Experiments 1-3	C	19	5	17	9:7	56.3
	F	22	8	51	22:26	45.8
	S	23	8	34	14:13	51.9
Experiments 4-6	C	24	11	56	29:22	56.9
	TF	27	12	51	28:23	54.9
	BS	26	11	69	33:36	47.8
Experiments 7 & 8	C	12	10	53	30:22	57.7
	WF	13	7	42	21:19	52.5
	WS	11	6	43	25:16	61.0

[1]C = Control; F = Float; S = Sink; TF = Top Float; BS = Bottom Sink; WF = Washed Float; WS = Washed Sink.

The data from all the experiments are summarized in table 2. There was very little difference in the conception rate in either of the three insemination groups, although it was slightly higher in the control groups. The sex ratio (% males) was also slightly higher in the controls, being 57.1%. Again, the differences were not significant; however, the controls had the smallest average litter size (4.8 young per litter), which was one rabbit per litter smaller than the 5.8 young born in the sink group. Thus, the sperm appears to be unaffected by the flotation process. While a separation of sperm was readily affected by flotation, this separation was not on the basis of the sex chromosome carried by the sperm. Consequently, the method does not appear to have any benefit in artificially controlling the sex ratio in animals.

TABLE 2. SUMMARY OF RESULTS OVER ALL EXPERIMENTS BY SPERM FRACTION INSEMINATED

Sperm fraction	No. females inseminated	No. pregnancies	Conception Rate, %	Total no. Born	Sex ratio		Av. litter size
					M:F	% Males	
Control	55	26	47.3	126	68:51	57.1	4.8
Float	62	27	43.5	144	71:68	51.1	5.3
Sink	60	25	41.7	146	72:65	52.6	5.8
Total	177	78	44.1	416			5.3

THE INCIDENCE OF PALE, SOFT, EXUDATIVE PORK IN SOUTHERN AND MIDWESTERN HOGS

R. H. Dalrymple and R. F. Kelly

Previous work at this station has shown that pale, soft, exudative (PSE) porcine muscle possesses inferior processing characteristics. PSE hams lost more weight in smoking and had lower yields through smoking than normal hams.

Pork muscles vary in their chemical, physical and morphological characteristics which influences their quality to a large extent. The quality ranges from a soft, pale and exudative condition to a dark, firm and dry appearance. The PSE condition has proven to be of serious economic importance to the meat packer because of excessive shrinkage (mainly exudate or water loss) during cooling and processing.

The objectives of this survey were (1) to correlate the incidence of PSE porcine muscle characteristics with season of the year and weather conditions prior to, during and after transport. Since Virginia packers get their swine both locally and from the midwest, it was desired to compare hogs arriving from these two climatically different areas since this condition has been shown to be related to weather changes. Secondly, it was desired to correlate muscle characteristics with several physical and quality attributes such as carcass grade, weight, muscle structure, marbling, pH, sex and cooler and ham temperatures.

Experimental Procedure

Twice a month 125 local hogs (North Carolina) and 125 midwestern hogs were sorted and tagged for identification purposes. They were then slaughtered and processed in the usual manner. A plant grader would grade each carcass and mark it for identification purposes. The carcasses would be chilled overnight with hourly cooler and randomly selected ham temperatures being recorded. The following day the hams would be scored for the following characteristics:

1. Source - North Carolina or midwest
2. Carcass grade
3. Ham weight
4. Firmness score
5. Color score
6. Structure classification
7. Degree of marbling
8. pH
9. Sex

Firmness was scored as follows:

0.5 - 1.0	very soft
1.5 - 2.0	soft
2.5 - 3.0	normal firmness
3.5 - 4.0	firm
4.5 - 5.0	very firm

Color scored as follows:

0.5 - 1.0 very pale
1.5 - 2.0 pale (two-toned)
2.5 - 3.0 normal
3.5 - 4.0 dark
4.0 - 5.0 very dark

Structural classification as follows:

1 open structure
2 intermediate
3 closed structure

Marbling on a 1-5 scale as follows:

1 abundant
2 moderate
3 small
4 traces
5 practically devoid

Weather data (temp. & humidity) was obtained from point of departure, and place of arrival for midwestern and at place of arrival for local hogs.

Preliminary Results

The survey which was initiated in September 1966 and continued to March 1, 1967 has given these results. Table 1 shows that midwestern hogs yielded hams that had a higher incidence of the PSE condition (31.50 vs. 18.42%). These hogs also yielded a higher percentage of normal colored soft-muscled hams (17.46 vs. 19.26%). The increased incidence of PSE hams from midwestern hogs raises questions as to the factors which cause PSE pork. Travel time, weather conditions and feedlot history no doubt are some factors which influence the incidence of PSE pork. These factors will be further investigated under laboratory conditions where their regulation is possible.

TABLE 1. INCIDENCE OF PSE PORK IN MIDWESTERN AND SOUTHERN HOGS

Muscle condition	Color score	Firmness	Source	
			Southern %	Midwest %
PSE	0.5 - 2.0	0.5 - 2.0	18.42	31.50
Normal	2.5 - 4.0	2.5 - 4.0	62.31	47.50
Normal-Soft	2.5 - 4.0	0.5 - 2.0	17.46	19.26

Table 2 shows the influence of carcass grade and ham weights on the PSE condition.

TABLE 2. INCIDENCE OF PSE CONDITION AS RELATED TO CARCASS GRADE AND HAM WEIGHT

Condition	Carcass grade[a]		Ham weight (lbs.)	
	Southern	Midwest	Southern	Midwest
PSE	1.94	1.69	15.8	15.2
Normal	1.69	1.70	14.9	14.8
Normal-Soft	1.47	1.53	15.0	14.8

[a]U.S. #1 = 1; U.S. #2 = 2; etc.

A study of table 2 shows that southern PSE hams come from lower grading (more fat thickness and/or shorter) hogs. This was not observed in the hogs from the midwest. The normal-soft hams came from higher grading hogs in both cases indicating less fat covering. Both the southern and midwestern PSE hams were heavier in weight indicating heavier muscling and/or older hogs.

Southern hams possessed higher degree of marbling than the midwestern hams.

These results are preliminary.

UTILIZATION OF UREA BY THE GROWING-FINISHING HOG

T. N. Meacham and H. R. Thomas

Feed represents approximately 80% of the cost in producing a market hog. One of the principle cost ingredients in the ration is the protein supplement. Significant savings could be made in feed costs if a cheaper source of protein could be devised. Urea and other non-protein nitrogen sources have been used extensively in ruminant feeding. The limited information available on the use of urea by swine is conflicting. The present study is being conducted to investigate the use of urea as a substitute for part of the ration protein for growing-finishing swine. The differential use of urea by pigs early in the feeding period as compared to the final phases is also being evaluated.

Procedure

Trial 1

Fifty-six crossbred feeder pigs averaging approximately 60 lbs. were allotted by weight to eight groups of seven pigs each. Two groups were assigned to each of the four experimental rations at random. Ration 1 was composed of a standard corn-soybean meal growing ration, containing 15% protein and served as the basal. Ration 2 was the negative control and contained 10% less total protein than the basal. Ration 3 was the same as ration 2 with urea added to produce a 15% total protein ration. Ration 4 was identical to ration 1 initially. When the pigs receiving ration 4 reached 125 lbs. live weight, ration 4 was replaced with ration 3. This was done to evaluate urea utilization during the last phase of the finishing period.

All rations were adjusted to a 13% protein basis when the pigs reached 125 lbs. Ration 2 contained 11.7% total protein during this phase.

The pigs were self-fed the rations on concrete in an enclosed building. Live weights were taken at 2-week intervals and the hogs were marketed when their respective pens averaged approximately 200 lbs.

Trial 2

Sixty crossbred feeder pigs averaging 49 lbs. were allotted by weight into three outcome groups averaging 39, 48 and 60 lbs., respectively. The pigs in each outcome group were assigned at random to the four experimental rations. This provided a pen of five pigs from each weight group on each of the four rations. The experimental rations were similar to those used in trial 1. The total protein level in the basal was 16% initially and then reduced to 14% at 75 lbs. and to 12% at 125 lbs. live weight.

Weighing and feeding procedures were the same as in trial 1.

Results

Trial 1

The average daily gain (ADG) and feed per pound of gain data are shown in table 1. Up to 125 lbs. live weight there was a slight advantage in ADG

Trial 2

Only limited performance data are available to date for trial 2. The pigs had been on feed 34 days at the last weigh period. These data are shown in table 2.

TABLE 2. AVERAGE DAILY GAIN AND FEED PER POUND OF GAIN - TRIAL 2 (POUNDS)

	Rations			
	1 Basal	2 Negative control	3 Urea	4 Basal/ urea[a]
Av. daily gain				
Repl. 1	1.70	1.52	1.55	1.48
2	1.43	1.20	1.31	1.36
3	1.33	1.11	1.23	1.13
Av.	1.49	1.28	1.36	1.32
Feed/lb. of gain				
Repl. 1	3.04	3.47	3.09	3.68
2	2.69	3.08	3.55	2.78
3	2.47	2.88	2.62	2.68
Av.	2.73	3.14	3.09	3.05

[a]Ration 4 is the basal up to 125 lbs. live weight. After pigs average 125 lbs., the urea ration (ration 3) is feed to 200 lbs.

The pigs on ration 1 (basal) had the greatest ADG up to the present, 1.49 lbs. The urea ration (#3) was next with 1.36 lbs., followed by rations 4 and then 2. There was not a great deal of difference in the gains of pigs on rations 2, 3 or 4. The relatively poor performance of the pigs on ration 4 (basal/urea) is not readily explained. They were receiving the same ration as the pigs on ration 1. Comparing the performance (ADG) of ration 2 and 3 indicates that at this point, the pigs appeared to be using the urea to some extent.

The feed efficiency data indicate a similar pattern. The overall efficiency was greater for the pigs on ration 1 (2.73 lbs. of feed per pound of gain). There was little difference in the efficiency of the pigs on rations 2, 3 and 4. The poor efficiency of the ration 3 pigs in the second outcome group caused this ration group to have a higher feed per pound of gain figure and tended to equalize the efficiencies of the last three ration groups.

The better utilization of urea by the younger and lighter pigs is in agreement with the first trial. This is a somewhat different result than was expected, since one might expect the quality of protein to lessen as the pigs matured.

for the basal groups as compared to the urea fed group which in turn gained somewhat faster than the negative control. This tended to indicate that some urea was being utilized. The ADG after 125 lbs., however, was definitely in favor of the basal group, 1.53 lbs., compared to around 1.39 for the other three groups. When the gains are examined over the entire trial, there appears to be little difference among those pigs receiving the negative control ration, urea throughout or urea after 125 lbs. There was, however, considerable variation between the two replications within a ration group which tended to mask a definite trend or pattern.

Up to 125 lbs. live weight, the feed required per pound of gain was lower for the basal groups, followed by the urea fed groups and was highest for the negative controls. After 125 lbs., the pattern changed somewhat with the ration 1 groups the lowest, followed by ration 2 and 4. Ration 3 groups required the greatest amount of feed. Overall averages for the entire trial were not too different. Ration 1 continued to have the lowest requirement with little differences among the other three ration groups.

TABLE 1. AVERAGE DAILY GAIN, FEED PER POUND OF GAIN - TRIAL 1 (POUNDS)

	Rations			
	1 Basal	2 Negative control	3 Urea	4 Basal/urea[a]
Av. daily gain to 125 lbs.				
Repl. 1	1.35	1.14	1.14	1.18
2	1.29	1.13	1.25	1.32
Av.	1.32	1.14	1.20	1.25
Av. daily gain after 125 lbs.				
Repl. 1	1.37	1.39	1.20	1.29
2	1.70	1.38	1.60	1.48
Av.	1.53	1.39	1.40	1.38
Overall mean	1.42	1.27	1.30	1.31
Feed/lb. of gain to 125 lbs.				
Repl. 1	3.37	3.94	3.64	3.46
2	3.28	3.44	3.35	3.17
Av.	3.32	3.69	3.50	3.32
Feed/lb. of gain after 125 lbs.				
Repl. 1	4.28	4.46	4.35	4.54
2	3.92	4.20	4.55	4.09
Av.	4.10	4.33	4.45	4.32
Overall mean	3.71	4.01	3.97	3.82

[a]Ration 4 is the basal up to 125 lbs. live weight. After pigs average 125 lbs., the urea ration (ration 3) is feed to 200 lbs.

INFLUENCE OF THE PHYSICAL FORM OF THE CREEP RATION ON BABY PIG PERFORMANCE FROM WEANING TO 56 DAYS OF AGE

C. J. D. McVeigh, Jr., C. C. Brooks and H. R. Thomas

Although research has shown that pelleting the ration of growing-fattening pigs increases rate of gain and lowers feed cost through less feed wastage and increased feed efficiency, comparatively little work has been reported on the merits of pelleting the ration for the baby pig. Limited experimentation, however, suggests that pelleting the ration may reduce waste and improve feed efficiency among early weaned pigs, but no improvement in rate of gain has been reported.

The present experiment was initiated to determine the effect of feeding a ration in meal or pellet form on growth and efficiency of feed conversion in the baby pig from weaning to 56 days of age. The study was carried out in the summer of 1966 at the Tidewater Research Station, Holland.

Procedure

Thirty litters of pigs were weaned at 1, 7, 14, 21, 28 or 35 days of age. Five litters were represented in each weaning age treatment group. Each litter was allotted at weaning, the individual pigs within each litter paired by weight and one of each pair randomly assigned to a ration in either pellet or meal form with the exception of the 10 litters comprising the 1- and 7-day weaning groups. These pigs were fed a reconstituted milk to 14 days of age, at which time they were assigned to meal or pellet treatment.

The treatment ration consisted of corn, SBOM, oat groats, wheat shorts, wheat bran, cane sugar, dried skim milk, lard, menhaden fish meal, vitamins and minerals.

Results

The effect of the physical form of the ration on the performance of the baby pig from weaning to 56 days of age is shown in table 1. Average daily gain differed little between meal and pellet treatment except in the 14- and 21-day weaned groups in which the pellet form appeared to be more favorable. There were, however, differences in average daily gain among weaning age groups. The 35-day group was lowest for both meal and pellet treatment, 0.59 and 0.54 lbs., respectively; and the 28-day group was highest, 0.99 and 1.01 lbs., respectively. There appeared to be no difference in feed consumption within the 6 weaning age groups between the meal and pelleted rations, nor was there an apparent trend in feed efficiency within weaning age groups. Among the weaning age treatments, however, the meal form was more efficient in the 7- and 35-day groups and the pellets in the 1- and 14-day groups. The physical form of the ration, however, appeared to have less effect than weaning age on efficiency of feed conversion.

TABLE 1. THE EFFECT OF THE PHYSICAL FORM OF THE RATION ON THE PERFORMANCE OF THE BABY PIG FROM WEANING TO 56 DAYS

	Weaning age (days)					
	1	7	14	21	28	35
No. litters	5	5	5	5	5	5
No. pigs weaned	63	43	46	42	38	47
No. pigs at 56 days	26	38	46	42	38	47
Ave. daily gain						
Meal	0.70	0.83	0.65	0.75	0.99	0.59
Pellets	0.71	0.87	0.81	0.90	1.01	0.54
Consumption/pig, lbs.						
Meal	61.0	54.8	55.7	57.7	59.1	27.4
Pellets	55.6	65.6	57.7	62.7	60.1	30.2
Lbs. feed/lb. gain						
Meal	1.85	1.67	2.04	2.01	2.10	2.22
Pellets	1.62	1.72	1.89	2.00	2.14	2.44

Conclusions

1. Physical form of the ration did not affect rate of gain in the baby pig except in the 21- and 28-day groups, which gained faster on a pelleted ration.

2. Feed consumption and feed efficiency did not appear to be affected by physical form of the ration.

REPRODUCTIVE PERFORMANCE OF GILTS REARED ON CONCRETE VERSUS OPEN LOT REARING

F. B. Masincupp and T. N. Meacham

There is a steadily increasing trend toward complete confinement in many phases of the swine industry. There is little information available concerning the effect of continuous confinement on concrete from birth on the reproductive performance and longevity of the sow. The present study was initiated to determine if gilts reared from birth in confinement had the same reproductive efficiency and longevity as gilts reared conventionally in open lots post weaning.

Procedures

Trial I

Twelve crossbred Yorkshire x Hampshire gilts were allotted at 56 days of age to two treatment groups according to litters in August of 1966. One group was placed in a large open lot and the other confined on concrete in an open shed. The gilts in both groups were self-fed until they weighed 150 lbs. and limited fed thereafter, to control growth. Feed intake was regulated so that the gilts in each group grew at approximately the same rate.

The gilts were checked daily for estrus to evaluate the effect of rearing environment on puberty. The gilts were bred around the 1st of February, 1967, to farrow in June.

Periodic observations were made to determine if the environment influenced the physical condition and health of the gilts.

Trial II

Fourteen Yorkshire x Hampshire gilts farrowed in August and September, 1966 were allotted to the same treatments used in trial I. The experimental procedures were the same in both trials.

Results

Trial I

The growth and reproductive performance to date is shown in table 1. The gilts in the open lot reached puberty 17 days earlier than those reared in confinement on concrete.

The average body weight of the gilts at breeding was quite similar, 238 lbs. for the open lot gilts and 240 lbs. for those confined. To maintain the uniform gains in both groups, it was necessary to feed the gilts in the open lots an additional pound per gilt daily.

TABLE 1. EFFECT OF REARING ENVIRONMENT ON REPRODUCTIVE PERFORMANCE

	Rearing Environment	
	Confinement	Open Lot
Trial I		
No. gilts	6	6
Av. age at first estrus, days	232	215
Av. weight at breeding, lbs.	240	238
Trial II		
No. gilts	7	7
Av. age at first estrus, days	226 (5)[a]	206 (6)[a]

[a]Number of gilts showing estrus to date.

The periodic observations of the gilts revealed a few cases of lameness which were temporary. The gilts outside in the open lot appeared firmer and in somewhat better condition.

Trial II

Only limited data are available for these gilts. One gilt in the open lot group and two in the confined lot have not reached puberty at this time. The average age for those which have reached puberty, however, shows the same pattern as in trial I with a 20-day advantage in favor of the open lot group.

Since only four of the 14 gilts have been bred, body weight at breeding data have not been calculated.

Summary

Based on the limited data available to date, it appears that confinement rearing may delay puberty in gilts. Gilts reared in confinement, however, require approximately a pound of feed less daily to equal the growth rate of gilts reared in open lots. Slight differences in physical condition have been observed.

INFLUENCE OF WEANING AGE ON GROWTH AND DEVELOPMENT OF THE BABY PIG AND SUBSEQUENT REPRODUCTIVE EFFICIENCY IN THE SOW

C. J. D. McVeigh, Jr., C. C. Brooks, T. N. Meacham and H. R. Thomas

Although considerable experimentation has been undertaken in the last decade in an attempt to define a commercially optimum time for weaning the baby pig from the standpoint of performance, the extent to which early weaning is feasible with modern hog facilities under good management and present-day nutrition has not been determined, nor has the precise effect of the parturition to weaning interval on subsequent reproductive efficiency in the sow been delineated.

Experiments were conducted in the spring and summer of 1966 at the V.P.I. Swine Research Center, Blacksburg, and at the Tidewater Research Station, Holland, to determine the effect of weaning age on: (1) the performance of the baby pig to 56 days of age, (2) subsequent reproductive efficiency in the sow.

Experimental Procedure

Experiment I, V.P.I. Swine Research Center, Blacksburg

Nine spring farrowed litters containing 52 Hampshire x Yorkshire pigs were weaned at 1, 7, 14, 21, 28 or 35 days of age. The pigs had access to a creep ration during the nursing period and this ration constituted the sole diet for the pigs from weaning to 56 days of age, with the exception of the pigs weaned at 1 or 7 days of age. These pigs were given a milk diet reconstituted from dried whole cow's milk in addition to creep feed from weaning to 56 days of age. The creep ration was composed of corn, SBOM, oat groats, wheat shorts, wheat bran, cane sugar, dried skim milk, lard and menhaden fish meal.

Reproductive data were obtained on the sows which farrowed these litters. The sows were bred on the first estrus following weaning and allowed to complete the gestation period. A comparison was then made between the previous and subsequent litter size.

Experiment II, Tidewater Research Station, Holland

Thirty summer farrowed litters containing 323 pigs of mixed breeding were assigned to treatments as in experiment I. Each weaning age was composed of 5 litters. The rations and feeding procedure were similar to that of experiment I, with the exception of the milk formula which consisted of dried skim milk (72.4%), lard (20%), cane sugar (5%), minerals and vitamins.

Reproductive data were obtained on the sows which farrowed these litters as in experiment I. Following breeding, however, the sows were slaughtered within a 21-day period and their reproductive tracts examined.

Results

Experiment I

Performance of the baby pig to 56 days is shown in table 1. Rate of gain was highest, 0.77 lbs., among the pigs weaned at 35 days of age. Daily gain in the 28-day treatment lot was only 0.58 lbs., however, and appeared to be affected by the large number (10) of pigs weaned. Feed per lb. of gain from birth to 56 days ranged from 2.41 lbs. in the 21-day treatment lot to 1.75 lbs. in the 35-day lot. The greater efficiency of the pigs weaned at 35 days of age was unexpected and may be due to litter difference; however, the effect of a small litter is shown by the lower efficiency of the 21-day weaned pigs in which the sow's ration was charged to only 3 pigs. Survival to 56 days was lowest among the 1-day weaned pigs with 75% of the total loss occurring following weaning. Post weaning death in this group, however, was caused by respiratory failure due to stomach compaction from overeating rather than debility or disease from early weaning.

TABLE 1. EFFECT OF WEANING TREATMENT ON BABY PIG PERFORMANCE AND SURVIVAL

	Weaning age in days					
	1	7	14	21	28	35
No. litters	2	1[a]	2	1	1	1
Ave. no. pigs weaned	6.0	7.0	6.5	3	10	7
Ave. no. pigs at 56 days	4.5	6.0	6.5	3	10	7
Birth wt., lbs.	2.85	3.46	2.91	3.35	2.75	3.44
Weaning wt., lbs.	2.9	7.0	8.1	14.7	15.0	26.0
56-day wt., lbs.	30.2	40.6	38.6	42.8	37.2	48.0
ADG, birth to 56 days, lbs.	0.49	0.66	0.63	0.70	0.58	0.77
Feed/lb. gain, birth to 56 days, lbs.[b]	2.04	2.14	2.10	2.41	2.17	1.75
ADG, weaning to 56 days, lbs.	0.52	0.69	0.72	0.81	0.73	0.99
Feed/lb. gain, weaning to 56 days, lbs.	1.86	2.05	1.68	1.45	1.63	1.08
% pigs died, nursing	7.7	0	23.1	0	9.1	12.5
% pigs died, weaning to 56 days	23.1	14.3	0	0	0	0

[a]Litter no. 1240 was removed from treatment due to premature farrowing.
[b]Includes the sow's ration during lactation.

The effect of weaning treatment on subsequent reproductive efficiency in the sow is shown in table 2. The weaning to estrus interval averaged 5.1 days with a range from 4 to 6.5 days (post-partum heat excluded). Pregnancy resulted from breeding at the first normal estrus except in the 1-day treatment lot which gilts conceived at the second estrus. Subsequent litter size appeared to favor the later weaning.

TABLE 2. EFFECT OF WEANING TREATMENT ON SUBSEQUENT REPRODUCTIVE BEHAVIOR AND LITTER SIZE

	Weaning age in days					
	1	7	14	21	28	35
No. sows	2	2	2	1	1	1
Ave. no. days, wean. to estrus	6.5[a]	4	6	5	5	4
Ave. no. days, farrow to estrus	7[a]	11	20	26	33	39
Ave. no. estrus periods to preg.	2[a]	1	1	1	1	1
Ave. no. days, wean. to preg.	27.5	4	6	5	5	4
Ave. no. pigs initially farrowed	7.0	8.0	8.5	3.0	11.0	9.0
Ave. no. pigs subseq. farrowed	7.0	6.5	7.0	12.0	11.0	11.0

[a]Excludes post-partum estrus displayed by sow no. 807.

Experiment II

Performance of the baby pig to 56 days is shown in table 3. Average daily gain to 56 days ranged from 0.52 lbs. in the 35-day treatment group to 0.76 lb. in the 28-day group. There was no significant difference, however, between the 21- and 28-day treatment groups nor between the 1- and 35-day groups. Daily gain among the 1-day weaned pigs was significantly greater than that of the 35-day weaned pigs in the last 12 days of the experimental period. The results show, as in experiment I, the depressing effect that a large litter exerts on gain when the nursing period is extended. Feed per lb. of gain to 56 days ranged from 1.89 lbs. in the 7-day treatment group to 2.41 lbs. in the 35-day group. There was no significant difference among the 7-, 14-, 21- or 28-day treatment groups or between the 1- and 35-day groups. Death loss during the post-weaning period was 60% in the 1-day treatment group but negligible in the other treatment groups. This difference was significant. The excessive mortality in the 1-day treatment group appeared to be related to ration inadequacy and improper rearing facilities for this age pig.

The effect of weaning treatment on subsequent reproduction in the sow is shown in table 4. The weaning to estrus interval averaged 36.2 days with a range from 14 days in the 14-day treatment group to 61.3 days in the 28-day treatment group. A total of 5 sows in the 1-, 14- and 28-day treatment groups failed to display estrus. Return to estrus was not influenced by litter size but did appear to be delayed by high environmental temperature. This relationship is shown graphically in figure 1. Pregnancy occurred in 21 sows but only 8 of the sows displayed normal embryos. Uterine scores showed inflammation in all treatment groups and normal involution in only the 21-, 28- and 35-day weaned groups. Uterine cultures disclosed a variety of pathogens with E. coli, Streptococcus and Staphlococcus predominating.

TABLE 4. EFFECT OF WEANING TREATMENT ON SUBSEQUENT REPRODUCTION IN THE SOW

	Weaning age in days					
	1	7	14	21	28	35
No. sows	5	5	5	5	5	5
Ave. no. pigs farrowed	14.0	9.4	10.4	10.0	9.8	14.4
No. sows displaying estrus	2	5	4	5	4	5
No. days, weaning to estrus	20.0	19.8	14.0	60.2	61.3	23.6
Ave. no. days farrow to slaughter	59.6	43.0	49.0	97.4	104.0	75.2
Uterine involution score	3.4	3.2	2.0	1.2	1.0	1.0
No. sows with normal tracts	3	1	3	4	5	5
Ave. uterine inflamm. score	3.2	5.4	2.0	2.4	2.4	3.0
No. sows with normal tracts	2	0	3	2	3	3
Ave. no. corpora lutea	25.5	19.8	19.7	17.4	17.3	20.4
No. sows with normal embryos	0	1	1	2	1	3
Ave. no. embryos	0	11.0	4.0	8.5	9.0	7.3
Ave. no. ova shed/pig prev. farrowed	1.8	2.3	1.9	1.7	1.8	1.4

Conclusions

Experiments I and II show that: (1) physiologically the baby pig is not ready for weaning at 1 day of age, (2) average daily gain tends to be depressed in a large litter if the nursing period is extended, (3) feed efficiency is improved when pigs are weaned from 7 to 28 days of age, (4) breeding the sow at the first normal estrus following weaning at 1 day post-partum is usually not successful, (5) some reduction in subsequent litter size can be expected if the sow is rebred during the first normal estrus following weaning sooner than 21 days post-partum, (6) high temperatures may delay the sow's return to estrus following parturition, and (7) uterine pathogens may be responsible for embryonic mortality or failure of the sow to conceive.

TABLE 3. LEAST SQUARES MEANS OF THE EFFECT OF WEANING AGE ON BABY PIG PERFORMANCE AND SURVIVAL

	Weaning age in days					
	1	7	14	21	28	35
No. litters	5	5	5	5	5	5
Ave. no. pigs farrowed alive	13	9.4	10.8	9.8	9.2	12.4
Ave. no. pigs weaned	12.6	8.6	9.2	8.4	7.6	9.4
Ave. no. pigs at 56 days	5.2	7.6	9.2	8.4	7.6	9.4
ADG, birth to 56 days, lbs.	0.53^{c}	0.71^{a}	0.64^{b}	0.72^{a}	0.76^{a}	0.52^{c}
ADG, weaning to 56 days, lbs.	0.53^{d}	0.76^{c}	0.71^{c}	0.88^{b}	1.00^{a}	0.60^{d}
ADG, last 12 days, lbs.	1.13^{e}	1.49^{ab}	1.17^{cde}	1.30^{bcd}	1.41^{abc}	0.88^{f}
56-day weight, lbs.	33.0^{c}	43.1^{a}	38.9^{b}	43.4^{a}	45.9^{a}	32.2^{c}
Lbs. feed/lb. gain, birth to 56 days, lbs.	2.30^{ab}	1.89^{c}	1.97^{bc}	2.11^{abc}	2.14^{abc}	2.41^{a}
Lbs. feed/lb. gain, weaning to 56 days, lbs.	2.27^{a}	1.80^{b}	1.91^{ab}	2.02^{ab}	2.08^{ab}	2.24^{a}
Pigs died while nursing	0.26^{a}	0.25^{a}	0.33^{a}	0.32^{a}	0.34^{a}	0.28^{a}
Percent[1]	6.6	6.1	10.5	9.9	11.1	7.6
Pigs died post-weaning	0.89^{a}	0.16^{b}	-0.01^{bc}	0^{bc}	0^{bc}	-0.05^{c}
Percent[1]	60.4	4.2	0	0	0	0
Pigs alive at 56 days	0.48^{b}	1.23^{a}	1.24^{a}	1.25^{a}	1.23^{a}	1.33^{a}
Percent[1]	24.8	88.9	90.0	90.1	88.9	94.3

$^{a,b...f}$Means bearing the same superscript are not significantly different ($P<.05$).
[1]Estimate calculated from transformed least square mean.

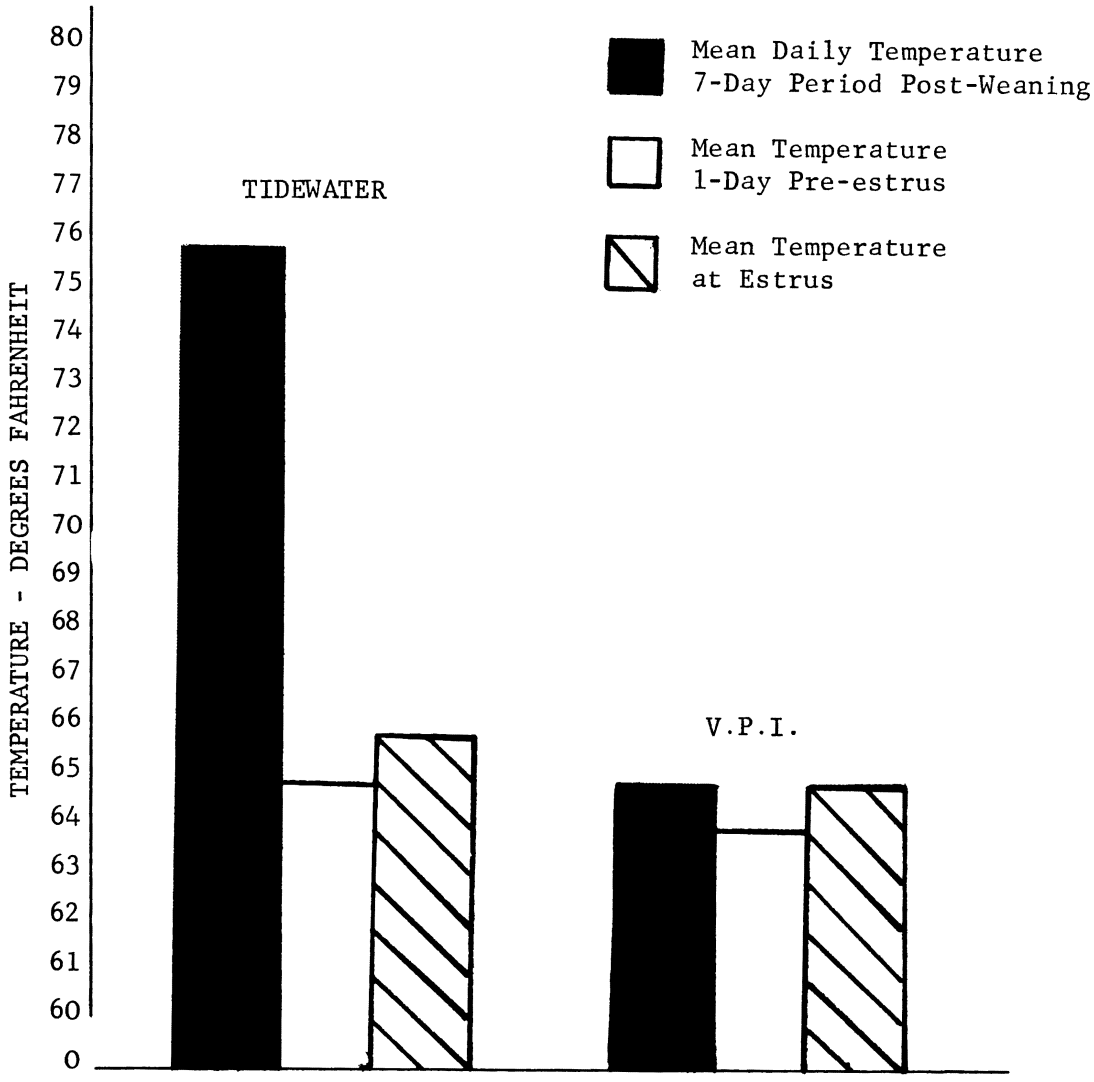


FIG. 1 EFFECT OF TEMPERATURE ON OCCURRENCE OF ESTRUS FOLLOWING WEANING

FLOOR-FEEDING VS. SELF-FEEDING SWINE FROM WEANING TO MARKET

H. R. Thomas, Tidewater Research Station

Labor has become a critical item in the process of producing finished hogs. Previous studies revealed that even on partially slatted floors, a considerable amount of labor was necessary for cleaning if the hogs were self-fed in pens allowing spacing of 4 to 6 sq. ft. per animal. Although pen cleanliness is highly unpredictable, indications were that the cleanliness of the pens improved as the slatted floor area was increased. This study was designed to investigate the effect of floor feeding on the selection of a dunging area.

Procedure

A semi-controlled environmental and a half-open shelter type building containing 8 identically constructed pens each, was used for this study. Pens were 5 ft. wide and 15 ft. long equipped with self-feeders and automatic waterers. Floors were of concrete construction. In each building there were 4 adjacent pens with 4 ft. slats and 4 adjacent pens with 8 ft. slats. Slats were of concrete construction 4 inches thick, 3 inches wide at the top and 2 inches wide at the bottom. Two pens in each building were self-fed (1 pen with 4 ft. slats and 1 pen with 8 ft. slats). The remaining 6 pens in each building were fed 5 times daily, at 3-hour intervals commencing at 6 A.M. All feed was automatically mixed and augered to the pen (actual weight of feed put in self-feeders was recorded). An automatic floor-feeding type system was used for depositing feed on concrete floor. The maximum feed intake per pig was estimated, with sample being weighed at scheduled intervals in order that an estimate of the feed consumption could be obtained. The amount of feed supplied to each pen was increased throughout the study in order to parallel the feed intake of the animals on self-feeders.

One hundred and twelve crossbred pigs were divided by weight into 7 outcome groups of 16 pigs each. Pigs in each outcome group were randomly assigned to the 16 pens (8 pens in each building). This resulted in a space allowance of approximately 9.5 sq. ft. of useable floor per animal. Animals were individually weighed at 2-week intervals. The study was concluded when the average weight of the pigs in each pen was approximately 200 lbs.

Results

The performance of the pigs for the entire study is shown in table 1. As in prior studies the differences in the performance due to facilities were small and inconsistent. The data in table 1, therefore, were pooled over both buildings by slat length and feeding system. In this study ventilation appeared to be a major problem. An allowance of 9.5 sq. ft. per pig far exceeds the advantageous use of floor space. The floors stayed in a relatively dry state, and free of feces throughout the entire test since most of the urine and feces was deposited over the slatted area and readily walked through the slots into the pits located below. Observations made

periodically throughout the study indicate that a 5 ft. slat would be the most satisfactory. In this study, floor feeding in the pens with 8 ft. slats was not practical since this allows too much area for feed wastage.

Performance was rather poor in all lots. This is thought to be the result of a combination of extremely cold weather and an outbreak of swine pneumonia.

Performance of pigs on self-feeders was slightly better than those fed on the floor at 3-hour intervals, 5 times daily. This no doubt is the result of failing to provide an adequate amount of feed to maintain the animal at the full feed level. Either too much or too little feed was dropped on the floor at times during the study. Floor feeding, such as the type used in this study, will require constant scrutiny and the best of management if it is to be successful.

TABLE 1. FLOOR-FEEDING VS. SELF-FEEDING FOR FINISHING SWINE

	8 ft. Slat				4 ft. Slat			
Lot No.	1	2	3	4	5	6	7	8
Feeding Method*	FF	FF	SF	FF	FF	SF	FF	FF
No. pigs	14	14	14	14	14	14	14	14
Initial Wt., lbs.	106	106	111	107	108	109	107	108
Final Wt., lbs.	187	196	196	187	198	205	203	192
A.D.G., lbs.	1.06	1.13	1.12	1.08	1.11	1.25	1.19	1.09
Av. Feed Consump., lbs/day	4.61	4.99	4.72	4.77	4.30	5.12	4.98	4.84
Feed/lb. Gain, lbs.	4.69	4.40	4.23	4.41	4.02	4.08	4.20	4.34

* FF denotes Floor-feeding
SF denotes Self-feeding

REPRODUCTIVE PATTERNS IN A HERD OF ANGUS COWS

R. R. Schalles and T. J. Marlowe

The productivity of a beef cow is measured by her ability to wean a heavy calf of desirable conformation each year. The objectives of this study were: (1) to evaluate the reproductive pattern in regard to age of cow at first calving, regularity of calving, length of the interval between calves, and calf performance; (2) to determine the effect that these several factors had on the length of time cows remained in the herd; and (3) to estimate the heritability and repeatability of calving interval, preweaning gains and weanling grade in a purebred herd of approximately 350 Angus cows.

Materials and Methods

Herd Management

The herd was entered in the Virginia BCIA program in 1955 and has continued in the program to the present. Even though all cows are registered, the herd was managed strictly as a commercial operation and was under the same manager for the entire 11-year period covered by the study. No calves were put on creep feed or nurse cows and none fitted for show. The nutritional level was adequate but below the level of most purebred herds in the area. Cows were grazed from early May to mid-November. During the winter months feeding of hay and silage was practiced. Cows were bred to calve for the first time at approximately 30 months of age with approximately half the cows bred to calve in the fall and the other half to calve in the spring. Some calves were born in all months, with the concentration during September through May, and only a very few calves born during June, July and August.

Groups of calves were usually weighed four times per year, in order to catch the calves as near seven months of age as practical. Calves that were weighed and graded under 120 and over 299 days were excluded from the study. All weights and grades were taken by an official weighing and grading team of the Virginia BCIA.

There was practically no culling during the first three years as the herd was being increased in size. The first major culling took place in 1959 when 69 cows were culled, and again in 1963 when 82 cows were culled. Culling was lightest in 1956, 1960 and 1962 when 13, 17 and 17 cows were culled, respectively. Cow culling was based primarily on past performance of the offspring, evaluation of the pedigree in regard to dwarfism, and her own weight and grade, in that order of importance. Culling was not related to the cow's age and those culled varied from 2 to 20 years, with an average of 8.5 years. The replacement and culling rate was quite variable from year to year, but in most cases replacement rate exceeded the culling rate, since the herd was growing in size, particularly in the early years. The highest replacement was in 1961 when 63 heifers were retained, which later produced one or more calves in the herd, and the lowest in 1955, when only 19 heifers later produced calves in the herd.

The Data

A total of 3,989 calving records were available for 769 cows. This was an average of 5.2 calves per cow. Complete records were not available on 57 cows, most of which were bought. Any period between calves of 20 months or more was considered as a year without calving. During the 11-year period, 43 sires produced 2,604 of the 2,638 calves with performance records. The number of offspring per sire varied from 11 to 196, with an average of 60.5 calves. Sires were used in the herd an average of 3.4 years, with a range from 1 to 7 years. The price paid for bulls ranged from $600 to $2,000.

Analytical Procedures

Calf gains and grades were adjusted for variation due to age of cow, age, sex and month of birth of calf, and year effects. Multiple regression analysis was used to estimate the effect that age of first calving, length of calving interval, regularity of calving and calf performance had on the length of time that a cow remained in the herd. Repeatability was estimated by intraclass correlation from between and within cow analysis of variance. Estimates of weanling traits were based on data from cows with two or more calf records and of calving interval from cows with three of more calf records. The heritability estimates were obtained from paternal half-sib analysis of variance.

Results and Discussion

During the period covered by this study there was an average annual percentage calf crop of 89 born and 87 weaned. The average age at first calving of 712 cows was 32 months and 12 days. The average calving interval was 1 year and 5 days, or 370 days. An average of 0.20 of a calf was skipped by the 626 cows having more than one calf. The average age at first calving interval varied little from year to year.

The average weight of all calves was 366 lb. (standard deviation $\pm$68 lb.) and average grade was 11.6 (standard deviation $\pm$1.5) at an average age of 192 days (standard deviation $\pm$38 days).

During the first eight years included in this study, 367 females were retained for replacement purposes which later produced one or more calves in the herd. This was 46% of the heifers produced during this same period. Very few females were purchased from outside sources.

Table 1 shows the means, regression coefficients, and level of significance of several factors as they relate to the age of the cow when culled. These regression coefficients would indicate that age at first calving has no significant effect on the age of the cow when culled; whereas, length of calving interval, preweaning gain and weanling grade were significantly related to the length of time a cow remained in the herd. The correlation coefficient between calving interval and age at culling was 0.39$\pm$.05, between age at first calving and calving interval 0.04$\pm$.05, and age at first calving and age when culled 0.06$\pm$.05. Age of cow when culled was not significantly related to her own performance as a calf, as indicated by the comparison of cows culled *vs.* cows not culled within age groups.

TABLE 1. MULTIPLE REGRESSION COEFFICIENTS ON AGE OF COW WHEN CULLED[a]

Factor	Mean	Regression Coef.	t-value
Age at 1st calving	2.8	0.27± .24	1.164
Calving interval	0.91	3.89± .54	7.170**
ADG of offspring	1.69	2.38±1.09	2.184**
Grade of offspring	11.5	-.53± .15	-3.589**
Age when culled	8.52		

[a] 390 observations
** P<.01

Least squares estimates showed that month and year of birth of the offspring and the age of the cow all had significant effects on the length of the calving interval. Considerable variation occurred due to month of birth, which was probably a reflection of the breeding season. Cows calving in May and August had a calving interval of 419 days; whereas, those calving in June and July had an interval of approximately 456 days. Calving was not intended during June, July and August, therefore, management was largely responsible for the longer calving interval. The shortest calving interval occurred among cows that calved during January through March. Most of these cows were bred during the early grazing season and while gaining in condition. There were significant year to year variations, which probably reflected the good or poor grazing condition the previous year. The range was 42 days with the longest interval occurring in 1960 and the shortest interval in 1964.

Cow's age had a significant positive influence on length of calving interval, although the regression coefficient was small (1.5 days per year of age).

Culling of cows appeared to be related to some extent to the preweaning gains and weanling grades of their calves. These factors were highly significant in the regression equation. In all significant comparisons, except the 10 through 13-year old group, cows not culled produced faster growing calves than the cows that were culled. The weaning grade of calves was also equal or superior for calves produced by cows that were not culled at a particular age.

Repeatability and heritability estimates for calving interval, preweaning gains and weanling grades of calves were also obtained. These values are shown in table 2. In all cases, the repeatability estimates were smaller

than the heritability estimates. This may be due, at least in part, to the year effects biasing the repeatability estimates downward. The heritability estimates were calculated on a within year basis and would be free of this bias. Sampling error could also have some effect. Management and fertility of the bull could influence the repeatability of calving interval.

TABLE 2. HERITABILITY AND REPEATABILITY OF PREWEANING AVERAGE DAILY GAIN, WEANING TYPE SCORE AND CALVING INTERVAL

Trait	Heritability	Repeatability
Weaning type score	0.31±.02	0.24±.03
Preweaning ADG	0.57±.09	0.18±.02
Calving interval	0.03±.20	0.02±.01

These estimates indicate that selection for preweaning gains and weaning grade should result in genetic improvement in the herd at a moderate rate. Because of the extremely low heritability and repeatability estimates for calving interval, one would not expect to make much, if any, progress from selection for shorter length of calving interval. It should also be pointed out that the calving interval of this herd could be shortened only about one month, at most, because of physiological limitations.

Summary

Data on 3,989 calving records and 2,638 calf performance records by 769 cows in a purebred herd of Angus cows were available for this study. The objectives were: (1) to evaluate the reproductive pattern in regard to age of cow at first calving, regularity of calving, length of interval between calves, and calf performance to weaning; (2) to determine the effect that these several factors had on the length of time cows remained in the herd; and (3) to estimate the heritability and repeatability of calving interval, preweaning gains and weanling grade.

The average age at first calving was 32 months and 12 days, calving interval was 370 days, and an average of 0.20 of a calf was skipped by the 626 cows having more than one calf. Average weight of all calves was 366 lb. and the average grade was 11.6 at an average of 192 days of age. Age at first calving had no significant effect on age of cow when culled; whereas, length of calving interval, preweaning gain and weanling grade significantly influenced the length of time a cow remained in the herd. Age of cow when culled was not significantly related to her own performance as a calf. Month and year of birth of offspring and the cow's age all significantly influenced calving interval.

Heritability estimates of calving interval, preweaning gain and weanling grade were 0.03, 0.56 and 0.31, respectively. Corresponding repeatability values were 0.02, 0.18 and 0.24.

GENETIC AND ENVIRONMENTAL CHANGES IN A HERD OF ANGUS COWS

R. R. Schalles and T. J. Marlowe

This study is based on Virginia BCIA records from a purebred Angus herd of approximately 350 cows over an 11-year period. The purpose of the study was to attempt to separate and to estimate the magnitude of the genetic and environmental portions of the total phenotypic change as measured by calf gains and weanling gains.

Materials and Methods

The Data

Records were available on 2,638 calves by 769 cows, 2,604 of them by 43 sires. Roughly half of the calves were born in the spring and the other half in the fall. Some calves were born in each month of the year with the peak months being October and March, and only a very few calves born during June, July and August. The number of offspring per sire varied from 11 to 196, with an average of 60.5. The average number of calves per cow was 3.4. Sires were used in the herd an average of 3.4 years, with a range from 1 to 7 years. Selection of bulls was based entirely on visual appearance and pedigrees, with the exception of one bull that was purchased on the basis of his performance record and sired calves only in the last year of the study. The price paid for bulls ranged from $600 to $2,000.

Replacement and culling rates varied considerably from year to year, but in most years replacement rates exceeded the culling rate, particularly during the earlier years as the herd was growing in size. The highest replacement was in 1961 when 63 heifers were retained, which later produced one or more calves in the herd. The low year was 1955, when only 19 heifers later produced calves in the herd. Culling was lightest in 1956, 1960 and 1962, when 13, 17 and 17 cows were culled, respectively. Heaviest culling took place in 1959, when 69 cows were culled and in 1963, when 81 cows were culled. Cows varied in age at time of culling from 2 to 20 years, with an average age of 8.5, and 47% of the cows being culled between 3 and 8 years of age.

Groups of calves were usually weighed and graded twice in the spring and twice in the fall in order to catch as many as practical between 6 and 7 months of age. Their average age was 192 days, with a standard deviation of $\pm$38 days. Calves under 120 or over 299 days were excluded from the study. All weighing and grading was done by an official team from the Va. BCIA. Average weight of the calves was 366 lb. with the standard deviation of 68 lb., and the average grade was 11.6 with a standard deviation of 1.5 grade points. All records were adjusted for variations caused by age of dam and age, sex and month of birth of calf. Cows were grouped according to age, as 2, 3, 4, 5, 6 and 7, 8 through 11, and 12-year olds and over.

The details concerning herd management are given in the previous paper entitled, "Reproductive Patterns in a Herd of Angus Cows."

Analytical Procedures

Estimates of year differences were obtained from a least squares analysis of unadjusted data. Two methods were used in an attempt to separate the genetic and environmental changes out of the total phenotypic changes from year to year. One method is based on the assumption that changes between half-sibs in successive years is due to one-half of the genetic change plus all of the environmental change. The average difference between calves from the same sire, born in successive years, was weighted according to the inverse of the variance among calves by the same sire within each of the two years involved and the number of sires having offspring in the two years involved. The equation used was:

$$\frac{\sum_i [1/\sigma^2_i \ (\bar{X}'_i - \bar{X}_i)]}{n(\sum 1/\sigma^2_i)}$$

Where $\bar{X}_i$ is equal to the average preweaning gain or grade of all calves by sire i in the first two years, $\bar{X}'_i$ equal to the average preweaning gain or grade of all calves by sire i in the second of two years, n equal to the number of sires having offspring in the two years involved, and $(\sigma^2_i)$is the variance of the difference, with the covariance between the half-sibs assumed to be zero. The data used had been corrected for variation due to age of dam, and sex and month of birth of calf.

The first year was taken as the base and the year differences were added algebraically and accumulated to obtain individual year estimates of one-half the genetic difference plus the environmental difference (1/2g + t). The sum of (1/2g + t) over all years was set equal to zero and the individual year values subtracted from the phenotypic year values obtained by the least square analysis. The remainder was multiplied by two to obtain an estimate of the genetic year trends. The environmental change was then obtained by subtracting genetic year differences from the total phenotypic year differences. This estimate of the environmental year differences was then used as an adjustment factor so as to compare performance of calves in different years with the effects of yearly environmental differences removed. There were 35 sires with 2,285 offspring records used in the paternal half-sib method of estimating genetic change, with 6 to 10 progeny groups spanning each consecutive two year period. The lowest number of progeny groups and offspring occurring between any two years was in 1959 and 1960, in which a large turnover in herd bulls occurred. The same period was poorly represented in the repeat mating data.

The second method of separating the genetic from the environmental changes was by use of repeat matings. Average differences between full-sibs in different years were assumed to be due entirely to environmental differences. Environmental year differences were obtained by setting 1955 as the base year and adding and accumulating differences to this base. A total of 280 repeat matings were available, ranging from 11 to 62 per year, which could be used to estimate the environmental effect of a given year. The repeat mating used spanned a period of from one to six years. Differences between full-sibs

spanning different periods of years were weighted according to the frequency of such matings. The equation used was:

$$\bar{X}j = \frac{\sum_i n_{ij} (\bar{X}_i + \bar{D}_{ij})}{\sum_i n_{ij}}$$

where $\bar{X}_j$ plus $\bar{X}_i$ are the environmental effects on preweaning gain or grade in year i or j, (j>i), $\bar{D}_{ij}$ is the average difference in preweaning gain or grade between full-sibs born in year j and i, and n_{ij} is the number of full-sibs pairs with one sib born in year i and the other sib born in year j. The sum of $\bar{X}_j$'s were set equal to zero and subtracted from the corresponding phenotypic constant obtained from least squares analysis to obtain an estimate of the genetic change from year to year.

Results and Discussion

Phenotypic Year Differences

Year differences were highly significant in both preweaning gain and weaning grade, varying from -.05 to .08 for average daily gain, and from -.61 to .82 for grade. The pattern for preweaning gains was very irregular, with the first three years being the highest, the next three years the lowest, and the remaining years up and down. Over all, however, there was a slight downward trend. The trend in grade was much more consistent, with the first three years being about 0.5 of a grade point below the average and the last two years about 0.7 of a grade point above the average. The regression coefficient showed an average decrease of -.07 lb. per day over the 11-year period in average daily gain, and an overall increase of 1.4 grade points in grade.

Comparison of Methods

The two methods of estimating environmental change in ADG gave drastically different results. When measured by the paternal half-sib method the environmental conditions affecting preweaning ADG improved over the 11-year period, but when measured by the repeat mating method, the regression coefficient was negative and twice the magnitude of the one obtained by the paternal half-sib method. A direct estimate of the genetic change was obtained by the paternal half-sib method, whereas, a direct estimate of the environmental change was obtained by the repeat mating method. In both cases, the change estimated directly followed more closely the phenotypic change which was negative. A similar finding was reported by Flower and co-workers at the Montana Station in 1964. Their data showed a negative phenotypic change in weaning weight and by use of consecutive repeat matings, they estimated a negative environmental trend. Armstrong (1964) at the Colorado Station, used repeat matings and a controlled population to estimate a positive environmental change in preweaning ADG and grade, but obtained a negative phenotypic change. Such large discrepancies did not occur

when estimating the change in weaning grade in the present study. The environmental change was negative by both methods, although very small by the repeat mating method, and the genetic change positive.

The repeat mating method may tend to bias the environmental effects downward due to selectively repeating matings which produce desirable offspring. This is especially true when the span between repeat matings is more than one year. This is not believed to be the case in this herd, however. It is more likely that the negative environmental trend was due to a change in the ideal of type over the 11-year period. The positive genetic effect on grade is probably explained largely by the visual selection of herd sires which gave very little, if any, emphasis to rate of gain.

Pre-planned repeat matings in sufficient numbers to give a reliable estimate would probably be the superior method of separating the genetic and environmental changes. Because of the small numbers and possible bias in repeat mating estimates used in this study, however, the estimates obtained by the paternal half-sib method were used as correction factors for the remainder of the study. The estimates from paternal half-sib method are not without the possibility of bias either. This procedure assumes that each sire is mated to a random group of dams in the herd, and the culling of breeding animals is not based on the performance of their first progeny. Also, a possible bias is introduced by the trend for older sires to be mated to older dams. Since age of sire was not available, it was difficult to determine if this trend occurred in the present data.

Effectiveness of Selection

During the first 8 years included in the study, 367 females were retained for brood cows. This was 46% of all the heifers produced. Very few females were purchased from outside sources. Table 1 shows the selection differentials in preweaning ADG and grade by year, as measured by the performance of selected females minus the performance of all females. The selection differentials were positive for both ADG and grade in all years, averaging 0.06 lb. per day per year for rate of gain, and 0.6 grade points per year for grade.

When comparisons were made of the performance of all first progeny of cows culled with the performance of first progeny of all cows not culled, the cows not culled produced calves with superior rates of gain in all significant comparisons, except the 10- through 13-year old group. The average grade of all calves was also equal to, or superior for, calves produced by cows not culled at a particular age; however, the regression coefficient of calf grade on age of dam when culled was $-.35 \pm .15$ and in two age groups the cows culled had first calves with a higher average grade than those not culled.

The results of this study indicate that selection of replacement heifers was in favor of higher growth rate and grade. Selection of herd sires was apparently based almost entirely on grade; however, performance data were not available on but one sire. Culling of cows was against those which produced slow gaining calves and possibly against those that produced

TABLE 1. PREWEANING PERFORMANCE OF SELECTED AND UNSELECTED HEIFERS

	All Heifers			Selected Heifers				Selection Differentials		
				Number[a]						
Year	No.	ADG	Grade	Total	With Records	ADG	Grade	ADG	Type	% Selected
1955	62	1.79	10.3	19	6	1.83	11.8	0.04	1.5	31
1956	103	1.77	10.8	40	30	1.85	11.8	0.08	1.0	39
1957	105	1.78	10.7	32	31	1.85	11.5	0.07	0.8	30
1958	105	1.70	11.3	54	51	1.74	11.7	0.04	0.4	51
1959	102	1.64	10.6	54	50	1.65	10.7	0.01	0.1	53
1960	91	1.67	11.5	57	47	1.74	11.9	0.07	0.4	63
1961	105	1.70	12.6	63	51	1.79	13.0	0.09	0.4	60
1962	126	1.76	12.4	48	44	1.83	12.6	0.07	0.2	38
1963	156	1.61	12.7	18	18	1.61	13.3	0.00	0.6	
1964	145	1.71	13.5							
1965	154	1.64	13.0							
Mean[b]	100	1.73	11.3	46	39	1.79	11.9	0.06	0.6	46

[a]The difference between total numbers and numbers with records is due to some heifers which were kept for replacements not having usable records.

[b]Mean of the first eight years only.

the better type calves to a small extent also. The selection practiced on the female side does not explain the negative genetic trend in ADG found by use of the paternal half-sib method of estimating genetic trends. It is regretted that data were not available on the sires. With the heritability estimate of 0.566 estimated from these data for ADG and 0.309 for grade, the average expected genetic progress from female replacement would be 0.37 lb. per day gain and 2.0 grade points over the 11-year period.

The repeatability and heritability estimates obtained in this study and shown in table 2 indicate that selection for preweaning gain and weaning grade should result in genetic improvement at a moderate rate. On the other hand, selection for shorter length of calving interval would be expected to yield very low, if any, results.

TABLE 2. HERITABILITY AND REPEATABILITY OF PREWEANING AVERAGE DAILY GAIN, WEANING TYPE SCORE AND CALVING INTERVAL

Trait	Heritability	Repeatability
Weaning type score	0.31±.02	0.24±.03
Preweaning ADG	0.57±.09	0.18±.02
Calving interval	0.03±.20	0.02±.01

Summary

Records on 2,638 calves produced by 769 Angus cows over an 11-year period were analyzed to determine the genetic patterns and effectiveness of selection of female replacements. Repeatability and heritability estimates were also obtained for preweaning ADG, weanling grade and calving interval.

Two methods were used to divide the total phenotypic changes into the fractions due to genetic and environmental effects. The two methods gave drastically different results. Least squares procedures were used to determine the phenotypic year effects on preweaning gain and weanling grade.

Phenotypic year differences were highly significant in both gain and grade with gain decreasing slightly over the 11-year period and grade increasing. Environmental effects were negative over the years when measured by the repeat matings method, but were positive when measured by the method of paternal half-sibs in successive years, causing the sign for genetic changes to be reversed for the two methods. The phenotypic and genetic changes in weanling grade were positive and the environmental changes negative by both methods.

Selected replacement heifers had a positive selection differential of 0.06 lb. per day per year for preweaning gain and 0.6 of a grade point for weanling grade over the 11-year period. Calves from cows culled after one year of age were little different in grade from calves by the cows that remained in the herd.

PHYSIOLOGICAL DEVELOPMENT OF YOUNG HEIFERS
I. INFLUENCE OF FEEDING INTENSITY ON PUBERTY AND CERTAIN SERUM LIPID LEVELS

W. S. Jones, Jr. and T. N. Meacham

This report summarizes the initial stage of a long range project designed to evaluate the influence of feeding intensity on udder development and milk production in beef heifers. The purpose of the following experiment was to compare the effects of a high plane of nutrition to a normal growing ration on puberty, serum cholesterol levels and lipoprotein patterns. The experiment also investigated the response of the blood lipids to the estrus cycle in the two treatments.

It has been known for some time that obese animals tend to be infertile. Although growth rate has been demonstrated to affect puberty and lactation, the mechanism is completely unknown. Most workers concentrated their studies on only one endocrine system which has contributed to the fragmentary nature of the present state of knowledge.

The blood lipid levels have been shown to readily change with the various hormones. If the plane of nutrition influences the entire endocrine balance of the animal, this may be manifested in the serum lipid levels.

Experimental Procedure

Ten sets of twin beef heifers of various breeds were obtained at an average age of 6.2 months on November 11, 1965, and accustomed to a ground hay and grain ration for two months. Then the twins were randomly split; one twin from each set was fed ad libitum and each of the other twins was fed to gain about 1.25 lbs. per day. The ad libitum group consumed 18.2 lbs./head/day for three months. The other group was limited to 12.2 lbs./head/day. The two rations are given below.

	Ration composition, %	
Ingredient	Limited fed	Ad libitum
Corn and cob meal	42	54
Ground, mixed hay	32.25	17.75
Cottonseed meal	12.5	15
Molasses	12.5	12.5
Salt	0.5	0.5
Dicalcium phosphate	0.25	0.25

On April 11, 1966 the heifers were put on pasture for 130 days. The full fed group was supplemented with 8.0 lbs. corn and cob meal/head/day. During the entire experimental period, weights were recorded every 30 days, and the animals were observed twice daily for estrus.

Three sets of identical twins were used for the next stage of the experiment. The twins, maintained on two levels of feed intake, were accustomed to a ground hay and grain ration for one month. Then from September 24 to December 20, 1966, blood samples were drawn on the day of estrus, day 5, 10 and 15 of each cycle for four cycles. Estrus was detected by a vasectomized, teaser bull, and the heifers were bled, then fed between 9:30 and 10:30 A. M. The rations fed during this period are listed below.

Ingredient	Ration composition, % Limited fed	Ad libitum
Ground, mixed hay	84	54.4
Corn and cob meal	6	35.3
Cottonseed meal	0	3.0
Molasses	10	7.3

The ad libitum group consumed 19 lbs./head/day. The other group was limited to 14 lbs./head/day.

Cholesterol was determined colorimetrically for all four cycles on serum stored at 0°F. The relative concentration of alpha and beta lipoproteins were determined on fresh serum during the last two cycles by paper electrophoresis.

Results and Discussion

The influence of feed intake on growth rate and age of puberty is shown in table 1. The twins of each set appear directly across from each other. The group on the high plane was significantly ($P<.01$) heavier than the limited-fed group before they reached pasture. The additional 8 lbs./head/day of corn and cob meal did not increase the ADG while on pasture. Thirty day weights of the ad libitum group indicated a slow adjustment to the change in feed. The full fed group did not gain more weight during the period on pasture, but their final weights were significantly ($P<.01$) different.

Average age of puberty was decreased by 20 days in the ad libitum fed group. If the two oldest sets of heifers were not considered, the differences in age increased to 36 days. This value just missed significance at the 5% level. It can be inferred that these two sets of heifers were too old to be influenced by the nutritional regime.

At the beginning of the blood analysis phase, the ad libitum fed group outweighed the limited-fed group 745 lbs. to 629 lbs. By the end of the 87-day trial, the ADG per animal in the ad libitum group was 1.43 lbs. The limited-fed group's ADG averaged 0.74 lbs.

The results of the blood analysis are summarized in table 2. Although the cholesterol and alpha lipoprotein levels were highest at estrus, the estrus cycle appeared to have had little effect on the serum lipids, thereby indicating that they are not a sensitive means of determining differences in estrogen production. The high plane of nutrition increased the serum cholesterol, but the percent of alpha lipoprotein was not altered.

In the homostatic organism, it is difficult for changes in an endocrine system to markedly influence blood components which can be balanced by many other factors. It can be concluded that the high plane of nutrition did not appreciably upset the overall endocrine balance, but the onset of puberty was hastened by the higher level of feeding.

TABLE 1. EFFECT OF NUTRITION ON GROWTH RATE AND AGE OF PUBERTY

High plane nutrition							Medium plane nutrition					
Animal no.	Age obtained (mos.)	Begin. wt. (lbs.)	ADG before pasture (lbs./day)	ADG on pasture	Final wt. (lbs.)	Age puberty (days)	Animal no.	Wt. start	ADG before pasture	ADG on pasture	Final wt.	Age puberty
99	3	240	2.13	1.27	515	279	98	270	1.18	1.08	595	341
75	4	295	2.25	.92	600	363	74	310	1.63	1.12	645	373
87	4	280	2.02	1.15	555	365	88	285	1.35	1.15	610	401
81	6	444	1.80	.85	705	360	80	475	1.52	.73	710	460
93	6	395	2.09	.62	575	463	92	385	1.40	.50	660	485
77	7	440	2.25	.50	650	426	76	415	1.69	.65	705	374
95	7	430	1.46	.42	560	444	94	400	0.90	.62	615	487
96	7	505	2.13	.38	665	310	97	480	1.57	.35	745	376
86	9	505	1.85	.38	770	463	85	550	1.63	.58	720	453
63	9	545	2.58	.31	700	454	64	490	1.85	.35	815	381
Means	6.2	407.9	2.06	0.68	682.0	392.7		406.0	1.47	0.71	629.5	413.1

TABLE 2. MEAN VALUES OF CHOLESTEROL AND PERCENT ALPHA LIPOPROTEIN DURING ESTRUS CYCLE

	Ad libitum				Medium intake			
	93	96	99	Means	92	97	98	Means
Estrus								
Cholesterol (mg. %)	153.84	121.56	130.62	135.34	111.88	111.56	115.94	113.13
% α lipoprotein	71.62	67.67	70.11	69.80	70.86	66.64	73.38	70.29
Day 5								
Cholesterol (mg. %)	154.13	110.94	131.56	132.21	121.25	103.12	118.44	114.27
% α lipoprotein	70.32	66.67	67.36	68.12	67.21	65.81	69.59	67.54
Day 10								
Cholesterol (mg. %)	158.68	107.19	133.12	133.00	113.75	96.88	128.75	113.13
% α lipoprotein	65.57	66.86	71.59	68.01	68.26	62.90	70.57	67.24
Day 15								
Cholesterol (mg. %)	154.42	110.94	130.31	131.89	106.88	101.56	127.19	111.88
% α lipoprotein	69.93	64.39	68.45	67.59	67.29	67.56	67.04	67.30
Means								
Cholesterol (mg. %)	155.27	112.66	131.41	133.11	113.44	103.28	122.58	113.10
% α lipoprotein	69.36	66.40	69.38	68.38	68.40	65.73	70.14	68.09

DIFFERENT LEVELS OF SUPPLEMENTAL GRAIN FOR FATTENING WEANLING STEER CALVES FED HIGH CORN SILAGE RATIONS

J. P. Fontenot, J. S. Copenhaver and R. C. Carter

A trial was conducted in 1965-66 to study the effect of feeding different levels of grain to weanling steer calves fattened on high corn silage rations. The results of that trial were summarized in the 1965-66 Progress Reports. A second trial is in progress and a summary of the results up to April 27 will be given in this report.

Experimental Procedure

Twenty-four weanling shorthorn steer calves were allotted to three lots according to breeding. The steers in all three lots were full fed corn silage and fed 2.5 lbs. cottonseed meal per head daily. In addition, they were fed the following levels of grain:

Lot 1 - None
Lot 2 - One-half of full feed
Lot 3 - Full feed

The steers were fed twice daily. The corn silage contained 32.0% dry matter, 3.14% crude protein, 6.62% crude fiber, 0.95% ether extract, 1.31% ash and 19.96% NFE. Based on the chemical composition the calculated TDN content of the silage was 21.6%. The grain consisted of a 1:1 mixture of ground ear corn and ground barley. Trace mineralized salt and a mixture of one part trace mineralized salt and three parts ground limestone were provided free choice.

Results

Rate of gain at the end of 154 days was very good for all lots. (Table 1). Daily gain for the steers fed no supplemental grain was 2.26 lbs. The gain was increased by about 0.2 lb. per day by about one-half of a full feed of grain. The gain was not increased further when grain was full fed. In fact, daily gains were 0.1 lb. lower for the full fed cattle, compared to those fed a limited grain level. As grain level increased less silage and more concentrates were required per pound of gain. Using normal feed prices, feed cost per pound of gain would increase with grain level.

TABLE 1. EFFECT OF FEEDING DIFFERENT LEVELS OF GRAIN TO FATTENING WEANLING STEER CALVES FED HIGH CORN SILAGE RATIONS (PRELIMINARY RESULTS)

Lot	1	2	3
Level of grain	None	1/2 Full feed	Full feed
No. of steers	8	8	8
Av. weight data, lbs.			
Initial wt.	507	505	488
Wt., 4/27	856	882	850
Gain	349	377	362
Daily gain	2.26	2.45	2.35
Av. daily feed, lbs.			
Corn silage	37.7	31.0	14.7
Cottonseed meal	2.46	2.45	2.35
Grain		5.73	11.14
Lbs. feed/lb. gain			
Corn silage	20.6	15.6	7.7
Cottonseed meal	1.3	1.2	1.2
Grain		2.9	5.8

VALUE OF HIGH UREA SUPPLEMENTS IN BEEF CATTLE FATTENING RATIONS

J. P. Fontenot, W. H. McClure and R. C. Carter

A fattening trial was conducted at the Shenandoah Valley Station, Steeles Tavern with weanling beef steer calves in 1965-66 to study the value of different high urea supplements and the results were reported in the 1965-66 Progress Reports. A second trial is in progress and a summary of the results up to April 27, 1967 will be given in this report.

Experimental Procedure

Twenty-one crossbred weanling steer calves from straightbred cows were allotted to Lots 1-4 and 23 crossbred weanling steer calves, from crossbred cows, were allotted to Lots 5-8. Allotment was made according to breeding of the steers. The steers were fed a limited amount of high quality corn silage, a full feed of grain and 2 lbs. per head daily of supplement. The cattle were fed twice daily. The supplements contained approximately 41% calculated crude protein. The composition of the supplements is given in table 1. Briefly, the composition was as follows:

Lots 1 and 5 - Cottonseed meal.
Lots 2 and 6 - Urea and ground shelled corn.
Lots 3 and 7 - Urea, ground shelled corn and cottonseed meal. The urea level was 50% of that in the supplement for Lots 2 and 6.
Lots 4 and 8 - Urea, ground shelled corn, dehydrated alfalfa meal, dry molasses and defluorinated phosphate. This was designated as complex urea supplement.

Vitamin A was included in all supplements at a level of 1,000,000 I.U. per 100 pounds. The grain consisted of a 5:3:2 mixture of ear corn, barley and wheat through March 1. Since March 2 the proportions have been 4:4:2, respectively. The cattle in all lots had access to a mineral mixture of 1 part salt and 1 part defluorinated phosphate.

TABLE 1. COMPOSITION OF PROTEIN SUPPLEMENTS USED IN FATTENING TRIAL

Ingredient	Composition (%) of supplements by lot[a]			
	Lots 1 & 5	Lots 2 & 6	Lots 3 & 7	Lots 4 & 8
Cottonseed meal	100.0		50.4	
Shelled corn		88.0	43.6	63.2
Urea, feed grade[b]		12.0	6.0	11.8
Dry molasses				5.0
Dehydrated alfalfa meal				15.0
Defluorinated phosphate				5.0

[a]Vitamin A was added to all supplements at the level of 1,000,000 I.U. per 100 lb. supplement.
[b]Contained 281% protein equivalent.

The average chemical composition of the corn silage and supplements is shown in table 2. The corn silage contained 37.6% dry matter. The calculated TDN content of the silage was 24.9%.

TABLE 2. CHEMICAL COMPOSITION OF CORN SILAGE AND PROTEIN SUPPLEMENTS

Feed	Dry matter	Crude protein	Crude fiber	Ether extract	Ash	NFE
	%	%	%	%	%	%
Corn silage	37.57	3.29	7.56	1.06	2.15	23.50
Protein supplements by lots						
Cottonseed meal (Lots 1 & 5)	89.81	39.99	11.35	3.71	5.43	29.32
Corn-urea (Lots 2 & 6)	87.70	42.78	3.47	4.18	1.00	36.27
Corn-urea-CSM (Lots 3 & 7)	88.46	42.79	7.21	4.52	3.35	30.36
Complex urea (Lots 4 & 8)	88.64	40.49	6.40	3.96	5.96	31.81

Results

The trial is still in progress. The results for the two lots fed the same supplement were averaged and the average values at the end of 164 days on trial are shown in table 3. Feed intake figures were similar for the cattle fed the various supplements. In this trial rate of gain was lowest for the cattle fed the complex urea supplement. If the results of last year's trial and those of the present trial up to 164 days are averaged there are no large differences in rate of gain. The daily gains are 2.35, 2.30, 2.34 and 2.34 lbs. for cottonseed meal, corn urea, corn-urea-cottonseed meal and complex urea supplements, respectively.

Acknowledgement: Appreciation is expressed to E. I. Dupont de Nemours & Co., Inc., Wilmington, Delaware for supplying the feed grade urea.

TABLE 3. PERFORMANCE OF FATTENING STEERS FED DIFFERENT PROTEIN SUPPLEMENTS

Protein supplement	Cottonseed meal	Corn-urea	Corn-urea-CSM	Complex urea
Lots	1 & 5	2 & 6	3 & 7	4 & 8
No. of steers	11	11	10	11
Av. weight data, lbs.				
Initial wt.	480	493	555	522
Wt., 4/27	871	893	942	898
Gain	391	401	387	376
Daily gain	2.40	2.44	2.36	2.29
Av. daily ration, lbs.				
Corn silage	14.7	14.7	14.8	14.0
Supplement	2.0	2.0	2.0	2.0
Grain	7.9	7.9	8.2	7.9
Lbs. feed/lb. gain				
Corn silage	6.2	6.0	6.3	6.1
Supplement	0.8	0.8	0.8	0.9
Grain	3.3	3.2	3.5	3.4

VALUE OF A HIGH UREA SUPPLEMENT FOR WINTERING WEANLING HEIFER CALVES FED A HIGH CORN SILAGE RATION[1]

J. P. Fontenot and F. S. McClaugherty

During 1966-67 a trial was conducted to compare the relative value of a high urea supplement and cottonseed meal for wintering weanling heifer calves fed a high corn silage ration.

Experimental Procedure

Forty-two weanling heifer calves (16 straightbred and 28 crossbred) were assigned to three groups (replicates) based on breeding, weight and origin. The heifers within each of the three replicates were allotted at random to two lots, according to breeding and weight. For one of the two lots the supplement consisted of cottonseed meal and for the other lot it consisted of a high-urea supplement. All lots were full fed corn silage and were fed 1 lb. protein supplement and a limited level of mixed hay per head per day. Thus, three lots (lots 1, 3 and 5) were fed cottonseed meal and three (lots 2, 4 and 6) were fed the high urea supplement. The composition of the high urea supplement was 63.2% ground shelled yellow corn, 5.0% dry molasses, 11.8% feed grade urea, 15.0% alfalfa meal and 5% defluorinated phosphate. The urea supplement was calculated to contain approximately the same crude protein level as cottonseed meal. Vitamin A was added to both supplements at the level of 1,000,000 I.U. per 100 lb. supplement. The chemical composition of the corn silage, hay and supplements is given in table 1.

TABLE 1. CHEMICAL COMPOSITION OF CORN SILAGE, HAY AND PROTEIN SUPPLEMENTS

	Dry matter	Crude protein	Ether extract	Crude fiber	NFE	Ash
	%	%	%	%	%	%
Corn silage	32.92	2.73	0.97	6.93	21.01	1.27
Mixed hay	88.26	15.96	2.53	25.36	39.30	5.11
Cottonseed meal	90.12	42.71	2.94	10.04	28.51	5.92
Urea supplement	87.24	42.96	3.41	6.50	26.55	7.81

The heifers fed the urea supplement were gradually adjusted to the urea supplement. Water and a 1:1 mixture of salt and limestone were available at all times. The heifers were weighed at 14-day intervals.

[1]Appreciation is expressed to E. I. Dupont de Nemours & Co., Inc., Wilmington, Delaware for supplying the feed grade urea and to Chas. Pfizer and Co., Inc., New York, N. Y. for supplying the vitamin A.

Results

Rate of gain and feed intake data are given in table 2. Although there were no consistent differences between lots within replicates there was a tendency for lower daily gain for the urea-fed cattle. When the figures for each supplement were averaged, the daily gain was 1.35 lbs. for the heifers fed cottonseed meal and 1.31 lbs. for those fed the urea supplement. Silage intake was slightly higher for the urea-fed lots.

TABLE 2. VALUE OF A HIGH-UREA SUPPLEMENT FOR WINTERING WEANLING HEIFER CALVES FED A HIGH CORN SILAGE RATION

	Replicate 1		Replicate 2		Replicate 3		Average	
	Lot 1 CSM	Lot 2 Urea	Lot 3 CSM	Lot 4 Urea	Lot 5 CSM	Lot 6 Urea	Lots 1,3,5 CSM	Lots 2,4,6 Urea
No. of heifers	7	7	7	7	7	7	21	21
Av. wt. data, lb.								
Initial wt., 11/22	529	526	427	415	422	429	459	457
Final wt., 3/28	705	712	625	605	614	606	648	641
Gain	176	186	198	190	192	183	189	184
Daily gain	1.26	1.32	1.42	1.36	1.37	1.26	1.35	1.31
Av. daily feed								
Corn silage	27.2	26.4	26.4	23.7	24.1	23.8	25.9	24.6
High urea supplement		1.0		1.0		1.0		1.0
Cottonseed meal	1.0		1.0		1.0		1.0	
Mixed hay	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2

SUPPLEMENTAL FEEDING OF FATTENING YEARLING STEERS GRAZING NATIVE PASTURE

J. P. Fontenot, F. S. McClaugherty and R. C. Carter

Based on the results of digestion trials on pasture at Blacksburg an experiment was conducted at the Southwest Station, Glade Spring to study further the problem regarding the minimum amount of supplemental concentrates that should be fed to grazing yearling steers, and when it should be fed in order to produce cattle yielding desirable carcasses. Two grazing trials were conducted in 1962 and 1963. In 1966 a third such trial was conducted.

Experimental Procedure

Thirty-two (32) yearling steers, grazing native pasture, were used for the trial conducted in 1966. The steers weighed 613 lbs. at the beginning of the grazing season. The cattle were allotted to four lots, which received the amounts of supplemental concentrate, by period, as shown in table 1. At the beginning of the grazing season the supplemental feed consisted of cracked shelled corn. Starting July 6 10% cottonseed meal was mixed with the corn.

TABLE 1. AMOUNTS OF SUPPLEMENTAL CONCENTRATES BY PERIOD DURING GRAZING SEASON - 1966

Dates	Amount fed by lots			
	Lot 1	Lot 2	Lot 3	Lot 4
Apr. 18 - June 10	None	2.0 lbs.	4.0 lbs.	Full feed
June 11 - July 29	None	3.5 lbs.	7.0 lbs.	Full feed
July 30 - Sept. 16	None	4.0 lbs.	7.5 lbs.	Full feed
Sept. 17 - Oct. 10	None	3.5 lbs.	6.5 lbs.	Full feed

The steers were implanted with 12 mg. stilbestrol at the beginning of the grazing season. All the steers were grazed on the same pasture and were driven to the barn once daily, at which time the lots receiving supplemental concentrate were fed. A mineral mixture of equal parts of salt and limestone was available in the barn. The steers were weighed at 2-week intervals during the trial.

Results

The results for the 1966 trial are given in table 2. Feeding 3.0 lbs. of grain resulted in a 0.29 lb. increase in daily gain. When the concentrate level was increased to 5.8 lbs. daily gain was increased only slightly, compared to feeding 3.0 lbs. The highest gain, 2.14 lbs./day, was recorded for the cattle full fed grain.

Average slaughter grade increased with each increase in grain level. When 3.0 lbs. grain were fed carcass grade was increased from low good to average good (lot 1 vs. lot 2). Carcass grade was not substantially increased further by further increases in grain level.

TABLE 2. PERFORMANCE OF YEARLING STEERS FED DIFFERENT LEVELS OF SUPPLEMENTAL FEED ON PASTURE

	Lot 1	Lot 2	Lot 3	Lot 4
No. of steers	8	8	8	8
Av. wt. data, lbs.				
Initial wt., 4/26	623	599	605	619
Final wt., 10/11	900	928	942	979
Gain	277	329	337	360
Daily gain	1.65	1.96	2.01	2.14
Av. concentrate intake per day, lbs.	0	3.0	5.8	10.9
Av. slaughter grade[a]	8.6	9.9	10.3	11.5
Av. carcass data				
Conformation[a]	10.3	11.1	10.9	11.5
Maturity[b]	1.1	1.1	1.1	1.1
Marbling[c]	3.1	3.9	3.8	3.9
Grade[a]	9.1	10.3	10.3	10.6
Av. dressing %[d]	57.0	58.1	58.6	58.9

[a]Code: 8 - high standard; 9 - low good; 10 - average good; etc.
[b]Code: 1 - young; 2 - intermediate; 3 - old.
[c]Code: 4 - slight; 5 - small; 6 - modest; etc.
[d]Based on weight on day of slaughter and warm carcass weight.

EFFECT OF ADDED NITRATE AND AVAILABLE ENERGY LEVEL OF BEEF CATTLE FATTENING RATIONS ON VITAMIN A METABOLISM

J. P. Fontenot, R. E. Lichtenwalner and R. E. O'Kelley

A trial was conducted in 1965-66 to study the effect of added nitrate and available energy level on vitamin A metabolism in fattening beef steers fed rations containing two levels of carotene. The results of that trial were summarized in the 1965-66 Progress Reports. A second trial is in progress and preliminary results will be given in this report.

Experimental Procedure

Forty-eight weanling steer calves were divided into outcome groups of eight based on origin, breeding and initial weight. The cattle within each group were allotted to eight rations. Two levels of available energy, nitrate and carotene were used. Specifically the design of the experiment was as follows:

Ration	Available energy	Added nitrate (KNO_3)	Carotene
1	Low	None	Low
2	Low	None	High
3	Low	1%	Low
4	Low	1%	High
5	High	None	Low
6	High	None	High
7	High	1%	Low
8	High	1%	High

The composition of the rations is given in table 1. The low energy rations contained approximately 60% calculated TDN and the high energy rations, approximately 70% TDN. Four rations (1, 2, 5 & 6) did not contain added nitrate and the other four rations contained 1% added potassium nitrate (KNO_3). The low carotene levels consisted only of the amount present in the natural feeds (av. of 1.5 mg./lb. ration). The rations containing the high carotene level contained 3.1 mg. per lb. of ration, in addition. This carotene was added as pure beta-carotene.

An attempt was made to feed the steers within each outcome group of eight (one steer from each ration) equal amounts of feed. The level was determined by the amount eaten by the steer consuming the least amount. The steers were individually fed their respective rations in coarsely ground form. They were kept in the individual stalls, inside the barn, at night for about 16 hours daily, at which time they had access to the feed. When not in the barn the steers were placed in large exercise pens and had access to water.

The steers were weighed at the beginning of the trial and at approximately 14-day intervals. Blood samples were taken prior to the beginning of the trial and generally at approximately monthly intervals. Liver samples were obtained prior to the start of the trial (November), January and March by liver biopsy.

Results

Performance data up to April 25 and liver vitamin A and blood methemoglobin data for November, 1966 (prior to start of trial) and March, 1967 are shown in table 2. Due to feed refusals by certain steers, the cattle within the outcome groups of eight did not always consume equal amounts of feed.

At the end of 152 days there were no consistent effects of added nitrate or supplemental carotene on rate and efficiency of gain. Rate of gain and feed efficiency were higher for the cattle fed the high energy rations than for those fed the low energy rations. Rate of vitamin A depletion from the liver was fairly rapid but not as rapid as in last year's trial. In the trial in progress, as in the trial conducted last year, there were no consistent differences in rate of vitamin A depletion among treatments. No physical symptoms of vitamin A deficiency or of nitrate toxicity have been observed. As shown in table 2, methemoglobin values were not higher for the nitrate fed cattle than for those not fed added nitrate.

Acknowledgement: Appreciation is expressed to Nitrogen Division, Allied Chemical Corporation, Hopewell, Va. for supplying the potassium nitrate.

TABLE 1. COMPOSITION OF RATIONS USED

Energy level	Low (60% TDN)				High (70% TDN)			
Added nitrate (KNO_3)	None		1%		None		1%	
Carotene Level	Low	High[a]	Low	High[a]	Low	High[a]	Low	High[a]
Lot no.	1	2	3	4	5	6	7	8
Ration composition, %								
Grass hay	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Ear corn	45.67	45.67	44.67	44.67	41.47	41.67	40.88	41.11
Corn cobs	25.83	25.83	25.83	25.83				
Shelled corn					33.78	33.59	33.40	33.19
Cottonseed meal	17.25	17.25	17.25	17.25	13.51	13.49	13.47	13.44
Trace mineralized salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Limestone	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Potassium nitrate	0.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00
Beta carotene		+[a]		+[a]		+[a]		+[a]

[a]3.10 mg. beta carotene were added per pound of ration.

TABLE 2. EFFECT OF ADDED NITRATE AND DIFFERENT LEVELS OF CAROTENE AND AVAILABLE ENERGY (PRELIMINARY RESULTS)

Energy level	Low (60% TDN)				High (70% TDN)			
Added nitrate (KNO_3)	None		1%		None		1%	
Carotene level	Low	High[a]	Low	High[a]	Low	High[a]	Low	High[a]
Lot no.	1	2	3	4	5	6	7	8
No. of steers	8	8	8	8	8	8	8	7[b]
Av. weight data, lbs.								
Initial wt.	510	498	501	491	479	505	479	502
Final wt. (4/25/67)	796	796	818	795	857	845	803	833
Gain	286	298	317	304	378	340	324	332
Daily gain	1.88	1.96	2.09	2.00	2.49	2.24	2.13	2.18
Av. daily feed, lbs.	16.4	16.9	16.8	16.4	16.5	16.6	14.9	15.6
Lbs. feed/lb. gain	8.71	8.62	8.07	8.21	6.64	7.39	6.98	7.13
Liver vitamin A, mcg./gm.								
November, 1966	33.9	43.9	26.4	35.4	54.8	32.3	36.9	38.3
March, 1967	15.8	16.8	9.8	8.1	13.2	17.2	14.8	9.7
Depletion, Nov. to Mar., %	53.4	61.7	62.9	77.1	75.9	46.7	59.9	74.7
Blood methemoglobin, % of total hemoglobin								
November, 1966	0.55	0.66	0.98	0.35	1.27	0.74	1.23	0.95
March, 1967	0.72	0.70	0.67	0.52	0.51	0.92	0.51	1.16

[a]3.1 mg. beta carotene were added per pound of ration.
[b]One steer suffered leg injury, so was removed from experiment.

THE VALUE OF A HIGH-UREA SUPPLEMENT AND DIFFERENT LEVELS OF SUPPLEMENTAL GRAIN FOR FATTENING WEANLING BEEF CALVES ON HIGH CORN SILAGE RATIONS[1]

J. P. Fontenot, F. S. McClaugherty, R. C. Carter and R. E. O'Kelley

In 1965-66 a trial was conducted at the Southwest Station, Glade Spring to study the value of a high urea supplement and the relative value of two levels of grain supplementation for fattening weanling heifer calves on high corn silage rations. The results of that trial were reported in the 1965-66 Progress Reports. A second trial was conducted in 1966-67 and the results of that trial will be presented here.

Experimental Procedure

Forty-three crossbred heifers, 22 from purebred dams and 21 from crossbred dams were used. The 21 heifers from crossbred cows were allotted to Lots 1-4 and the 22 from purebred dams were allotted to Lots 5-8. The cattle received the following concentrates:

Lots 1 and 5 - Urea supplement and a limited level of ear corn
Lots 2 and 6 - Cottonseed meal and a limited level of ear corn
Lots 3 and 7 - Urea supplement and a high level of ear corn
Lots 4 and 8 - Cottonseed meal and a high level of ear corn

The grain level fed Lots 1, 2, 5 and 6 was adjusted periodically to 1% of bodyweight and that for Lots 3, 4, 7 and 8 was adjusted to 2% of bodyweight. The urea supplement contained 63.2% ground shelled corn, 11.8% feed grade urea (281% protein equivalent), 5.0% dry molasses, 15.0% dehydrated alfalfa meal and 5.0% defluorinated phosphate. Stabilized vitamin A was incorporated into the cottonseed meal and the urea supplement at the rate of 1,000,000 I.U. per 100 lb. supplement. The supplements were fed at the rate of 2 lbs. per head per day. In addition to the grain and protein supplement the heifers were full fed high quality corn silage. The cattle were fed twice daily. The chemical composition of the feeds is given in table 1. Based on average chemical composition the calculated TDN content of the corn silage was 22.3%. The protein content of the two supplements was similar. The heifers had access to a 1:1 mixture of salt and ground limestone.

Results

There were no substantial differences in rate and efficiency of gain between the cattle fed cottonseed meal and the high urea supplement, as shown in table 2. Daily gains were about 0.3 lb. greater for the heifers fed the high level of grain than for those fed the low level. The cattle

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[1]Appreciation is expressed to E. I. Dupont de Nemours & Co., Inc., Wilmington, Delaware for supplying the feed grade urea and to Chas. Pfizer and Co., Inc., New York, N. Y. for supplying the vitamin A.

fed the high grain level required more grain and less silage per pound of gain.

Average slaughter grade, carcass grade and dressing percentage were not substantially affected by kind of protein supplement. Average slaughter grade was higher for the cattle fed the high grain level than for those fed the low level. However, there were no marked differences in carcass grade and dressing percentage between the cattle fed the two grain levels.

TABLE 1. CHEMICAL COMPOSITION OF FEEDS

Feed	Dry matter	Crude protein	Crude fiber	Ether extract	Ash	NFE
	%	%	%	%	%	%
Corn silage	32.92	2.73	6.93	0.97	1.27	21.01
Urea supplement	87.24	42.96	6.50	3.41	7.81	26.55
Cottonseed meal	90.12	42.71	10.04	2.94	5.92	28.51
Ear corn	84.72	7.56	8.13	3.46	1.85	63.72

TABLE 2. THE VALUE OF A UREA SUPPLEMENT AND RELATIVE VALUE OF DIFFERENT LEVELS OF GRAIN FOR FATTENING WEANLING HEIFER CALVES ON A HIGH CORN SILAGE RATION. 154 DAYS

Lots	1 & 5	2 & 6	3 & 7	4 & 8
Supplement	Urea	Cottonseed meal	Urea	Cottonseed meal
Level of grain	1/2 Full feed	1/2 Full feed	Full feed	Full feed
No. of cattle	10	12	10	11
Av. wt. data, lb.				
Initial wt.	472	471	474	483
Final wt.	723	717	768	781
Gain	250.5	246.0	293.0	297.5
Daily gain	1.56	1.52	1.82	1.85
Av. daily feed, lb.				
Corn silage	20.7	19.9	11.0	10.9
Supplement	2.0	2.0	2.0	2.0
Ear corn	5.6	5.5	11.0	11.0
Lbs. feed/lb. gain				
Corn silage	13.4	13.1	6.0	5.9
Supplement	1.2	1.3	1.1	1.1
Ear corn	3.6	3.6	6.0	6.0
Av. slaughter grade[a]	11.5	11.5	12.6	12.4
Av. carcass grade[a]	11.6	11.4	11.2	11.3
Av. dressing %[b]	59.4	58.4	59.2	58.7

[a]Code: 11 - high good; 12 - low choice; etc.
[b]Based on final liveweight and warm carcass weight.

WHAT BULL BUYERS SPEND THEIR MONEY FOR

Thomas J. Marlowe and George A. Morrow

In 1959 a beef cattle performance testing station was established at Culpeper, Virginia so that breeders could bring together at one location top indexing bull calves and compare their performance on a standardized feed test of 140-days duration. During the period 1958-1966, 800 Angus and Hereford bulls completed the test. There were a few Shorthorn and Charolais bulls also, but they were not included in this study.

All bulls completing the test and meeting the standards established by the Virginia Beef Cattle Improvement Association (BCIA) were eligible to sell in the Association-sponsored sale following the end of each feed test. Of the 514 Angus completing the test, 390 were sold, and of the 286 Hereford bulls, 233 were sold at public auction. Sales were held in the spring of each year since 1959, except that both a spring and fall sale were held in 1961. The bulls were sold to breeders in 19 states.

Several breeders who are performance testing bulls at home have inquired as to how the bulls should be priced for sale. It is of interest to all participants, both consignors and purchasers of the Culpeper-tested bulls, to know how the sale price has been influenced by the performance records made available to the buyers. This study was an attempt to answer this question and to determine what bull buyers spend their money for.

Materials and Methods

There are many variables which affect the sale price of bulls, and of course not all buyers are looking for the same things in their herd bull. We were limited in this study to those variables for which we had observations and which were made available in the sale catalog or could be seen by the buyer at the time of the sale. Variables included in this study were: (1) herds from which the bulls came, (2) year of sale, (3) preweaning ADG, (4) weanling grade, (5) weanling index value, (6) 365-day weight, (7) 140-day test ADG, (8) end-of-test grade, (9) sale weight, (10) lifetime index value, (11) age, (12) pedigree evaluation for dwarfism, (13) condition of the animal, (14) masculinity development, (15) tail setting and (16) horned or polled condition among the Herefords.

The 390 Angus bulls came from 61 herds and the 233 Hereford bulls from 45 herds. An estimate of the individual herd effect was obtained for each herd selling five or more bulls through the Culpeper sales. Herds selling less than five bulls were grouped together. Consequently, the number of bulls per herd ranged from 5 through 34, with an average of 15.4 for the Angus, and from 5 through 22, with an average of 9.7 for the Herefords. The composite groups contained 82 Angus and 48 Hereford bulls. A separate analysis was done for each breed. Bulls ranged in age from 11 to 20 months with the Angus averaging 426 days and the Herefords 430 days, or about 14 months each.

Least squares analyses were used to obtain estimates of herd and year effects and also to obtain the partial regression coefficients for certain discrete variables, such as grade, dwarfism classification, masculinity development, tail setting and the horned or polled condition of the Herefords. Continuous variables, such as age, 365-day weight, sale weight and preweaning, ROP test and lifetime gains, were included in the least squares regressions. In a separate analysis, multiple correlation and regression coefficients were obtained within each breed for preweaning ADG, weanling grade, ROP test ADG, end-of-test grade, lifetime ADG, sale age or weight, dwarfism status, masculinity development, condition score and year of sale. Herd effects were ignored in the latter analyses.

Results and Discussion

Most of the factors studied influenced the sale price of both Angus and Hereford bulls. The order of importance and the approximate dollar value of those traits having significant effects on sale price, except year and herd effects, are shown in the table below for both Angus and Hereford bulls. Herd and year effects were not included in the order of rank, although they both had a highly significant influence on sale price.

ORDER OF IMPORTANCE AND APPROXIMATE DOLLAR VALUE OF TRAITS HAVING A SIGNIFICANT EFFECT ON SALE PRICE

Order	ANGUS Trait	Dollar Value	Order	HEREFORDS Trait	Dollar Value
1	Final grade (pt.)	$137.13	1	Final grade (pt.)	$200.70
2	Age (mo.)	39.00	2	365-day wt. (100 lb.)	229.50
3	365-day wt. (100 lb.)	88.54	3	Clean Pedigree	104.27
4	Lifetime ADG (.1 lb.)	28.35	4	Polled Condition	106.37
5	Clean Pedigree	36.45	5	Prewean. ADG (.1 lb.)	20.94
6	ROP test ADG (.1 lb.)	11.20	6	ROP test ADG (.1 lb.)	13.84
			7	Age (mo.)	20.58
Average Sale Price		$601.58	Average Sale Price		$678.76

The average sale price of all Angus bulls was $601.58 and of all Hereford bulls $678.76. The largest single influence was year effect, which ranged from $142 below average to $184 above average for the Angus, and from $273 below average to $281 above average for the Hereford bulls. Likewise, herd effects ranged from $116 below to $150 above average for the Angus, and from $132 below to $195 above average for the Herefords.

When we took out the year effects and ignored the herd effects, we found that buyers paid more attention to conformation and type (grade) than to any other single factor. Angus buyers paid $137 and Hereford buyers paid $200 per each additional grade point. 365-day weight was considered very important by both Angus and Hereford breeders, as indicated by its ranking in second place by Hereford buyers and third place by Angus buyers. Hereford buyers paid 229.50 and Angus buyers 88.54 for each additional 100 lb. in 365-day weight.

Angus buyers considered age and/or weight of bull at sale time of more importance (second place) than did Hereford buyers (seventh place). Angus buyers paid $39 and Hereford buyers $20 for each additional month of age. Both Angus and Hereford buyers were conscious of the dwarfism problem and paid more money for bulls with clean pedigrees. Angus buyers paid $36.45 and Hereford buyers $104.27 more, on the average, for animals with ancestors free of the dwarf gene. In fact, Hereford buyers were so concerned that the consignors agreed, in 1963, that no Hereford bull would be consigned to the feed test that did not have a clean pedigree. Consequently, all Hereford bulls sold since 1964 have had their pedigrees searched by the American Hereford Association and declared free of dwarfism.

Lifetime ADG (gain from birth to end of feed test) was ranked fourth in priority by Angus buyers, worth $28.35 for each 0.1 lb. above the average, but had a significant negative influence on the sale price of Hereford bulls. On the other hand, Hereford buyers paid $20.94 for each additional 0.1 lb. above the average in preweaning gain; whereas, this trait had no significant influence on the sale price of Angus bulls. Neither Angus nor Hereford buyers let the ROP test gains influence them greatly in what they paid for a bull. It ranked last for Angus and next to last for Herefords among the traits that significantly influenced sale price.

Hereford buyers ranked the polled condition fourth in order of importance and paid an additional $106.37 per head for polled bulls. Buyers of both breeds apparently paid little or no attention to weanling grade, tail setting, masculinity development or condition, except as the latter two traits influenced grade.

When ADG and grade were combined into an index and included in the analysis instead of ADG and grade separately, and herd effects ignored, lifetime index became the most important effect on sale price of Angus bulls and second only to year effects on sale price of Hereford bulls. Each index point above the average was worth $21.60 for the Angus and $24.50 for the Herefords. (The values obtained from the least squares analysis in which herd effects were also removed were $24.74 for the Angus and $29.32 for the Herefords.) The index at weaning had no significant effect on the sale price of Angus bulls but was significant for the Herefords. The significant effect on the Herefords was probably due entirely to the preweaning ADG portion of the index.

Summary

This study was conducted to determine the major factors influencing the sale price of performance tested Angus and Hereford bulls. Of 800 bulls tested, 623 were sold at public auction to breeders in 19 states. Of the 14 factors studied, eight significantly influenced the sale price of Angus bulls and 9 significantly influenced the sale price of Hereford bulls. There were some breed differences, the most striking one being the importance placed on rapid preweaning gain by the Hereford buyers, whereas, Angus buyers considered it of only minor importance. The reverse was true for lifetime gains. Another major breed difference was the effect of age of bull on sale price. Buyers of both breeds considered conformation and type to be very important, along with rapid growth, freedom from the problem of dwarfism and the reputation of the breeder who consigned the bull for sale. Buyers of both breeds paid little attention to weaning grade, tail setting, condition or fatness, or masculinity development. The year to year fluctuations in sale price were highly significant.

PUREBRED VERSUS CROSSBRED COWS OF THREE BEEF BREEDS

J. A. Gaines, W. H. McClure, and R. C. Carter

The objective of this experiment is to compare the productivity of purebred and crossbred cows in terms of percentage calf crop born and weaned, birth and weaning weights of the calves, as well as their post-weaning performance. The cow herd, consisting of sixty purebreds (Angus, Hereford and Shorthorn), and sixty crossbreds (reciprocal two-breed crosses) among these three breeds, was purchased as calves in 1960. Contracts were made with six breeders to mate a random one-half of each herd to a bull of a different breed and half to a bull of the same breed. Thus both purebred and crossbred heifers came from each of six herds.

The heifers were bred first, as two-year-olds, in 1962. Six bulls were used the first year; twelve bulls were used the second and third years. Bulls used each year were two purebreds of each of the Angus, Hereford, and Shorthorn breeds, and two crossbreds of each of the crosses Angus x Hereford, Angus x Shorthorn, and Hereford x Shorthorn (or the reciprocals). The crossbred bulls were bred to the purebred cows and the purebred bulls to the crossbred cows. Thus all calves were either three-breed or back-crosses. All bull calves were castrated soon after birth.

This report is based on results from three calf crops. The total number of matings involved is 359. The average birth date of 168 calves from purebred dams was 18 Feb.; it was 16 Feb. for 171 calves from crossbred dams (Table 1). Bull calves from purebred dams weighed 72.7 lbs. at birth; those from crossbred dams weighed 75.4 lbs. Heifer calves from purebred dams weighed 69.4 lbs. at birth; those from crossbred dams weighed 70.1 lbs. (Table 1). From 180 matings of purebred cows, 93.3% calved and 89.9% weaned calves; from 179 matings of crossbred cows, 95.5% calved and 92.7% weaned calves (Tables 2 and 3).

Steers from purebred dams weighed 423 lbs. at weaning; those from crossbred dams weighed 446 lbs. Heifers from purebred dams weaned at 406 lbs.; those from crossbred dams weighed 435 lbs. There was only two days' difference between the ages of calves from purebred cows and calves from crossbred cows (Table 4). Feeder grade at weaning was low choice for all groups (Table 5).

With respect to post-weaning performance, 81 steers from purebred dams gained 2.22 lbs./day on full feed, graded low choice alive before slaughter, and graded high choice in the carcass. The slaughter weight of these steers was 900 lbs., the carcass weight was 536 lbs., and the dressing percent was 59.5. The 76 steers from crossbred dams gained 2.30 lbs./day on feed, and graded low choice before slaughter and in the carcass; their slaughter weight was 940 lbs., carcass weight was 555 lbs., and dressing percent was 59.2 (Tables 6 and 8).

Seventy-one heifers from purebred dams gained 1.98 lbs./day on feed, and graded low choice before slaughter and in the carcass; their slaughter weight was 752 lbs., carcass weight was 443 lbs., and dressing percent

was 58.7. Sixty-nine heifers from crossbred dams gained 2.00 lbs./day on feed, and graded low choice before slaughter and in the carcass; their slaughter weight was 783 lbs., carcass weight was 461 lbs., and dressing percent was 58.9 (Tables 7 and 9).

Tentative conclusions at this time are: (1) crossbred cows weaned 2 to 3 percent more calves than purebred cows, (2) weaning weights of steer calves were 23 lbs. in favor of crossbred dams, and weaning weights of heifer calves were 29 lbs. in favor of crossbred dams, (3) steer calves from crossbred cows weighed 40 lbs. more at time of slaughter and had heavier carcasses by 19 lbs., when compared to steers from purebred cows, (4) heifer calves from crossbred cows weighed 31 lbs. more at time of slaughter and had heavier carcasses by 18 lbs., when compared to heifers from purebred cows. Other differences were small.

TABLE 1. BIRTH DATES AND WEIGHTS

Breeding of Dams	Av. Birth Date	Av. Birth Weight, lbs.	
		Males	Females
Purebred	18 Feb.	72.7	69.4
Crossbred	16 Feb.	75.4	70.1
Difference	2 days	2.7	0.7

TABLE 2. COWS BRED, COWS CALVING, CALVES BORN AND CALVES ALIVE AT 36 HOURS

Breeding of Dams	Cows Bred	Cows Calving		Alive at 36 Hours
		No.	%	
Purebred	180	168	93.3	167
Crossbred	179	171	95.5	169
Difference			2.2	2

TABLE 3. CALVES WEANED OF COWS BRED

Breeding of Dams	Cows Bred	Calves Weaned	Calves Weaned of Cows Bred, %
Purebred	179	161	89.9
Crossbred	178	165	92.7
Difference			2.8

TABLE 4. AGES AND WEANING WEIGHTS

Breeding of Dams	Av. Age at Weaning	Weaning Weight, lbs.	
		Steers	Heifers
Purebred	229 days	423	406
Crossbred	231 days	446	435
Difference	2 days	23	29

TABLE 5. FEEDER GRADE AT WEANING

Breeding of Dams	Feeder Grade	
	Steers	Heifers
Purebred	11.5	12.0
Crossbred	12.0	12.1

Grade Code: Choice, 12; Good Plus, 11.

TABLE 6. POST-WEANING DATA ON STEERS

Breeding of Dams	No. Fed	Daily Gain, lbs.	Slau. Grade	Carcass Grade
Purebred	81	2.22	11.9	12.7
Crossbred	76	2.30	12.1	11.8
Difference		.08	0.2	0.9

TABLE 7. POST-WEANING DATA ON HEIFERS

Breeding of Dams	No. Fed	Daily Gain, lbs.	Slau. Grade	Carcass Grade
Purebred	71	1.98	11.9	11.9
Crossbred	69	2.00	12.1	11.7
Difference		0.02	0.2	0.2

TABLE 8. POST-WEANING DATA ON STEERS

Breeding of Dams	No. Fed	Slaughter Weight, lbs.	Carcass Weight, lbs.	Dressing Percent
Purebred	82	900	536	59.5
Crossbred	75	940	555	59.2
Difference		40	19	0.3

TABLE 9. POST-WEANING DATA ON HEIFERS

Breeding of Dams	No. Fed	Slaughter Weight, lbs.	Carcass Weight, lbs.	Dressing Percent
Purebred	71	752	443	58.7
Crossbred	69	783	461	58.9
Difference		31	18	0.2