Progress Reports: Feeding Tests With Sheep, Swine, and Beef Cattle, 1945-46

DEPARTMENT OF ANIMAL HUSBANDRY

and Cooperating Departments

OKLAHOMA AGRICULTURAL EXPERIMENT STATION
Oklahoma A. and M. College, Stillwater

W. L. BLIZZARD, Director LOUIS E. HAWKINS, Vice Director

Experiment Station Bulletin No. 296 April, 1946

Contents

Feeding Dried Sweet Potatoes to Fattening Hogs

By C. P. THOMPSON

A feeding experiment was initiated in which we are attempting to find the value of dried sweet potatoes for fattening hogs. The rations used and the method of feeding given in Table I. The hogs had been on feed only 44 days at the time the data in Table I were prepared, so the results can be considered only as preliminary and definite conclusions sholud not be drawn.

The protein supplement used in all lots consisted of 4 parts meat scraps, 2 parts cottonseed meal, 2 parts soybean meal, and 2 parts dehydrated alfalfa meal. The corn fed was ground yellow corn of fair quality. The sweet potatoes were secured from Louisiana as the Oklahoma product was not available; they were an artificially dehydrated product that had been finely ground and had a pleasant aroma and bright color. All lots were fed a simple mineral mix consisting of equal parts of salt, bone meal and finely ground limestone. Water was available at all times to all the hogs.

TABLE I.—Preliminary Report of Feeding Dried Sweet Potatoes for Fattening Hogs.

Lot No.	I	II	III	IV	V	VI
	Corn Protein Supplement Self-fed	Sweet potatoes Protein Supplement Self-fed	Corn Sweet potatoes Protein Supplement Self-fed Separately	Corn 75% Sweet potatoes 25% Protein Supplement Self-fed	Corn 50% Sweet potatoes 50% Protein Supplement Self-fed	Corn 25% Sweet potatoes 75% Protein Supplement Self-fed
No. of hogs	10	10	10	10	10	10
Days fed	44	44	44	44	44	44
Av. initial wt.	107.8	104.5	100.6	100.6	100.3	106.5
Av. final wt.	166.2	139.3	153.1	148.6	143.3	143.9
Total gain	58.4	34.8	52.5	48.0	43.0	37.4
Av. daily gain	1.33	.79	1.18	1.10	.98	.85
Feed per 100 lbs. gain						
Corn	428		212	312	233	101
Sweet potatoes		632	120	104	233	303
Protein supplement	58	118	60	67	91	107
Total	486	750	492	483	557	511
Supplement used (pct. of ration)	12.0	15.7	12.2	13.8	16.3	20.9

The Experimental Range Unit

The Area

The range experimental work conducted by the Animal Husbandry and Cooperating Departments of the Oklahoma Agricultural Experiment Station is carried on in the area of Lake Carl Blackwell 12 miles west of Stillwater. A tract of 4500 acres, which borders the north side of the lake, is divided into experimental pastures, reserve pastures, and hay meadows for various experiments with range beef cattle. Corrals, scales, and other physical equipment, while not elaborate, are arranged for carrying on an experimental program.

Little Bluestem is the predominating grass in the area but Big Bluestem, Side Oats Grama, Buffalo and Blue Grama are also found in appreciable quantities. Various less common grasses and weeds are present. The soil of the area is underlain by sandstone, and the characteristic color of the surface soil is well described by the name "Redlands" that applies to the recreational area adjacent to the experimental range.

The area now occupied in range experimental work with beef cattle was formerly privately owned but was purchased by governmental agencies in the middle 1930's and later turned over to the Oklahoma Station for investigational purposes. Some of the area had been farmed, some had been used for hay meadows, while the remainder had been used for grazing.

The Steer Pastures

The steer pastures are approximately 200 acres in size. Each consists of about 55% good grass sod and 45% old fields that are in process of reseeding. Ample shade is available in each pasture and all lots border on the lake from which the cattle water.

The Cow Pastures

The No. 1 cow pasture in which the cows are grazed in summer but confined and fed in a trap in the winter is of approximately 170 acres. Consequently the cows had 8.5 acres each for the summer months, of which about 19% was old field and the remainder was native sod. Their hay was cut in August from an area very similar to the native sod of their pasture. The cows in lots 2 and 3 were grazed the entire year in pastures of approximately 245 acres. The proportion of old fields to grass land was similar to that of the other cows. The cows had shade available and were watered from wells.

The Experimental Cattle

All the cattle used in these experiments were well bred grade Herefords that represent the better kind of commercial cattle found on many Oklahoma ranches. The cows were either raised by the Experiment Station or purchased from cattlemen of the state. Good purebred Hereford bulls were used on these cows. The steers used in the experiments were good to choice and were range raised. The previous history and present condition of all cattle was considered in securing uniform experimental lots. Standard experimental procedure was followed in dividing the cattle into uniform lots.

The Utilization of Bluestem Grass in Maintaining The Commercial Cow Herd

By A. B. DARLOW, V. G. HELLER, W. D. CAMPBELL and J. C. HILLIER

Winter feed is a major problem for those maintaining a cow herd in the Bluestem area. Bluestem and associated grasses are generally recognized as producing excellent summer but poor winter feed. As these grasses mature their feeding value declines, so that by fall and winter they have only a fraction of their former nutritive value. The greatest losses are in the protein and phosphorus content of the dry grass.

Two methods of maintaining a commercial cow herd have been tested at this station for the past four years. They are: (1) Yearlong grazing on 10 acres of Bluestem grass and 2.25 acres of old fields per cow; plus the feeding of cottonseed cake during the five winter months; (2) grazing for seven months on 7 acres of Blustem grass and 1.6 acres of old fields plus the feeding of prairie hay and cottonseed cake in a five-acre trap during the five winter months.

Two groups of 20 good, grade Hereford cows were placed on this experiment in the spring of 1942. Since then the older and poorer producing cows have been culled and replacements added. Every effort has been made to keep the two groups as much alike as possible as to age, breeding, and conformation. Good purebred bulls have been used. The breeding and producing efficiency of the herd has been maintained at a very high level throughout the experiment.

Results of the first three years work on this experiment were reported at the 19th Annual Livestock Feeders' Day in 1945. In order to study the effects of these two systems of

grazing on the productivity of the pastures, a change was made in the spring of 1945. The pasture that was formerly grazed only seven months has been enlarged and is now grazed yearlong, and the pasture formerly grazed yearlong has been reduced in area and grazed for seven months only. Results are shown in Table I.

TABLE I.—Yearlong Grazing vs. Summer Grazing and the Winter Feeding of Hay for the Commercial Cow Herd on Bluestem Ranges.

	Grazed Yearlong	Grazed 7 mo. Fed Hay 5 mo.
Summer Period		
Weights (pounds)		
Av. weight per cow April 7, 1945	978	970
Av. weight per cow Nov. 3, 1945	1000	980
Av. gain per cow during period	22	10
Calf Crop (pounds)		
Av. birth weight per calf	69	73
Av. weaning weigh per calf (Oct. 23, 1945)	413	418
Wintering Period (1945-1946)		
Weights (pounds)		
Av. weight per cow Nov. 3, 1945	993	980
Av. weight per cow before calving	1006	1051
Av. gain per cow up to calving	13	71
Av. weight per cow at end of winter period (April 3, 1946)	904	923
Av. loss per cow for winter period (Nov. 3-April 3)	—89	—57
Av. birth weight per calf	67	68
Average Daily Ration (pounds)		
Cottonseed meal (41%)	2.97	1.32
Prairie hay	None	20.36
Bluestem grass	Free-choice	None
1-1-1 Mineral	.02	.02
Salt	.03	.03
Cost of Year's Feed Per Cow (dollars)		
*Bluestem grass (10 and 8.54 acres resp.)	14.00	11.96
Cottonseed cake	12.40	5.57
Cost of making 3074 pounds of hay	----	9.22
1-1-1 Mineral	.08	.12
Salt	.08	.08
Total cost	26.56	26.95

* Grazed yearlong, 10 acres pasture. Grazed and fed, 7 acres pasture, 1.54 acres meadow.

FEED AND GRASS PRICES

Bluestem grass	$1.40 per acre	41% Cottonseed cake	$56.00 per ton
Cost of cutting, baling, and stacking hay	6.00 per ton	1-1-1 Mineral mix.	31.00 per ton
		Salt	15.00 per ton

Both groups have been provided salt and a mineral mixture of equal parts of salt, steamed bone meal and ground limestone. Samples of blood have been taken from the cows in each group at regular intervals and analyzed for calcium, phosphorus and carotene. The analyses are summarized in Table II. Table III shows the chemical analyses of the feeds used.

Summary

1. Grazing yearlong and feeding 2.97 pounds of 41% cottonseed cake per head daily during the winter period proved to be a slightly more economical way to winter cows during this fourth winter trial. Heavy late September rains and a very dry and open winter with very little green feed characterized the grazing conditions. The hay was of fair quality.

2. The feeding of one ton of prairie hay saved 158 pounds of cottonseed cake and .97 acres of grass in maintaining the commercial cow herd. The cost of cutting, baling and piling a ton of hay was figured at $6.00. The cake and grass saved by feeding the hay has a present value of $5.78. No charge was made for the labor of feeding either lot of cattle.

TABLE II.—Chemical Analyses of Cow's Blood.

	*Mg /100 ml plasma.		**Micrograms /100 ml plasma.
	Calcium*	Phosphorus*	Carotene**
Lot I, Grazed yearlong			
Oct. 22, 1945	10.9	3.08	295
April 3, 1946	10.5	4.47	1125
Lot II, Grazed 7 months, hay 5 months			
Oct. 22, 1945	11.1	3.25	459
April 3, 1946	10.4	4.20	576

TABLE III.—Chemical Analyses of the Feeds Used.
(Percent)

	Water	Ash	Protein	Fat	Fiber	N.F.E.	Ca.	P.	Carotene*
Prairie hay**	8.43	6.19	3.13	2.25	30.54	49.46	.455	.043	24.92
Native grass (11-11-45)	6.62	7.36	2.54	1.65	31.96	49.87	.425	.030	5.99
Native grass (3-14-46)	8.38	5.60	2.02	1.57	33.26	49.17	.262	.018	†
Cottonseed cake	7.62	7.18	41.00	6.48	8.41	29.31	.190	1.158	

* Micrograms per gram.
** Prairie hay cut August 25, 1945—Yield 1 ton per acre.
† Negligible.

3. As in past years there was no significant difference in the birth or weaning weight of the calves from these two groups of cows or in the average weights of the cows at the end of the summer grazing season. The group grazed yearlong have lost slightly more weight during the winter but gained it back during the summer grazing season. Excellent breeding efficiency has been maintained in both groups.

Protein and Mineral Supplements for Wintering Two-Year-Old Steers on Grass

By A. E. DARLOW, V. G. HELLER, W. D. CAMPBELL, J. C. HILLIER and J. A. HOEFER

The nutrient deficiencies of mature Bluestem grass have become so well-recognized that it is a common practice to feed a protein supplement to steers wintered on grass. This practice corrects to a certain degree the protein, mineral (usually phosphorus) and energy deficiencies of the dry native grass. The variation of natural protein supplements in mineral content (chiefly phosphorus), and the availability of supplements containing urea, makes it important to determine the comparative value of these supplements when fed to cattle wintered on grass.

Another problem in the wintering of steers is the shrink which commonly occurs between the time grass starts to grow in the spring and the time it has made sufficient growth to meet the requirements of the cattle. The Experiment Station is now trying to establish methods of holding winter gains, and to determine the difference in summer gains among steers handled in different ways during the period March 15 to April 15 when steers continued on pasture usually shrink.

Objectives

The objectives of the experiment are as follows:

1. To determine the comparative value of cottonseed cake, soybean cake and urea* pellets as sources of protein for two- and three-year-old steers wintering on dry native grass.

2. To determine the value of adding steamed bone meal as a supplement to soybean meal.

* See footnote to Table II.

3. To study the relationship between the estimated calcium and phosphorus intake of the steers and calcium and phosphorus level in the blood.

Procedure

Ninety-six two- and three-year-old steers were divided, according to accepted experimental procedure, into four lots and placed in four similar 200-acre pastures and fed as follows:

Pasture I—Lot 1
Cottonseed cake
Salt (free-choice)

Pasture II—Lot 2
Soybean cake
Salt (free-choice)

Pasture III—Lot 3
Soybean cake
Salt (free-choice)
Steamed bone meal in sufficient quantity to provide the same phosphorus intake as Lot 1

Pasture IV—Lot 4
Urea pellets
Salt (free-choice)
Steamed bone meal in sufficient quantity to provide the same phosphorus intake as Lots 1 and 3

The protein supplements were fed in equal amounts to all four lots. At regular intervals, the sters were weighed and samples of feed, grass and blood (from 10 steers in each lot) obtained for chemical analysis.

Results

The preliminary results obtained this year, the first year of a three-year study, are shown in Table I. Tables II and III show the chemical analyses of the feeds and the calcium, phosphorus and carotene content of the blood of the steers.

Summary and Observations

Since the data reported herein represent the results of only one year's work, all conclusions and observations are tentative.

1. Soybean cake was slightly superior to cottonseed cake in producing winter gain, although the difference was small. Both of these supplements were definitely better than the urea pellets, which supported a daily gain of only .05 pound.

2. The addition of .12 pound (1.92 oz.) of special steamed

bone meal to the soybean cake increased the rate of gain approximately .1 pound per day.

3. The feeding of bone meal to the steers in Lot 3 and Lot 4 in amounts sufficient to equalize the phosphorus intake with that of the steers in Lot I resulted in slightly higher average blood phosphorus levels for the mineral-fed steers.The differ-

TABLE I.—Results of Feeding Protein and Mineral Supplements to Steers Wintered on Bluestem Pasture.
(Nov. 6, 1945 to March 12, 1946—126 days)

	Lot 1	Lot 2	Lot 3	Lot 4
Supplements*	Cottonseed cake	Soybean cake	Soybean cake Bone meal	Urea pellets Bone meal
No. of Steers	24	24	24	24
Average Weights Per Steer (Lbs.)				
Initial weight	854	854	854	854
Final weight	887	900	911	860
Total gain	33	46	57	6
Daily gain	.26	.36	.45	.05
Average Daily Ration (Lbs.)				
Bluestem grass	†	†	†	†
Cottonseed cake	3.02	---	---	---
Soybean cake	---	3.07	3.07	---
Urea pellets	---	---	---	3.02
Salt	.07	.11	.12	.08
Bone meal	---	---	.12	.05
Winter Cost Per Steer (Dollars)				
Bluestem grass	4.00	4.00	4.00	4.00
Cottonseed cake	10.65	---	---	---
Soybean cake	---	11.22	11.22	---
Urea pellets	---	---	---	11.04
Salt	.07	.10	.11	.08
Bone meal	---	---	.49	.20
Total feed cost	14.72	15.32	15.82	15.32
Returns (Dollars)				
Initial cost @ 13.00 per cwt.	111.02	111.02	111.02	111.02
Total cost (steer plus feed)	125.74	126.34	126.84	126.34
Appraised price per cwt.				
March 12	16.00	16.00	16.00	16.00
Value per head (less 3% shrink)	137.66	139.68	141.39	133.47
Return per head	11.92	13.34	14.55	7.13

* All lots received salt free-choice.
** Initial and final weights represent an average of 3 days' weight.
† All lots had equal Bluestem pasture.

FEED PRICES

Bluestem grass	$ 4.00 per steer	Urea pellets	$58.00 per ton
Cottonseed cake	56.00 per ton	Salt	15.00 per ton
Soybean cake	58.00 per ton	Steamed bone meal	65.00 per ton

ence, however, was small and is apparently without significance as regards the rate of gain.

4. Blood levels of calcium and phosphorus were normal for all lots.

5. Grazing conditions during the winter season 1945-46, as indicated by rate of gain, were very poor as compared with former years. Rainfall during the last two weeks of September was excessive, followed by an extremely dry period which remained unbroken until January 1946. The unfavorable weather conditions apparently had a detrimental effect on the winter grass. Further evidence of the poor grazing conditions is furnished by the low blood carotene values of the steers during the late stages of the wintering period. This year the level of carotene in the blood during February was only about one-third as high as values obtained a year ago, indicating that practically no green feed was available.

TABLE II.—Chemical Composition of Feeds.

Description	PERCENTAGE COMPOSITION OF DRY MATTER								
	Moisture	Ash	Protein	Fat	Fiber	NFE	Ca	P	Carotene (ppm)
Grass May '45	78.40	8.8	16.4	3.4	32.0	39.4	.419	.312	400.0
Grass Nov. '45	6.46	8.41	2.41	1.91	35.00	52.26	.479	.032	7.6
Grass Mar. '46	8.38	6.11	2.21	1.71	36.31	53.68	.286	.020	0
Cottonseed cake	7.62	7.77	44.37	7.01	9.10	31.72	.206	1.253	--
Soybean cake	12.55	6.46	45.99	6.05	5.88	35.62	.404	.649	--
Urea pellets*	9.65	6.60	46.24	5.45	7.47	34.24	.222	1.018	--
Steamed bone meal	3.12	90.60					33.50	14.69	--

* Urea pellets (43% protein equivalent) consisted of urea, hominy feed, cottonseed meal and blackstrap molasses, with approximately 25 percent of the nitrogen being furnished by urea.

TABLE III.—Calcium, Phosphorus, and Carotene Content of the Blood of Steers Receiving Different Supplements.

Lot	Supplement	Calcium*		Phosphorus*		Carotene**	
		Initial	Final	Initial	Final	Initial	Final
1	Cottonseed cake	11.7	10.7	5.00	5.16	396	89
2	Soybean cake	10.7	11.1	5.29	5.13	393	67
3	Soybean cake+ bone meal	11.2	10.8	5.36	5.26	343	87
4	Urea pellets+ bone meal	11.1	11.4	5.17	5.84	353	83

* Mg. per 100 ml. plasma.
** Micrograms per 100 ml. plasma.

Vitamin A (Carotene) in Rations For Sheep and Cattle

By J. A. HOEFER, W. D. GALLUP, and J. C. HILLIER

The complete or balanced ration is one which supplies energy (carbohydrates and fats), protein, minerals and vitamins in amounts adequate to meet the requirements of the animal. Quite frequently so much emphasis is placed on the first three nutrients mentioned that the vitamin requirements of our farm animals are overlooked. Under some conditions this oversight may result in serious loss.

Fortunately for the cattleman and sheepman, not all of the forty or more known and unknown factors called vitamins have to be considered seriously in preparing balanced rations. Sheep and cattle, being ruminants, are unique in that they have the ability to synthesize many of the vitamins which must be supplied in rations of non-ruminants. However, one vitamin which is just as essential as protein and minerals in the rations of sheep and cattle is vitamin A, usually supplied in the form of its provitamin, carotene.

Vitamin A is a fat soluble vitamin found only in animal tissue and never in plant tissue. Carotene, a yellow pigment, however, is present in varying quantities in plants and this compound can be converted by the animal into vitamin A. The best and most practical sources of carotene for sheep and cattle are green pastures, hays which are cured so as to retain much of their original green color, and high quality silages. The cereal grains (with the exception of yellow corn), the protein supplements, old hay or improperly cured hay, mature grass, and drought-parched pastures are practically devoid of carotene and are therefore of little value as sources of vitamin A to farm animals.

Although numerous symptoms of a typical vitamin A deficiency might be listed, the practical results of feeding rations low in vitamin A (carotene) are reproductive disturbances, characterized by irregular estrous cycles, low breeding efficiency, retained placentae, sterility, and weak or dead offspring at time of birth. Cows and ewes will frequently conceive and then later either abort or give birth to weak or blind offspring, which often fail to survive. Cows may appear to be normal in all respects and yet give birth to calves so deficient in vitamin A that they have little chance of survival. Such calves often have diarrhea, and frequently develop pneumonia.

Calves and lambs, even under the best of feeding conditions, are born with a very low reserve of vitamin A in their bodies. This condition makes it extremely important that they receive an adequate amount of vitamin A during this most critical period, the first month of their lives. The need for vitamin A is one of the reasons why colostrum milk plays such an important role in the nutrition of young animals. Under normal conditions colostrum milk is 10 to 20 times richer in vitamin A than is normal, whole milk.

An early indication of vitamin A deficiency is nightblindness or an inability to see in dim light. This symptom is one of the first to be observed in fattening cattle fed for extended periods on rations containing a high proportion of grain and a limited amount of low-grade roughage. Nightblindness may also develop in animals maintained on winter pastures or on pastures damaged by insufficient rainfall and overgrazing.

A question of prime importance to the feeder is when or how soon will symptoms of vitamin A deficiency appear after an animal is placed on a deficient ration? The answer to such a question is not a simple one for the reason that it is conditioned by a great many factors. In general, deficiency symptoms will appear when the vitamin A reserves of the body have been exhausted; this may require from 30 to 200 or more days. All animals have the ability to store great quantities of vitamin A (and carotene in the case of cattle) during periods of high carotene intake. The chief storage place in the body is the liver, which may contain 90 percent or more of the total vitamin A reserves. Some vitamin A and carotene is stored in the fat deposits of the body. Grass-fattened beef is sometimes yellow because it contains a large amount of carotene. It is important to remember that these reserves are available for use by the animal whenever the ration fails to supply sufficient carotene to meet minimum requirements, and that deficiency symptoms do not develop until these reserves are used up.

The condition of an animal is not necessarily a good measure of the vitamin A storage in the body or the adequacy of the ration. The best yardstick available at the present time is the amount of carotene and vitamin A in the blood, and also the amount stored in the liver when this data is available. These measures properly used and interpreted are a fairly reliable index of the state of vitamin A nutrition of an animal.

The data in Table I show the relationship between the type of ration fed and the concentration of carotene and vitamin A in the blood and liver of two-year-old steers. These data were collected at this Station during the summer and fall of 1945. Twenty head of steers were divided into four lots and treated as follows:

Lot 1—Dry lot 112 days; full fed shelled corn (yellow) cottonseed cake and prairie hay.

Lot 2—Pasture 112 days.

Lot 3—Same as Lot 1 but for 175 days.

Lot 4—Pasture 112 days plus dry lot feeding 63 days.

The data in Table II show liver and blood plasma vitamin A of sheep in relation to carotene intake. Since sheep do not store carotene, the values given are for vitamin A only.

TABLE I.—Average Carotene and Vitamin A Level in the Blood and Liver of Steers Under Different Systems of Management.†

Lot	Management	Period	Blood Plasma*		Liver**	
			Carotene	Vitamin A	Carotene	Vitamin A
1	Dry lot	Apr. 28-Aug. 18	117.6	22.9	227.0	2797.0
2	Pasture	Apr. 28-Aug. 18	523.0	25.4	1057.4	6996.4
3	Dry lot	Apr. 28-Oct. 20	85.3	19.0	189.1	941.3
4	Pasture+	Apr. 28-Aug. 18				
	Dry lot	Aug. 18-Oct.20	97.0	27.7	297.1	4828.3

* Micrograms per 100 ml plasma.
** Micrograms per 100 grams of liver.
† Five steers per lot. Days in period: Lot 1, 112; Lot 2, 112; Lot 3, 175; Lot 4, 112 in pasture and 63 in dry lot.

TABLE II.—The Vitamin A Content of the Blood and Liver of Lambs.

No. of Lambs	Carotene intake per day (Mg.)	Days	Plasma* Vitamin A		No. of livers	Liver** Vitamin A
			Initial	Final		
18	0	187	20.6	13.6	4	974.8
18	5.82	187	22.2	27.7	6	3922.6
The following lambs were fed a low carotene ration for 194 days followed by a carotene supplement for 92 days:						
6	1.94	92	13.3	19.1	4	166.8
6	3.88	92	13.2	23.9	4	499.5
The following lambs received a limited carotene intake for 373 days and were then turned out on green pasture for 7 days before being slaughtered:						
7	Pasture	7	16.4	35.1	7	1553.6

* Micrograms per 100 ml plasma.
** Micrograms per 100 grams of liver.

An examination of the data presented in the tables shows that both sheep and cattle have a great capacity to store vitamin A in their bodies while on rations rich in carotene, the precursor of vitamin A. It is also apparent that these reserves are used up when the animal is placed on a deficient ration and the animal will have protection in direct proportion to the amount of vitamin A stored.

A good feeding program therefore is one which will take into consideration the requirements of the animal not only for energy, proteins and minerals but also for vitamins, especially vitamin A. Such a program makes maximum use of high quality pastures and roughages. The inclusion of good pasture or a high quality dry roughage in the ration will cover up a multitude of feeding errors; when these feeds are not available a deficiency of vitamin A may result.

In addition to studying the requirements of our farm animals for vitamin A and the relationship between intake and storage, this Station is also investigating the comparative nutritive value of different sources of carotene and the effect of other factors, such as urea, other vitamins, etc., upon the level of vitamin A in the blood stream and its retention in the liver.

Linebreeding

By J. A. WHATLEY, JR.

Since the time of Robert Bakewell in the 18th Century, linebreeding has been used successfully by many prominent breeders of purebred livestock. The methods of Bakewell were so successful that most of the founders of our present breeds of livestock followed his methods in developing their foundation herds.

What Is Linebreeding?

Essentially, linebreeding consists of the mating of animals in such a way that their offspring will remain closely related to an unusually desirable ancestor. As a system of breeding it usually enjoys a better reputation among breeders than an inbreeding system not directed toward some chosen ancestor.

Linebreeding is accomplished by mating animals which are both related to the desired animal but there is no relationship (or at least only a small amount) between the mated animals through any other common ancestor. Since the mated animals are both related to the animal to which the linebreeding is

directed, their offspring will naturally be inbred to a certain extent. Thus linebreeding involves some inbreeding, although it is usually inbreeding of a mild form and nearly all of the inbreeding is due to the animal being linebred too.

Some Linebred Pedigrees.

Figure 1 illustrates a linebred pedigree. Miss D. Master is an Angus cow linebred to the bull, Evascus of Page, who appears three times in this four-generation pedigree. Measuring the relationship by the percentage-of-blood method, we find that Miss D. Master has 62½ percent of the blood of Evascus of

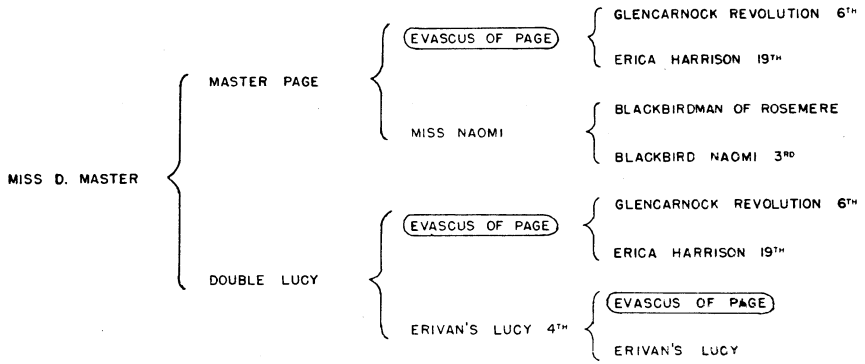

Fig. 1.—Pedigree of an Angus cow showing linebreeding to Evascus of Page. Relationship between Evascus of Page and his linebred daughter is 57% (62½% of blood). The inbreeding of Miss D. Master is 18¾%.

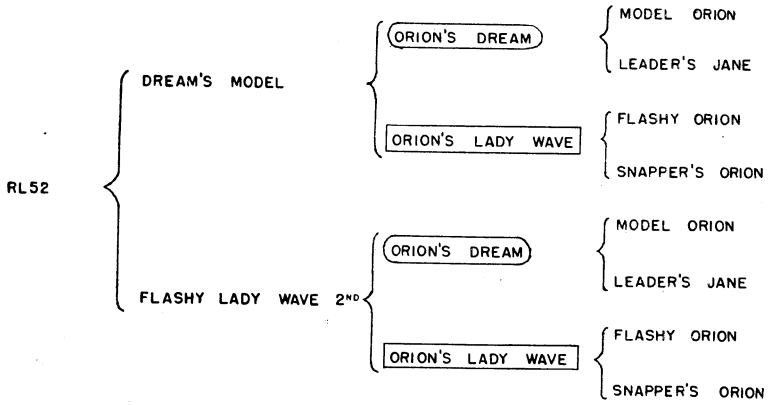

Fig. 2.—Pedigree of the Duroc Jersey boar RL52 whose sire and dam are full brother and sister. RL52 has 50% of the blood of Orion's Dream as well as 50% of the blood of Orion's Lady Wave (Relationship equals .45). He is 25% inbred.

Page and is more closely related to him than if she were an own daughter. Contrast this pedigree with the pedigree in Figure 2, which shows more inbreeding than Figure 1 (25 percent as compared to 18¾ percent) but does not show linebreeding toward a particular ancestor. RL52 is as closely related (45 percent or 50 percent of blood) to his double granddam, Orion's Lady Wave, as he is to his double grandsire, Orion's Dream. RL52 then is not a linebred animal, but Miss D. Master is clearly linebred to Evascus of Page.

Linebreeding may involve rather intense inbreeding such as the mating of daughter to sire, or it may be such as to involve rather mild inbreeding as cousin matings. The degree of inbreeding involved in a linebreeding program will depend upon the degree of relationship between the sire and dam.

Figure 3 shows an arrow type pedigree of Prince Barbarian of Sunbeam who is a linebred Earl Marshall bull. Notice that in a pedigree constructed in this manner each ancestor appears only once. If an ancestor appears more than once in the pdeigree an additional arrow is drawn to each offspring. Such a diagram of a pedigree brings out more clearly the influence of the animal to which the linebreeding is directed. Five of the direct ancestral lines in this pedigree are stopped in the 3rd or 5th generation by Earl Marshall. The concentration of Earl Marshall blood is not as intense here as the concentration of Evascus of Page blood in Figure 1 in which more closely related individuals were mated. The relationship of Prince Barbarian of Sunbeam to Earl Marshall is 26 percent, which is just slightly more than that of grandson and grandsire. The inbreeding of Prince Barbarian, all of which is due to Earl Marshall, is less than 6 percent, which is very low. This is an illustration of a mild type of linebreeding which involves a very mild amount of inbreeding. The inbreeding in this kind of pedigree would certainly not be too intense for effective control by selection.

Figure 4 is an illustration of deliberate and intense linebreeding to Prince Domino. The intent to maintain a high relationship to Prince Domino is clearly obvious here. The Hereford bull, Real Prince D. 55th, has a relationship of 57 percent (62½ percent of blood) to Prince Domino. Because of the higher relationship to the common ancestor there is also a greater amount of inbreeding involved (20 percent) as compared to Figure 3 (6 percent). If a high relationship is to be maintained to a common ancestor, a reasonable amount of inbreeding will be incurred. In this pedigree it is also of interest to note that both the sire and dam of Real Prince D. 55th carry 62½ percent of the blood of Prince Domino.

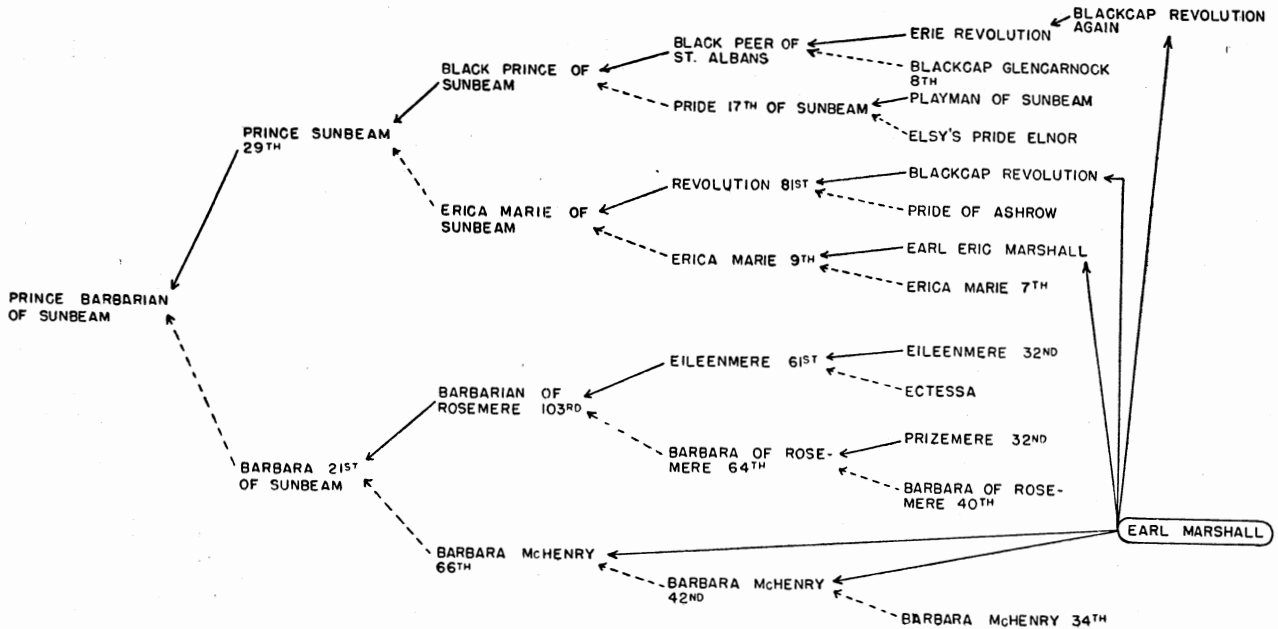

Fig. 3.—Pedigree of Prince Barbarian of Sunbeam whose rel ationship to Earl Marshall is 26% (27% of blood). His inbreeding is only 6%, all due to Earl Marshall.

Why Linebreed?

The purpose of linebreeding is to maintain a high relationship to some chosen ancestor so that a reasonable amount of his good points may be maintained in the herd while further improvement is being made by selection.

When an unusually desirable animal is found, a system of linebreeding is the only means available by which his desirable inheritance can be maintained or built up in a herd. Without a linebreeding program the ancestor's inheritance will be halved in each succeeding generation after his use. For example the relationship of a son to his sire is 50 percent, grandson to grandsire 25 percent, great grandson to great grandsire 12½ percent, etc.

Many outstanding breeding animals are old or dead before their breeding abilities are realized. When such an animal is found it may be desirable to spread his inheritance throughout the herd. This can easily be accomplished as long as he is alive by extensive use of his sons and daughters, but after his death the only way to concentrate his blood in the herd is by mating of his descendants with each other.

Linebreeding is an effective means of increasing prepotency or the ability of an individual to transmit his traits to his offspring. The inbreeding that is incurred in a linebreeding program will tend to fix the heredity of the individuals so that they breed true. Unfortunately inbreeding will fix undesirable traits as quickly as it will fix desirable traits. It is this tendency to uncover undesirable traits which requires that intense selection be practiced in a linebreeding program in order to eliminate the individuals with the undesirable traits as they are produced in the herd. The selected individuals of the desired kinds then will be more prepotent and will be more likely to transmit desirable inheritance to their offspring. Intense se-

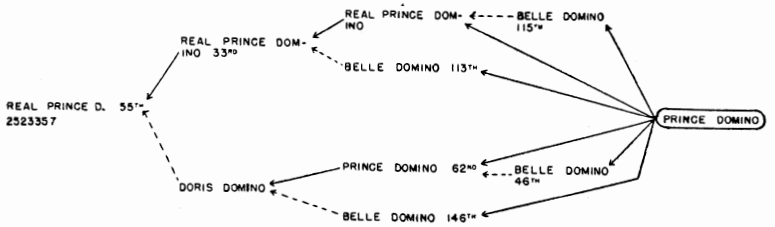

Fig. 4.—Pedigree of the Hereford bull Real Prince D. 55th, showing intense concentration of the blood of Prince Domino. His relationship to Prince Domino is 57% (62½% of blood). His inbreeding is 19½%.

lection with linebreeding toward an individual of proven breeding ability should enable a breeder to fix some of the good characteristics of the ancestor being linebred to, and thus make his progeny more prepotent for his desirable traits. The breeder should be cautioned at this point that linebreeding involving too rapid a rate of inbreeding may result in such a rapid fixation of undesired traits that he cannot eliminate them all by selection.

Who Should Linebreed?

Linebreeding should only be practiced in purebred herds which are well above average in individual merit and consequently have a higher proportion of desirable hereditary factors. Linebreeding in any herd of lower qualifications will likely result in the fixation of more harmful than beneficial traits and consequently cause more harm than good.

Linebreeding should be restricted to those skillful breeders who are good judges of livestock and make the minimum number of mistakes in the selection of breeding stock.

Linebreeding should be practiced only when a sufficiently outstanding individual who has proven his breeding ability is available. Linebreeding to an inferior or only average individual has small chance of success. Furthermore, linebreeding to an animal of good individuality but of poor breeding ability is not likely to be successful.

How intense a linebreeding program can one use and expect reasonable success? In general, the better the herd and the individual on which the linebreeding program is to be based, the more intense the linebreeding program may be. It is doubtful, however, if a linebreeding program as intense as sire-daughter matings would be successful under most conditions. The risk is too great. More undesirable traits likely would be fixed than could possibly be eliminated by selection. Half brother x sister or grandsire x granddaughter matings would be less risky, but again it is questionable if many breeders could afford to take the risks involved in a breeding program of this kind. Certainly if such a system is contemplated it would be tried on a small scale at first to determine if it works reasonably well. Also one should expect to be required to cull more heavily with this type of program than with one which involves less intense inbreeding. Probably some system of cousin matings would give the breeder the best opportunity to improve his herd average and increase the prepotency of individuals without having to eliminate too many of his animals as undesirables. Such a system of mating would

result in a herd in which three to four sires are maintained in service each generation. Perhaps a two-sire herd would be satisfactory with the plan to introduce outside blood from time to time by the purchase of females or males which are of the same line of breeding as the animals in the herd.

Small breeders could work out a linebreeding program which would not involve too intense inbreeding by working in cooperation with one another. If several breeders are building their program around one individual they could swap sons and grandsons of his. Also they might purchase their sires from an established breeder, making sure that the sires they use are closely related to the animal to which they are linebreeding. This would not be difficult if the parent herd is also linebreeding to the same animal.

Since one cannot linebreed to one animal indefinitely, sooner or later the program will find itself directed toward one of his decendants. This is desirable if that descendant is himself of outstanding breeding ability. One of the great dangers for a linebreeding program in a small herd is the likelihood that the linebreeding will by chance be directed toward a mediocre descendant merely because of the small size the herd. This might easily result in the fixation of undesired heredity in spite of all the breeder could do to avoid it. If such an event does occur an outcross may be necessary to eliminate the undesired traits. An outcross will usually accomplish this result and then the program may be renewed using the outcross stock.

In conclusion it may be stated that a carefully conceived linebreeding program accompanied by the intense selection of breeding stock can do much toward improving the breeding ability of a herd provided that the linebreeding is not accompanied by such a rapid rate of inbreeding as to fix too much undesired heredity. Most linebreeding programs should involve the judicious use of outcrosses to eliminate undesired traits when and if they become fixed in a herd.

Yield and Feeding Value of Prairie Hay Cut at Different Stages of Maturity

By H. M. BRIGGS, W. D. GALLUP, A. E. DARLOW and C. KINNEY

Prairie hay is a crop that varies widely in its feeding value as well as in its yield, depending on the season of the year in which it is made. Most people prefer early cut hay for feeding. This test was planned to determine the yield and feeding value per pound of early cut hay as compared to late cut hay. For the second year, a series of four hay plots was cut at the following times: Series I, the third week in June; Series II, the third week in July; Series III, the third week in August; and Series IV, the third week in September. The four plots had a total of 2.334 acres and were the identical area studied a year ago.

The hay was mowed, raked with a side delivery, and baled with a pick-up baler and stored as soon as dry. The June hay was wet with approximately one-half inch of rain, and consequently discolored. The July and August cuttings received no rain and were stored as bright hays. The September cut hay received 14 inches of rain from the time it was cut until it was baled and stored; as a result it was badly discolored and of very low quality. The hay from each cutting was weighed Jan. 10, 1946 to get the cured weight. The yield data are given in Table I, and the corresponding yields for the summer of 1944 are given for comparison.

The hay was sampled and the average chemical analysis is given in Table II. The chemical composition of the second growth grass from the time the hay was cut to September and October, respectively, is presented in Table III. Such regrowth is commonly used for pasturing livestock.

At the present time the 1945 production of hay that is mentioned in Tables I and II is being fed to steers in metabolism

TABLE I.—Yield of Prairie Hay Cut at Four Stages of Maturity. (Weighed Jan. 10, 1946.)

Cut Third Week Of:	Cured weight (lbs.)		Cured yield (tons per A.)	
	1945	1946	1945	1946
June	3678	5090	.79	1.09
July	5875	5615	1.26	1.20
August	4680	6360	1.00	1.36
September	5790	5623	1.24	1.20

TABLE II.—Chemical Composition of Hay Cut at Different Seasons.

Time of cutting hay	Dry matter %	Composition of Dry Matter: Ash %	Protein %	Ether extract %	Crude fiber %	N.F.E. %	Ca %	P %	"Crude" Carotene* P. P. M. When cured	"Crude" Carotene* P. P. M. Stored 6 mo.
June	94.33	6.92	5.77	1.93	33.94	51.44	0.36	0.07	34.6	10.0
July	94.43	7.32	5.70	2.25	32.44	52.39	0.40	0.07	66.6	28.7
August	93.92	6.88	4.70	2.19	34.24	51.99	0.41	0.06	73.2	29.3
September	94.25	7.06	4.05	2.14	35.03	51.72	0.42	0.05	49.9	6.0

* Carotene values are reported as parts per million of dry matter on all samples. The June hay has been discolored by a shower. The September hay suffered severe rain damage before storage; when cured the carotene content was 49.9, but after rain damage it dropped to 8.7 before storage.

TABLE III.—Chemical Composition of the Dry Matter of Second-growth Grass.

Length of growing period	Protein %	Ether extract %	Crude fiber %	N.F.E. %	Ca %	P %	"True" Carotene* P.P.M.
June to Sept.	5.22	2.53	31.89	53.01	0.44	0.05	48.1
July to Sept.	6.18	2.25	33.59	51.71	0.39	0.06	54.2
Aug. to Sept.	7.62	2.24	33.52	51.02	0.37	0.06	50.0
June to Oct.	3.27	2.14	34.86	52.12	0.44	0.03	23.2
July to Oct.	4.28	2.03	34.83	51.00	0.50	0.05	56.9
Aug. to Sept.	5.95	2.05	35.11	46.43	0.60	0.06	94.8

* "True" carotene by Wall and Kelley procedure.

stalls to measure its digestibility and total digestible nutrient (T. D. N.) feeding value.

OBSERVATIONS

1. The rainfall during the growing season may have a marked effect on the month in which the maximum yield of hay may be obtained. It appears the optimum yield may be obtained in either July or August.

2. The protein content of the hay decreases and the crude fiber content tends to increase as the season advances.

3. Storage has a marked effect on the loss of carotene from the hay. Normal hays lose approximately two-thirds of their carotene in the first six months of storage. A fourteen-inch rainy spell lowered the carotene content of September hay from 49.9 P. P. M. to 8.4 P. P. M. before it could be baled. The rains started just as baling was starting. Such leached hays lose little carotene in storage; after six months storage this hay still had 6.0 P. P. M. carotene.

Urea as a Partial Protein (Nitrogen) Supplement For Beef Cattle

By H. M. BRIGGS, W. D. GALLUP, A. E. DARLOW, J. C. HILLIER, C. KINNEY, E. HARRIS, D. F. STEPHENS, J. A. HOEFER, and W. D. CAMPBELL

A year ago this Station reported an attempt to extend the available supply of protein feeds for beef cattle through the use of urea. It was pointed out that steers in metabolism stalls had made satisfactory use of the nitrogen (protein equivalent) in urea when it replaced 25% or 50% of the nitrogen (protein) of cottonseed meal. Similar satisfactory results were reported when urea replaced some of the cottonseed meal in supplementary protein pellets that were fed to fattening calves in the dry lot or yearling heifers being wintered on the range.

This past year the use of urea in beef cattle rations has been continued.* One phase of the work will be found reported in this publication under the title of "Protein and Mineral Supplements for Wintering Two-year-old Steers on Grass."

* These studies are partially supported through a research grant of the E. I. DuPont De Nemours & Co. (Inc.), Wilmington 98, Del.

Metabolism of the Fattening Ration.

Three long-yearling Hereford steers that averaged approximately 650 lbs. were fed a fattening ration that corresponded to the average fattening ration fed to calves in the study the year before and very similar to that fed the fattening calves this year. The rations fed are reported in Table I.

Table II presents the average apparent digestion coefficients and nitrogen storage from feeding each experimental ration. The rations were fed in rotation, with each steer getting one of three experimental rations in each of three successive trials. Some feed was refused when pellets containing urea were used as the supplement, but none was refused when cottonseed meal supplemented the ration.

Fattening Experiment.

A fattening experiment was started November 24, 1946, using three lots of 10 head each. The calves are steers and heifers of the Angus, Shorthorn, and Hereford breeds. They were divided in the usual experimental manner and have been weighed each 28 days. The calves are still on feed but by March 16, the day the calculations reported in Table III were made, they had been on feed 112 days. The composition of Formulas 1 and 2 and the cottonseed meal are given in Table I.

Wintering Experiment With Heifers.

Two lots each of 10 grade yearling Hereford heifers were divided equally and wintered on range pastures. Lot I was fed Formula 1 pellets containing urea, and Lot II was fed cottonseed meal. The composition of the feeds is given in Table I. Both lots had access to salt and 1:1:1 mineral mix, but no other feed in addition to winter grass. The results are given in Table IV.

Observations.

1. Results secured this past year indicate that under conditions of a metabolism trial, urea-containing pellets proved a satisfactory protein supplement when added to corn and prairie hay. The pellets that had 25% of their protein (nitrogen) from urea and the remainder from cottonseed meal gave results slightly superior to straight cottonseed meal or a pellet containing 50% urea nitrogen.

2. Urea-containing pellets have to date produced slightly less gain than cottonseed meal when used to supplement a fattening ration of corn and prairie hay. All steers are being continued on their test rations until finished. A year ago, in a

TABLE I.—The Daily Allowance and Chemical Analysis of the Feeds Fed Yearling Steers in a Metabolism Study.

Feed	Daily Allowance in Lbs.			Chemical Composition of Dry Matter (Percent)				
	Ration A	Ration B	Ration C	Protein	Fat	Fiber	N.F.E.	Organic matter
Prairie Hay	2.12	2.12	2.12	4.64	2.13	34.86	51.03	92.67
Ground corn	10.00	10.00	10.00	8.73	5.07	2.13	82.61	98.54
Cottonseed meal	1.75	----	----	45.24	6.91	10.01	31.95	94.11
*Formula 1 (25% Urea N)	----	1.75	----	45.97	6.18	7.92	33.61	93.68
*Formula 2 (50% Urea N)	----	----	1.75	47.00	5.09	5.66	37.28	95.03

* The urea containing pellets or Formulas No. 1 and 2 consisted of urea, hominy feed, cottonseed meal and 10% blackstrap molasses. Formula 1 had 25% of its nitrogen (protein equivalent) in the form of urea while Formula 2 carried 50% urea nitrogen. The pellets were manufactured through the courtesy of Nutrena Mills, Inc.

TABLE II.—The Average Apparent Digestion Coefficients, T. D. N., and Nitrogen Storage of Fattening Rations Fed to Steers.

Supplement fed with prairie hay and corn	Ration No.	Apparent Digestibility (Percent) of:					T.D.N. of rations	Gms. nitrogen stored daily
		Crude Protein Nx6.25	Ether extract (Fat)	Crude fiber	NFE Extract	Organic matter		
Cottonseed meal	A	56.9	69.8	40.4	74.5	69.4	64.3	34.1
Formula 1	B	63.4	77.6	47.7	77.2	73.3	68.3	42.3
Formula 2	C	63.1	79.3	47.9	76.1	72.5	67.4	37.6

similar 153-day feeding period, both the pellets containing 25% and 50% urea protein (nitrogen) proved equal to cottonseed meal.

3. Yearling heifers were wintered as satisfactorily on pellets containing 25% of their protein (nitrogen) in the form of urea and the balance from cottonseed meal as when all the protein was furnished by cottonseed meal. These results correspond to those secured a year ago in a similar study.

TABLE III.—A Progress Report of the Performance of Fattening Calves when Supplemented with Cottonseed Meal and Urea-containing Supplements; Winter 1945-46, First 112 Days of Experiment.

Lot No.	I	II	III
No. Head per Lot	10	10	10
Supplement	Formula 1 (25% Urea N)	Formula 2 (50% Urea N)	Cottonseed meal
Average Weight per Steer (lbs.)			
Initial weight	398	399	400
Weight March 16	595	582	615
Daily gain	1.76	1.63	1.92
Average Daily Ration			
Corn	8.4	8.5	8.8
Formula 1 (25%)	1.8	---	---
Formula 2 (50%)	---	1.8	---
Cottonseed meal	---	---	1.8
Prairie Hay	2.0	2.0	2.0
Feed Req. per Cwt. Gain (lbs.)			
Corn	479	520	457
Formula 1 (25%)	100	---	---
Formula 2 (50%)	---	109	---
Cottonseed meal	---	---	95
Prairie hay	113	120	103

TABLE IV.—Winter-gain of Yearling Heifers Fed Cottonseed Meal or a Urea-containing Pellet as a Supplement to Cured Grass; Nov. 6, 1945, to April 3, 1946, 148 Days.

Lot No.	I	II
No. Head per Lot	10	10
Supplement	Cottonseed meal	Formula 1 (25% Urea N)
Average Weight per Heifer: (lbs.)		
Initial	638	638
Final	681	686
Daily gain	.29	.33
Average Daily Ration: (lbs.)		
Dry grass	free choice	free choice
Cottonseed meal	2.34	---
Formula 1 (25% Urea N)	---	2.34

4. Heavy steers did not make as satisfactory gains on urea containing pellets this past year as did steers receiving cottonseed meal or soybean meal (See "Protein and Mineral Supplements for Wintering Two-year-old Steers on Grass" in this report.)

Supplements for Fattening Two-year-old Steers on Grass

I. Results for 1945.
II. Summary of Results Secured in Three Year Study.

By A. E. DARLOW, V. G. HELLER, J. C. HILLIER, DAVE CAMPBELL, BRUCE R. TAYLOR,* DWIGHT STEPHENS, H. M. BRIGGS, and J. A. HOEFER.

The Study in 1945.

In the spring of 1945 the third year's investigation was made on the question, "Does it pay to feed cottonseed cake, corn, or a mineral supplement to two-year-old steers being fattened on grass?" Ground rock salt was provided free-choice in all pastures, and the mineral that was fed consisted of equal parts steamed bonemeal, ground limestone, and salt. The ground shelled corn or cottonseed cake was mixed with the commercial molasses feed and fed in bunks once daily at from 7:30 to 8:00 a. m.

THE PASTURES: The steers were grazed on the experimental range area north of Lake Carl Blackwell. The bluestem grasses, particularly Little Bluestem, predominate in the area.

THE STEERS: One hundred thirty-two head of long yearlings, Herefords of medium quality, were purchased in the fall of 1944 for the experiment. The cattle were wintered on the range during the winter months and gained an average of 77 lbs. per head on soybean cake and old grass. The steers were divided into four lots of 33 steers each.

Observations.

1. Steers that received salt as the only supplement to bluestem grass outgained steers that received in addition a mineral mixture of equal parts steamed bone meal, finely ground limestone and salt (Table IV). The mineral fed steers for some reason gained .32 lbs. less per day and did not produce car-

* Resigned September, 1944.

casses with as much finish; however they sold for the same price on foot and had similar dressing percentages. This is the only year in a three-year study that the steers receiving only salt gained as well as those receiving calcium and phosphorus supplement.

2. Caked-on-grass steers gained .29 lbs. more daily than steers fed a similar amount of corn and sold for $.60 more per cwt. (Table IV). The carcass grades of both lots were very similar as was the dressing percentage. The corn-fed steers shrank less enroute to market.

3. These cattle had been purchased in the fall of 1944 and cost $11.43 per cwt. at that time. They were wintered on grass and 2.4 lbs. of soybean cake and gained an average of .68 lbs. daily during the wintering period. They were appraised at the start of the summer grazing period at $13.75 per cwt. (Table IV). Based on these figures the cattle returned a nice profit for their wintering but all lots lost money during the summer.

4. The analysis of the grass showed a seasonal decline in the protein content from 16.4 percent in May to 5.4 percent in the latter part of August (Table I). The carotene and phosphorus contents of the grass showed a similar decline through the grazing season.

5. The cattle made nearly one-half of their total summer gain in the first thirty days of the grazing season (Table II). During this trial the fed steers substantially outgained those that were not fed during the first part of the season. The effects of feeding were not as apparent the first month in the first two years of this study.

6. There was little change in the blood calcium or phosphorus of the steers during the grazing season (Table III). All of the rations appeared satisfactory for maintaining adequate mineral levels in the blood.

Three-year Summary and Observations.

1. Two out of three years, steers fed a simple mineral mix of bone meal, limestone and salt outgained steers that received only salt but in the third year the gain was reversed. The 23 salt fed steers gained an average of .09 lbs. per head more daily during the three years of the study. This difference is not great enough to warrant the conclusion that mineral reduced the gain.

2. Mineral fed steers sold for an average of $.08 more per cwt. and consequently were $1.52 per head more profitable than those fed only salt. The mineral steers dressed 1.3 percent higher which justifies the higher price at marketing time

TABLE I.—Chemical Analysis of the Bluestem Grass (Dry Matter)*

	% Moisture	% Ash	% Crude Protein	% Fat	% Crude Fiber	% N. F. E.	% Ca	% P	P. P. M. Carotene
May 1	78.4	8.8	16.4	3.4	32.0	39.4	.419	.312	—
June 5	67.1	7.0	8.9	2.5	33.7	47.9	.411	.112	383
July 6	62.2	6.8	8.0	2.2	33.8	49.2	.471	.102	298
July 30	63.2	6.8	6.0	2.5	33.4	51.3	.352	.094	174
Aug. 23	43.2	6.5	5.4	2.1	34.2	51.8	.402	.089	189

* Data for Big Bluestem grass only.

TABLE II.—Average Gain Per Head by Months

Time	Lot No. 1	Lot No. 2	Lot No. 3	Lot No. 4	Average	% Total Gains
April 28-May 28	110	101	138	121	118	47
May 28-June 25	68	35	36	79	54	22
June 25-July 23	36	45	61	54	49	19
July 23-Aug. 18	30	25	25	42	30	12
Totals	244	206	260	296	251	100

TABLE III—Average Change in Blood Calcium and Phosphorus During the Grazing Period[1]

	CALCIUM			PHOSPHORUS		
	Initial	Final	Change	Initial	Final	Change
Lot I	11.2	10.9	−.3	5.2	4.8	+.4
Lot II	11.1	11.5	+.4	4.4	4.4	0
Lot III	11.2	11.1	−.1	5.6	5.3	−.3
Lot IV	11.2	11.1	−.1	4.9	4.9	0

[1] The data were secured on ten steers on May 28, and on the same ten at the close of experiment. The values are reported in Mg. per 100 Ml. of plasma.

TABLE IV.—Supplements for Fattening 2-Year-Old Steers on Bluestem Grass April 28 to August 19, 1945—(112 days)

Pasture Number	1	2	3	4
Number of Steers	33	33	33	33
Supplements Used	None	1-1-1 Minerals*	Gr. Shelled Corn	Cottonseed Cake
Average Weights Per Steer (Lbs.)**				
Initial Weight	787.	782.	786.	786.
Final Weight	1008.	967.	1022.	1055.
Total Gain	221.	185.	236.	269.
Daily Gain	1.97	1.65	2.11	2.40
Average Daily Ration (Lbs.)				
Gr. Shelled Corn			4.54	
Cottonseed				4.54
Molasses Feed			.48	.48
Salt	.074	.037	.072	.059
Mineral*		.034		
Bluestem	Ad. Lib.	Ad. Lib.	Ad. Lib	Ad. Lib.
Cost Per Steer (Dollars)				
Bluestem Grass	9.00	9.00	9.00	9.00
Gr. Shelled Corn			11.45	
Cottonseed Cake				13.75
Molasses Feed			1.81	1.82
Salt	.06	.03	.06	.07
Mineral*		.06		
Total Feed Cost (Grass and Supplement)	9.06	9.09	22.32	24.63
Cost of Steers				
@ $13.75 per Cwt.	108.21	107.52	108.07	108.07
Total Cost (Feed plus Steer)	117.27	116.61	130.39	132.70
Returns (Dollars)				
Selling Price (Per cwt. Okla. City)	12.00	12.00	12.65	13.25
Actual Net Selling Price per Steer	108.36	103.92	121.10	125.80
Return per Steer	—8.91	—12.69	—9.29	—6.90

TABLE IV.—(continued)

Marketing Data				
Shrink in Marketing	7.9	8.0	4.0	7.8
Dressing Percentage	56.4	56.0	57.1	56.9
Carcass Grades	32 commercial 1 utility	28 commercial 5 utility	33 commercial	2 good 30 commercial 1 utility

* Equal parts of salt, steamed bone meal, powdered limestone.
** Initial and final weights are on the average of 3 days weights.

FEED PRICES

Bluestem Grass	$ 9.00 per steer	Molasses Feed	68.00 per ton
Gr. Shelled Corn	1.26 per bu.	Salt	$ 9.00 per ton
Percent Cottonseed Meal	54.00 per ton	Gr. Limestone	14.00 per ton
		Steamed Bone Meal	65.00 per ton

TABLE V.—A Summary of the Value of Supplements for Fattening Two-Year-Old Steers on Bluestem Grass; 1943, 1944, and 1945 (Average 115 days)

Lot	1	2	3	4
Total Number Steers	83	83	83	83
Supplement Used	None	Mineral*	Gr. Shelled Corn	Cottonseed Cake
Average Weights Per Steer (Lbs.)				
Initial Weight**	745	743	745	744
Final Weight**	989	976	1018	1040
Total Gain	244	233	273	296
Daily Gain	2.10	2.01	2.35	2.55
Average Daily Ration (Lbs.)				
Ground Shelled Corn			4.43	
Cottonseed Cake				4.43
Molasses Feed			.50	.50
Salt	.07	.05	.05	.05
Mineral*		.07		
Bluestem Grass	Ad. Lib.	Ad. Lib.	Ad. Lib.	Ad. Lib.

TABLE V.—(continued)

Cost Dollars Per Steer				
Bluestem Grass	8.73	8.73	8.73	8.73
Ground Shelled Corn			11.22	
Cottonseed Cake				13.02
Molasses Feed			1.77	1.77
Salt	.05	.04	.04	.04
Mineral		.05		
Total Feed Cost	8.78	8.82	21.76	23.56
Cost of Steers	95.42	95.05	95.27	95.27
Total Cost (Feed plus Steer)	104.20	103.87	117.03	118.83
Returns (Dollars)				
Selling Price, Per Cwt.	11.75	11.83	12.73	12.88
Actual Selling Price, Per Steer	107.80	108.91	122.74	123.76
Return Per Steer	3.60	5.04	5.71	4.93
Marketing Data				
Shrink in Marketing %	7.6	7.6	5.8	7.4
Dressing Percentage	54.3	55.6	56.9	57.5
Average Carcass Grade***	2.04	1.93	2.28	2.14

* Equal parts of salt, steamed bone meal, powdered limestone.
** Intital and final weights are an average of 3 days weights.
*** Carcass grades: 4=choice, 3=good, 2=commercial, 1=utility.

AVERAGE FEED PRICES

Bluestem Grass	$ 8.73 Per Steer-Season
43% Cottonseed Meal	50.66 Per ton
Ground Shelled Corn	1.23 Per bu.
Molasses Feed	59.00 Per ton
Salt	13.00 Per ton
Limestone	14.00 Per ton
Steamed Bone Meal	67.00 Per ton

but their carcass average grades were slightly lower than the salt fed steers.

3. Feeding steers an average 4.43 lbs. of cottonseed cake and one-half pound of commercial molasses feed daily produced .45 lbs. more gain per day as compared to Lot 1. The steers, however, sold for an average of $1.13 more per cwt. and were $1.33 more profitable per head when additional labor costs were not considered.

4. Corn-fed steers gained .25 lbs. more daily than did the check steers in Lot 1. The cattle sold for an average of $.98 more per cwt. and returned a profit of $2.11 more per head not considering the extra labor required in feeding the steers.

5. Caked-on-grass steers gained .2 lbs. more per head daily in the three year study than similar steers fed a like amount of ground shelled corn. The caked steers brought an average of $.15 more per cwt. at the market but because of increased feed costs lacked $.78 per steer of being as profitable.

6. Cake fed steers dressed an average of .6 percent more than steers fed corn on grass but they did not yield carcasses with quite as much finish and consequently did not grade as well. Cake fed steers shrank more heavily enroute to market.

Summer Gains of Yearling Steers Wintered at Different Levels

By A. E. DARLOW, V. G. HELLER, DAVE CAMPBELL, H. M. BRIGGS, J. C. HILLIER, J. A. HOEFER, and DWIGHT STEPHENS

The question of how well steer calves should be wintered to make maximum returns from grass the following summer is an important one for many Oklahoma cattlemen. Previous work at the Oklahoma Agricultural Experiment Station indicated that steer calves wintered to gain 1 pound per day (medium level) made better use of the grass the following summer than those wintered to gain 1½ pounds per day (well wintered). In 1944 the calves wintered at the medium level made a greater profit than the well wintered steers when they were either grazed throughout the summer or grazed for about 90 days and then full-fed in dry lot for 100 days.

This experiment was repeated during the 1944-1945 season with two additional lots wintered at a low level.

SUMMARY TABLE—The Response Made by Yearling Steers Wintered at Different Levels to Summer-long Grazing or to Early Grazing Followed by Dry-lot Feeding.

Lot No.	1	2	3	4	5	6
Steers Per Lot	10	9	10	10	10	10
Level of Wintering	High	Med.	High	Med.	Low	Low
PHASE I—PREVIOUS WINTER* (Nov. 26, 1944 to April 13, 1945; 137 days)						
Winter Rations	Oats C.S.M. Silage	C.S.M. Silage	Oats C.S.M. Silage	C.S.M. Silage	C.S.M. Pr. Hay	C.S.M. Range
Average Weights Per Steer: (Lbs.)						
Initial Weight, (11/26/44)	398	400	397	402	400	400
Final Weight, (4/13/45)	644	572	649	565	528	506
Winter Gain	246	172	252	163	128	106
Average Daily Gain	1.79	1.25	1.84	1.19	0.93	0.78
Appraised Price (4/13/45)	14.50	14.50	14.50	14.50	14.50	14.50
Returns for Wintering (Dollars)	22.23	19.11	22.94	17.91	10.47	13.16
PHASE II—EARLY SUMMER—ALL GRAZED (April 13 to July 7, 1945; 85 days)						
Average Weights Per Steer: (Lbs.)						
Initial Weight, (4/13/45)	644	572	649	565	528	507
Final Weight, (7/7/45)	741	679	754	688	653	668
Gain on Pasture to 7/7/45	97	107	105	123	125	161
Average Daily Gain	1.14	1.26	1.23	1.45	1.47	1.89
Financial: (Dollars)						
Cost Per Steer on Grass (3% Shrink)	90.58	80.45	91.28	79.46	74.26	71.17
Cost of Grass	5.00	5.00	5.00	5.00	5.00	5.00
Cost of Salt and Mineral	.08	.08	.08	.08	.08	.08
Total Cost	95.65	85.53	96.36	84.54	79.34	76.25
Appraised Price (7/7/45)	14.00	14.00	14.00	14.00	13.75	13.75
Value Per Steer (7/7/45) (3% Shrink)	100.63	92.21	102.39	93.43	87.10	89.09
Profit Per Steer (Phase II)	4.98	6.68	6.03	8.89	7.76	12.84
Profit Per Steer (Phase I and II)	27.21	25.79	28.97	26.80	18.23	26.00

* For detailed report see Okla. Agri. Exp. Sta. Mimeo. Circ. No. 136 "Feeding and Grazing Experiments with Beef Cattle," page 16.

SUMMARY TABLE (continued)

PHASE III—LATE SUMMER; GRAZED OR FED
(July 7 to Oct. 20; 105 days)

Lot No.	1	2	3	4	5	6
Steers Per Lot	10	9	10	10	10	10
Level of Wintering	High	Med.	High	Med.	Low	Low
Method of Handling	Dry Lot	Dry Lot	Range	Range	Range	Range
Average Weights Per Steer: (Lbs.)						
Initial Weight, (7/7/45)	741	679	754	688	653	668
Final Weight, (10/20/45)	925	875	771	747	728	735
Gain (7/7/45 to 10/20/45)	184	196	17	59	75	67
Average Daily Gain	1.75	1.87	0.16	0.56	0.71	0.64
Average Daily Ration: (Lbs.)						
Range	---	---	Ad. Lib.	Ad. Lib.	Ad. Lib.	Ad. Lib.
Corn	13.5	13.1	---	---	---	---
Cottonseed Meal	1.5	1.5	---	---	---	---
Prairie Hay	5.6	5.7	---	---	---	---
Mineral 1-1-1	.04	.03	.03	.03	.03	.03
Salt	.06	.04	.06	.06	.06	.06
Total Feed Cost July 7-Oct. 20						
Range	---	---	3.00	3.00	3.00	3.00
Corn	32.08	30.80	---	---	---	---
Cottonseed Meal	4.44	4.44	---	---	---	---
Prairie Hay	4.11	4.14	---	---	---	---
Salt	.05	.04	.04	.04	.04	.04
Mineral 1-1-1	.07	.07	.07	.07	.07	.07
Total	40.75	39.47	3.11	3.11	3.11	3.11
Financial: (Dollars)						
Appraised Value	100.63	92.21	102.39	93.43	87.10	89.09
Total Cost	141.38	131.68	105.50	96.54	90.21	92.20
Selling Price	15.91[1]	15.21[2]	12.75	12.75	12.75	12.75
Value Per Head**	143.35	128.61	92.31	88.61	86.57	86.96
Returns Per Steer—Phase III	+ 1.97	— 3.11	—13.19	— 7.93	— 3.64	— 5.24
Profit—3 Phases	29.18	22.68	15.78	18.87	14.59	20.76
Shrink in Marketing (percent)	2.6	3.3	6.1	7.0	7.4	7.2
Dressing Percent	59.1	56.1	— — Sold as Feeder Cattle — —			
Carcass Grades	3 Choice 7 Good	5 Choice 4 Good				

** Actual selling price.
[1] 9 steers at $16; 1 steer at $15.
[2] 6 steers at 15.50; 3 steers at $14.50.

FEED PRICES: See opposite page.

How Cattle Were Handled.

WINTERING—PHASE I

Sixty head of good quality New Mexico Hereford steer calves were divided into six uniform lots of ten head each and wintered as follows: Lots 1 and 3 (well wintered) received 24 pounds of Atlas sorgo silage, 1 pound of cottonseed cake and 2.5 pounds of oats. Lots 2 and 4 (medium level) were fed a ration of 26 pounds of Atlas sorgo silage and 1 pound of cottonseed cake. Lot 5 (low level) was wintered in a trap at the Experimental Range on 11 pounds of prairie hay and 1.3 pounds of cottonseed cake. Lot 6 (low level) was wintered on a good native pasture and 2 pounds of cottonseed cake daily.

Details on the gains produced during the winter and the returns for wintering can be found in the summary table.

EARLY SEASON GRAZING—PHASE II

The six lots were all run together on a 240-acre native Bluestem pasture from April 13 to July 7, a period of 85 days. Salt and mineral were available at all times. Individual weights were taken at 28-day intervals. On July 7 these steers were sorted into lots and appraised by a representative of a commission firm. The well and medium witered lots were appraised at $14.00 and those winterd at the low level at $13.75 with a 3 percent shrink on all lots.

DRY LOT FEEDING AND LATE GRAZING—PHASE III

Lots 1 and 2 were placed in dry lot on July 7 and full fed on a ration of shelled corn, cottonseed meal and prairie hay until October 20, a period of 105 days.

Lots 3, 4, 5, and 6 remained on the same pasture and under the same conditions as in Phase II.

Observations

PHASE II—EARLY SUMMER GRAZING

1. In general the calves that made the least gain during the winter gained the most during the early summer grazing period. During this 85-day grazing period the well wintered steers (Lots 1 and 3) averaged 101 pounds per head and those

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FEED PRICES (DOLLARS)

Corn	1.26 per bu.	2.25 per cwt.
43% C.S.M.	58.00 per ton	2.90 per cwt.
Prairie Hay	14.00 per ton	.70 per cwt.
Salt	14.00 per ton	.70 per cwt.
Mineral	30.00 per ton	1.50 per cwt.
Grass	8.00 per steer	

wintered at the medium level (Lots 2 and 4) averaged 115 pounds per head. The steers wintered at the low level on hay averaged 125 pounds and those wintered at the low level on range averaged 161 pounds per head. In all cases the lots of steers wintered at the higher level still outweighed their mates which had made less winter gain.

2. The appraised price was $14.50 per hundred on all lots at the beginning of phase II, while the appraisal at the end was $14.00 on the well and medium wintered lots and $13.75 on the two lots wintered at the low level. This difference in the appraised price is indicative of the premium that was being paid for fleshy feeders at that time. If all the cattle had been sold at this time the profit per steer for this phase of the experiment would have been: For the well wintered cattle (Lots 1 and 3), $5.51; for the medium wintered steers (Lots 2 and 4), $7.79; for the steers wintered at the lower level on hay, $7.76; for the steers wintered at the lower level on grass, $12.84.

3. On the point of combined profits from both phase I and II the well wintered steers averaged $28.09 per head, the medium wintered cattle $26.30 per head, and those wintered at the lower level on hay $18.23 and on grass $26.00 per head.

Phase III—Late Grazing or Dry Lot Feeding

1. In the dry lot the steers wintered at the medium level (Lot 2) outgained the well wintered steers (Lot 1) by 12 pounds per head but were still 50 pounds per head lighter than the well wintered steers (Lot 1) at the end of phase III. This additional 50 pounds meant an increase of 3% in carcass yield and 70 cents per hundred in selling price and made the Lot 1 steers return $5.08 per head more for the period.

2. In total profit for the three phases Lot 1 returned $29.18 per head while Lot 2 returned $22.68 per head, a difference of $6.50 per head in favor of the well wintered steers. This method of wintering steer calves to gain 225 to 250, grazing them for about 90 days and then full feeding in dry lot again proved to be an excellent way to market a maximum amount of pasture and silage, and a minimum amount of grain, in the form of a good to choice finished yearling.

3. Among the four lots of steers that were grazed throughout phase III those wintered at the highest level (Lot 3) made little gain while those wintered at the medium (Lot 4) and low level (Lots 5 and 6) made correspondingly more gain during this period. While the well and medium wintered steers were still somewhat heavier than those wintered at the lower level, they did not carry enough additional weight or bloom to

to sell higher even though fleshy feeders were still in demand.

4. This one year's results indicate that for the production of feeder yearlings the low level of wintering on grass was most profitable.

A Comparison of Dried Sweet Potatoes, Wheat, and Corn for Fattening Steer Calves

By A. E. DARLOW, W. D. CAMPBELL, FRANK B. CROSS
V. G. HELLER and H. M. BRIGGS

Wheat is a crop that varies widely from year to year in its price and availability as a feed for livestock. The Experiment Station has been studying the value of wheat for fattening cattle in a series of studies that started when it was cheap and readily available. The study was continued this year in order to have a more complete answer about how to feed it, and its relative feeding value, when it becomes a competitive feeding grain again in some future year. Again this year we studied whether the wheat should be rolled or ground, self-fed or hand-fed, and how satisfactory chopped sorgo bundles were as compared with Atlas Sorgo silage as a roughage to be fed with wheat. The rations and results are given in Table II.

Last year we satisfactorily fed dried sweet potatoes to fatten steers and this study was repeated again this year. The results of feeding this product as compared to corn or wheat are also given in Table II.

The Feeds.

The dried sweet potatoes supplied by the Horticulture Department were grown at the Oklahoma Vegetable Research Station near Bixby. They consisted largely of the Puerto Rico variety. All sizes of potatoes were included. The potatoes were dug during October and November. The gross yield was about 200 bushels per acre, but it was so wet at the time of digging that an appreciable portion of the crop decomposed and therefore had to be discarded before processing. The sound portion of the crop was run through a slicer and spread on an old concrete road-bed in layers varying from one to two inches in depth. The slices were turned two or three times and sacked when they were leathery and would crackle when broken. It required about three pounds of sound potatoes to make a pound of the dried product. Because of unsatisfactory

TABLE I.—The Chemical Composition of Feeds Used in Fattening Steer Calves (Percent).

Feed	Water	Ash	Protein	Ether extract	Fiber	N.F.E.	Ca	P
Corn	12.74	1.72	8.33	2.79	2.13	72.29	.05	.29
Wheat	11.60	1.52	12.05	1.13	2.48	71.22	.02	.29
Dried sweet potatoes	11.62	6.01	6.52	1.26	3.16	71.43	.26	.18
Cottonseed meal	8.79	5.37	41.26	6.30	9.13	29.15	.20	1.19
Alfalfa hay	9.45	7.68	14.71	2.64	24.38	41.14	1.07	.28
Atlas sorgo silage	62.00	5.20	2.24	1.14	8.61	20.63	.13	.08
Sorgo bundle feed	15.59	5.74	4.73	2.08	26.98	44.88	.22	.13

drying weather, the product was not as bright nor did it have as desirable an odor as that which was fed a year ago. Some potatoes molded slightly before they dried, due to the wet weather. However, the steers did not find the potatoes unpalatable.

The Atlas sorgo silage and bundles were made from the same crop and taken from the same field. Both were harvested in early October.

Analyses of all the feeds are given in Table I.

Choice Hereford steer calves were secured from the Mullendore Trust Company ranches and charged into the experiment at $13.00 per cwt. They were divided into uniform lots and fed the rations given in Table II. Lots 1 and 4 were self-fed their grain following the 41st and 43rd days respectively. After having been slowly worked to full feed, the other lots were full-fed by hand during the entire experiment. Alfalfa hay was fed separately in the morning to all lots, but the silage or chopped bundles were fed twice daily. The protein supplement of the two-self-fed lots was mixed with the silage, while both the grain and protein supplement fed the hand-fed lots were mixed with the silage or chopped bundles. After the steers were on full feed they never entirely cleaned up their feed. The results of the study are given in Table II.

Observations

I. Steer calves fattened on dried sweet potatoes gained as rapidly as did steers that were fattened on ground shelled corn. Packer buyers, however, appraised the steers fattened on sweet potatoes 50 cents per cwt. lower at the close of the experiment. A year ago two lots of steers fattened on ground corn and sweet

TABLE II.—The Use of Corn, Wheat, Dried Sweet Potatoes, Silage, and Bundle Feed for Fattening Steer Calves in Dry Lot.
(Oct. 25, 1945 to April 12, 1946—169 days.)

Lot No.	I Ground corn, self-fed Cotton-seed meal and silage, mixed Alfalfa	II Ground wheat, cotton-seed meal and silage, mixed Alfalfa	III Ground wheat, cotton-seed meal and chopped bundles, mixed Alfalfa	IV Rolled wheat, self-fed Cotton-seed meal and silage mixed Alfalfa	V Rolled wheat, cotton-seed meal and silage, mixed Alfalfa	VI Dried sweet potatoes, cotton-seed meal and silage, mixed Alfalfa
No. steers per lot	10	9[4]	10	10	10	10
Av. Wt. Per Steer: (Lbs.)						
Initial	481	482	482	482	481	481
Final	863	847	863	833	866	864
Daily gain	2.26	2.16	2.26	2.08	2.28	2.27
Av. Daily Ration: (Lbs.)						
Gr. corn	12.5	---	---	---	---	---
Gr. wheat	---	11.6	11.8	---	---	---
Rolled wheat	---	---	---	10.6	11.6	---
Dried sweet potatoes	---	---	---	---	---	12.2
Cottonseed meal	1.5	1.5	1.5	1.5	1.5	2.1
Alfalfa hay	1.0	1.0	1.0	1.0	1.0	1.0
Silage	6.5	7.5	---	7.4	7.5	7.5
Chopped bundles	---	---	4.2	---	---	---
Salt	.02	.02	.02	.02	.02	.01
1:1:1 mineral mix	.05	.07	.05	.04	.07	.04
Feed Per Cwt. Gain: (Lbs.)						
Gr. corn	553	---	---	---	---	---
Gr. wheat	---	535	524	---	---	---
Rolled wheat	---	---	---	508	509	---
Dried sweet potatoes	---	---	---	---	---	540
Cottonseed meal	66	68	66	71	65	94
Alfalfa hay	44	46	44	48	44	44
Silage	286	347	---	353	329	330
Chopped bundles	---	---	185	---	---	---
Feed Cost Per Cwt. Gain[1]	$15.46	$17.45	$17.10	$16.84	$16.59	---[2]
Financial Result Per Steer: (Dollars)						
Appraised value per cwt.	$16.50	$16.25	$16.15	$16.00	$16.25	$16.00
Sale value[3]	136.28	131.71	133.36	127.51	134.52	132.24
Initial cost	62.54	62.72	62.60	62.60	62.50	62.56
Feed cost	59.07	63.68	65.32	59.25	63.86	---
Total steer and feed cost	121.61	126.40	127.92	121.85	126.36	---
Profit per steer	14.67	5.31	5.44	5.66	8.16	---

[1] Feed prices charged: Corn $1.28 per bushel; wheat $1.59 per bushel; cottonseed meal $56.00 per ton; alfalfa hay $19.00 per ton; silage $5.00 per ton; bundles $10.00 per ton; salt $15 per ton; and 1:1:1 mineral mix $31.00 per ton.

[2] The sweet potatoes were prepared experimentally and no market charge was made in the financial statement of the lot.

[3] Calculated basis of Oklahoma City after deducting a market cost of $.30 per cwt. and 2½% shrinkage.

[4] One steer developed a telescoped intestine, was removed, and the data calculated on the basis of 9 steers. He had made average gains unti he became sick.

potatoes made very similar gains and sold at the same price; the corn-fed cattle made a yield of 62% while the dressing percentage of the dried sweet potato cattle was 61%.

2. In the current feeding experiment it required 540 lbs. of dried sweet potatoes, 28 lbs. additional cottonseed meal, and 44 lbs. additional silage to equal 553 lbs. of corn in producing 100 lbs. gain on fattening steer calves. Strictly from a standpoint of gain the sweet potatoes were worth $2.14 per cwt. or were worth 95% the price of corn. Charging actual market prices for the remainder of the feeds consumed, and making no charges for labor, etc., ground corn could be calculated to have sold for $2.94 per cwt. through the steers and dried sweet potatoes as having sold at $2.65 per cwt. when the differences in the selling price of the steers is considered; or from an economic standpoint, sweet potatoes were worth 90% as much as corn.

3. It required more corn per pound of gain than it did of wheat. This is the fourth year in our series of studies on wheat that this has been true, but in most cases corn cattle have outgained the wheat cattle. Cattle self-fed on rolled wheat ate roughage to a better advantage than did cattle self-fed corn but would not consume as much grain.

4. In three former studies, ground wheat was less palatable than corn. The results this year confirm those of former years.

5. In reverse of the results secured last year, the cattle receiving rolled wheat in Lot V outgained those in Lot II receiving a like amount of ground wheat mixed with the silage.

6. Rolled wheat was consumed with more relish when mixed with silage than when fed in self-feeder. The hand-fed cattle not only ate more but gained .2 lb. more per head daily and were valued 25 cents per hundred higher than the self-fed cattle.

7. This year Atlas Sorgo bundles gave much more satisfactory results as compared to silage than they did a year ago. The calves fed the bundles outgained the silage fed check lot. Each 100 lbs. of chopped bundles replaced 188 lbs. of silage, 6 lbs. of wheat and 1 lb. each of cottonseed meal and alfalfa hay. The steers eating silage consumed 2.47 lbs. of dry matter each day in the form of silage while the bundle fed steers consumed 3.54 lbs. of the same type of dry matter in the chopped bundles.

How Well Should Calves Be Wintered?

By A. E. DARLOW, W. D. CAMPBELL, V. G. HELLER, and H. M. BRIGGS

Few questions are a bigger problem to the Oklahoma cattle producer who carries his calf crop through their first winter than how to do the job most satisfactorily. Really the question of how to winter the calves most satisfactorily breaks itself down into two questions:

1. How well should calves be wintered?
2. What is the cheapest method of doing a satisfactory job?

During the last two years, choice steer calves have been wintered at different levels and all yearlings grazed until midsummer. Part of the yearlings were then placed in dry lot and the others completed the grazing season on grass. The results from last year's study are discussed in this publication under the title "Summer Gains of Yearling Steers Wintered at Different Levels."

The Current Study

Choice Hereford calves, part of which were produced in our experimental herd and part purchased from the P. B. Turner and Sons ranches of Waurika, were used in the wintering study. Four lots of ten calves each have been wintered in dry lot and fed the same feeds as were used the past two years. Two of these lots have been wintered at a level cattlemen would term "well wintered," while the other two were wintered at a "medium" level. Two other lots were handled as they were last year. One lot was wintered in a five-acre trap and received

TABLE I.—Chemical Analysis of Feeds Used in Wintering Steer Calves.

Feed	Water %	Ash %	Protein %	Ether extract %	Fiber %	N.F.E. %	Ca %	P %
Oats[1]	8.90	3.60	12.00	4.70	10.60	60.20	.09	.33
Cottonseed meal	8.79	5.37	41.26	6.30	9.13	29.15	.20	1.19
Atlas Sorgo Silage	62.00	5.20	2.42	1.14	8.61	20.63	.13	.08
Prairie hay (cut Aug. 20, 1945)	8.43	6.19	3.13	2.25	30.54	49.46	.46	.04
Native grass (3/13/46)	8.38	5.60	2.02	1.57	33.26	49.17	.26	.02

[1] The analysis of oats was taken from Morrison's Feeds and Feeding.

TABLE II.—Methods and Levels of Wintering Calves.
(Nov. 14, 1945 to April 12, 1946—149 days)

Lot No.	I	II	III	IV	V	VI
Level of Wintering	High	Med.	High	Med.	Low	Low
Ration	Oats Cotton-seed meal Silage	Cotton-seed meal Silage	Same as Lot I	Same as Lot II	Cotton-seed meal Prairie hay	Cotton-seed meal Range
Av. Weights per Steer: (Lbs.)						
Initial	400	400	400	400	400	400
Final	598	541	602	544	527	504
Av. daily gain	1.32	.94	1.34	.96	.85	.69
Av. Daily Ration: (Lbs.)						
Atlas sorgo silage	20.8	24.4	20.6	24.2	---	---
41% cotton-seed cake	1.0	1.0	1.0	1.0	1.5	2.7
Oats	2.7	---	2.7	---	---	---
Prairie hay	---	---	---	---	9.8	---
Range grass	---	---	---	---	---	---
						Free choice
Gr. limestone	.10	.10	.10	.10	---	---
Salt	.03	.04	.03	.03	.05	.05
1-1-1 mineral	.03	.04	.02	.03	.01	.02
Feed Required Per Cwt. Gain: (Lbs.)						
Atlas sorgo silage	1573	2593	1539	2530	---	---
41% cottonseed cake	75	106	74	104	180	392
Oats	206	---	202	---	---	---
Prairie hay	---	---	---	---	11.53	---
Range grass	---	---	---	---	---	---
						Free choice
Expenses: (Dollars)						
Feed per cwt. gain	$11.33	$9 .62	$11.09	$ 9.37	$12.59	$12.96
Feed cost per steer	22.46	13.56	22.45	13.44	15.98	13.52
Cost of steer	54.00	54.04	54.00	54.05	54.07	54.03
Feed and steer cost	76.46	67.60	76.45	67.49	70.05	67.55
Estimated Return: (Dollars)						
Appraised price per cwt.	$16.00	$16.35	$16.00	$16.35	$16.25	$16.25
Value per steer (3% shrink)	92.84	85.84	93.49	86.24	83.13	79.49
Return for wintering	16.38	18.24	17.04	18.75	13.08	11.94

FEED PRICES

Atlas sorgo silage	$ 5.00 per ton	Prairie hay	$13.00 per ton
Cottonseed cake	56.00 per ton	Range grass	2.00 per head
Oats	.81 per bu.	Limestone	13.00 per ton
Salt	15.00 per ton	Mineral	31.00 per ton

prairie hay and cottonseed cake, while the other lot received only cottonseed cake while running on winter range. The latter two lots have not been wintered at as high a level as the calves lot wintered. The rations used, the feed required per unit of gain, and the estimated financial returns are given in Table II.

2. These calves will all be taken to grass and the response they make to grass, or to grass followed by feeding, will be reported at a later date when the results are complete.

The feeds fed in the study are given in Table I. Salt, a simple mineral mix (equal parts of steamed bone meal, ground limestone and salt) and water were always available to all lots.

Observations

1. The cattle that were wintered at the highest level of gain were appraised at the lowest value per pound at the close of the experiment. These cattle, which were Lots I and III, were appraised at $16.00 per cwt. while the medium wintered cattle in Lots II and IV were appraised a $16.35 per cwt. Cattle in Lots V and VI which were wintered at a comparatively low level were valued at $16.25 per cwt.

2. If all calves had been sold at the end of the wintering period the 20 head in Lots II and IV, which had made an average daily gain of .95 lb., would have been most profitable. They returned an average of 18.50 per head above their original cost and the winter feed bill.

3. A year ago steers wintered at the highest of three levels were the most profitable but they were valued at the same price per pound as thinner calves. Oats were also cheaper a year ago than they have been this past winter.

4. Adding 2.7 lbs. of oats daily to the ration produced .38 lb. more daily gain but the calves lacked 3.6 lbs. of eating as much silage per head daily.

5. The steer calves in Lot V that were wintered in a trap ate 9.8 lbs. of prairie hay daily when it was offered free choice. In addition to hay, they were fed 1.5 lbs. cottonseed cake daily and made an average daily gain of .85 lb. Last year they showed $2.69 less profit than steer calves fed cake on grass but this year they were $1.16 more profitable than calves caked on grass.

6. The calves wintered on cake and grass have made less gain than calves wintered in trap on hay or in dry lot on silage. They remained in strong condition but made nearly .1 lb. less gain than calves handled the same way a year ago.Their labor

charge per head would be less than for calves handled in dry lot or trap.

7. These data tell only a portion of the story that these cattle will be used to tell. Today we can only say what the financial return would be if all were sold. The calves are all being taken to grass the first part of the summer. Some of each level of wintering will be grazed the entire grazing season. One half of the steers wintered at the two higher levels will be returned to dry lot, following a short period of grazing, and will be fattened. Will the well wintered steers market grass this coming summer to as good an advantage as those wintered to gain at a slower rate? Watch for these results.

4-46/2½M