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Agricultural Experiment Station

College of Agriculture, West Virginia University

N. J. GIDDINGS, Acting Director
Morgantown

Effect of Winter Rations on Pasture Gains of Calves Marketed as Three-Year-Old Steers

Fig. 2.—Calves at Beginning of Experiment, December 22, 1922.

By
C. V. WILSON, R. H. TUCKWILLER,
and
E. W. SHEETS

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Effect of Winter Rations on Gains of Calves Marketed as Three-Year-Old Steers

The work reported in this bulletin is part of a series of experiments on beef-production problems in the Appalachian Mountain region that has been in progress since December 22, 1924, in cooperation between the Bureau of Animal Industry of the United States Department of Agriculture and the West Virginia Agricultural Experiment Station, on the farm of David Tuckwiller, in Greenbrier County.* This farm is situated in the southeastern part of the state, in the bluegrass area. The results of this experiment apply not only to West Virginia, but also the adjacent states having similar conditions, as shown in Figure 1. Some of the methods and results may be utilized to advantage by cattle feeders in other parts of the country.

The topography of most of this region is mountainous. Practically all the region is suitable for grazing. There are a great many valleys and plateaus where the land varies from almost level to gently rolling. Such land is well adapted to pasture and the production of cultivated crops. Though the region for the most part is cleared of virgin forest, there are still large areas of cut-over land. The farms vary in size from less than 100 to more than 1,000 acres. On most farms there is sufficient tillable land for the production of winter feed. Relatively little surplus grain is produced.

Most of the grass-fattened cattle which go annually to eastern markets are produced in this region. The fact that most of them are finished for market on grass alone attests the value of the pastures, which consist largely of bluegrass. The use of grain for finishing cattle is not

g. 1.—Map showing region to which this work applies. The black dot indicates the location of the farm on which the experiment was conducted. The shaded portion represents the area to which the results are applicable, and the dotted portion shows an additional area to which the results apply in part.

*The work of the Federal Department was under the direction of E. W. Sheets, Chief, Animal Husbandry Division, Bureau of Animal Industry.

general, although there are many sections where the practice is followed, particularly in the valleys of some of the larger streams. far the greater number of farmers who handle beef cattle either grass stockers and feeders or finish cattle for market from grass alone. Therefore, one of the principal beef-production problems is to determine the best and most economical method of wintering the calves and the one that will enable them to make the best possible use of the pasture the following summer, when the cheapest gains are made. A common practice in this area has been to winter steers on dry feed, such as hay, corn stover, and wheat straw, and on corn silage to a less extent, in such way that they lose materially in weight. They are then pastured the following summer and sold from grass as stockers, feeders, or finished steers. There are some who hold that it is profitable to permit this loss of weight, which with older steers usually varies from 25 to 100 pounds. Others believe that calves wintered on silage, or on a ration of which silage is a part, will not do well on grass the following summer.

OBJECTS AND PLAN OF THE WORK

The experiments as a whole had the following general problem in view:

- (1) To ascertain the effect of different wintering rations on subsequent pasture gains.
- (2) To determine the most satisfactory and economical method of wintering.
- (3) To determine the best method and the cost of raising beef cattle in West Virginia.

The results of previous work with cows, calves, yearlings, and two-year-olds are published in bulletins 186, 190, and 191 of the West Virginia Agricultural Experiment Station and in United States Department of Agriculture bulletins 870, 1024, 1042, and 1251, respectively. In all the previous work the cattle were kept one year on dry feed.

This bulletin is a report of the work with calves kept from wintering age until marketed as three-year-old steers.

The objects of this experiment were:

- (1) To study the effects of the following winter rations when fed to calves, upon the subsequent gains of the steers on pasture when marketed as grass-fat three-year-olds.

RATION I
Clover hay
Corn silage
Wheat straw

RATION II
Cottonseed meal
Corn silage
Wheat straw

RATION III
Mixed hay
Grain mixture

(2) To study the effects of the following rations when fed to same calves as yearlings, upon the subsequent gains of the steers marketed as grass-fat three-year-olds.

RATION I	RATION II	RATION III
Clover hay	Cottonseed meal	Mixed hay
Corn silage	Corn silage	Corn silage
Wheat straw	Wheat straw	Wheat straw

The three lots of yearlings fed during the winter of 1923-24 were each made up of 30 steers, 10 from each of the three lots of the preceding year.

(3) To obtain a continuous feed and growth record for steers from weaning age until they are fattened on grass as three-year-olds.

KIND OF STEERS USED

For use in this experiment 100 good to choice Hereford steer calves were obtained in north central Texas. They arrived at the farm about the end of November, 1922, having been in transit from Texas 18 days and showing to a marked degree the effects of the long journey and insufficient feed. On December 22, when the feeding started, the calves averaged 386 pounds in weight, ranging from 300 to 500 pounds. (See Figure 2, on cover page.)

METHOD OF FEEDING AND HANDLING THE STEERS

For the experimental feeding 90 of the calves were selected and divided into three lots of 30 each. In making this division care was taken to have the lots as nearly uniform as possible in quality, size, and condition. The three lots were each given the same amount of space in an open barn and were kept under cover all winter. The steers were fed twice a day, and the feed, both concentrates and roughage, was carefully weighed at each feeding. Water was supplied in the barn at all times and salt was constantly available.

The steers were weighed individually three days in succession at the beginning and at the end of the winter feeding period, and averages taken for their initial and final weights. They were also weighed once every 28 days, in the morning after feeding. Numbered ear tags were used, so that ready identification of each individual could be made and records accurately kept.

In the spring of each year, as soon as the grass was good enough, which was usually about April 25, the steers from all the lots were turned into the same or similar pastures with no additional feed. Weights were taken once every 28 days during the first two summers. During the last summer, weights were taken only once, July 22, before the final weight on September 10, when they were marketed.

One steer was struck by lightning on June 6, 1925, this being only animal lost in the three years.

The outline in Table 1 shows how the steers were fed each winter until they were fattened on grass as three-year-olds. Only the feeds to be compared are put into the diagram. Corn silage and wheat straw were fed to every lot each winter, except Lot III in the first winter, which received mixed hay and a grain mixture.

TABLE 1.—Outline of Three Years' Winter Feeding.

1922-23		1923-24		1924-25	
Lot	Ration	Lot	Ration	Lot	Ration
I (30 calves)	Clover hay Corn silage Wheat straw	A (30 yearlings, 10 each from Lots I, II, and III of preceding winter)	Clover hay Corn silage Wheat straw	(90 head two- year-olds, Lots A, B, and C of pre- ceding winter combined)	Cottonseed meal Corn silage Wheat straw
II (30 calves)	Cottonseed meal Corn silage Wheat straw	B (Same as A)	Cottonseed meal Corn silage Wheat straw		
III (30 calves)	Mixed hay Grain mixture*	C (Same as A)	Mixed hay Corn silage Wheat straw		

*Consisted of 3 parts, by weight, of corn, 1 of bran, and 1 of linseed meal.

QUANTITY OF FEED CONSUMED AND GAINS MADE

Table 2 shows the total quantity of the different feeds consumed by the various lots and the average daily ration per steer in each winter during each of the three winters. All lots were fed to gain in weight during the winter.

At the beginning of the second winter feeding period, December 17, 1923, three new lots were made by taking 10 steers from each of the three original lots, and these are hereafter designated as Lots A, B, and C. The purpose was to offset the effects of the rations fed the first winter and to make it possible to get a fair and direct comparison of rations fed the second winter. In order to study more in detail the effects of the winter ration on subsequent gains the second winter and thereafter, each 10 steers from the original Lots I, II, and III of the first winter were numbered A₁, A₂, A₃, B₁, B₂, B₃, and C₁, C₂, C₃. The letters designate each lot of 10 steers, and the numerals

TABLE 2.—Average Total and Daily Rations and Gains per Steer During the Three Winters. All Amounts Are Given in Pounds.

of winter	Lot	Winter Feed	Total Feed per Steer	Daily Feed per Steer	Average Initial Weight per Steer	Average Weight per Steer at End of Winter	Total Gain per Steer
(124 Days)	I	Clover hay	400.0	3.2	388	446	58
		Corn silage	1,528.5	12.3			
		Wheat straw	124.0	1.0			
		Cottonseed meal	92.2	.7			
	II	Corn silage	1,528.5	12.3	383	462	79
		Wheat straw	412.5	3.3			
	III	Mixed hay	1,240.0	10.0	389	502	113
		Grain mixture*	368.5	3.0			
(120 Days)	A	Clover hay	603.0	5.0	575	662	87
		Corn silage	2,166.0	18.0			
		Wheat straw	242.0	2.0			
		Cottonseed meal	120.0	1.0			
	B	Corn silage	2,166.0	18.0	576	655	79
		Wheat straw	603.0	5.0			
	C	Mixed hay	603.0	5.0	575	615	40
		Corn silage	2,166.0	18.0			
		Wheat straw	242.0	2.0			
(126 Days)	All three lots the same	Cottonseed meal	135.2	1.1	905	940	35
		Corn silage	3,272.0	26.0			
		Wheat straw	607.5	4.8			

*Consisted of 3 parts, by weight, of corn, 1 of bran, and 1 of linseed meal.

indicate the source from which they came. For example, the numeral identifies the 10 head taken from the original Lot I. By referring to Table 2 it may be seen that Lot A was fed clover hay, corn silage, and wheat straw during the winter of 1923-24 (second winter), and that Lot I also received the same feeds the first winter. A₁, then, identifies 10 head of steers fed the first winter on clover hay, corn silage, and wheat straw, and the second winter on the same ration. A₂ designates the 10 head fed during the winter of 1923-24 on mixed hay, silage, and wheat straw, and the previous winter on mixed hay and grain mixture, and so on. The gains made by the steers on pasture during the summer periods are shown in Table 3.

Reference to Table 2 shows that during the first winter Lot I gained 58 pounds; Lot II, 79 pounds; and Lot III, 113 pounds. During the following summer (Table 3), Lot I gained 127 pounds; Lot II, 119 pounds; and Lot III, 99 pounds per steer.

TABLE 3.—Average Total and Daily Gain in Pounds per Steer on Pasture During the Three Summer Periods.

Years and Days on Pasture	Lots	Initial Weight, Beginning of Summer	Final Weight, End of Summer	Total Gain	Daily Gain
1923 (236 days)	I	446	573	127	6.
	II	462	581	119	.
	III	502	601	99	.
1924 (241 days)	A	662	898	236	.
	B	655	916	261	1.
	C	615	900	285	1.
1925 (141 days)	All combined . .	940	1,259	319	2.

During the second winter Lot A gained 87 pounds; Lot B, pounds; and Lot C, 40 pounds. In the second summer Lot A gained 236 pounds; Lot B, 261 pounds; and Lot C, 285 pounds.

These data show that when the cattle are turned on grass in the summer (without additional feed) the lots which gain heavily during the previous winter do not gain so much in the following summer, and that the lots gaining least in winter make relatively large summer gains.

COMPARISONS OF WINTER RATIONS

In order to make a more complete study of the effect of different winter rations from year to year on the grass-fat steers ultimately produced, Table 4 was prepared.

Since all 90 head were fed the same ration during the third winter, as noted before, Table 5 comparing the first two years is given.

Fig. 3.—Three-year-old Steers at Close of Experiment, on Arrival at Jersey City Market, September, 1925.

TABLE 4.—Average Weights of Steers at Beginning and End of Each Winter Period in Pounds.

Lots and Rations	December, 1922	April, 1923	December, 1923	April, 1924	December, 1924	April, 1925	September, 1925	Total Gain (988 Days)
10 steers from Lot I, fed clover hay, silage, and straw first winter	385	442	555	652	874	900	1,200	815
10 steers from Lot II, fed cottonseed meal, silage, and straw first winter	371	447	562	635	879	919	1,213	842
10 steers from Lot III, fed mixed hay and grain mixture first winter	398	515	609	698	940	969	1,302	904
Lots A _{1,2,3} fed clover hay, silage, and straw second winter								
10 steers from Lot I fed as A ₁	374	432	542	615	858	902	1,202	828
10 steers from Lot II, fed as A ₂	391	476	589	680	947	999	1,268	877
10 steers from Lot III, fed as A ₃	379	488	599	671	942	965	1,291	912
Lots B _{1,2,3} fed cottonseed meal, silage, and straw second winter								
10 steers from Lot I fed as A ₁	404	465	592	632	927	960	1,307	903
10 steers from Lot II fed as A ₂	387	463	561	607	886	933	1,284	897
10 steers from Lot III fed as A ₃	390	502	572	608	891	919	1,259	869
Lots C _{1,2,3} fed mixed hay, corn silage, and wheat straw second winter								

COST OF RATION

To figure the cost of wintering and summering the steers (Table) it becomes necessary to fix the prices for feeds used in the experiment. On account of fluctuations of the market, and also for simplicity in making the various calculations, an approximation of the local market feed prices per ton and pasture per day for the three years was used as follows:

Corn silage	\$ 6.00
Cottonseed meal	50.00
Mixed hay	18.00
Clover hay	17.00
Wheat straw	7.00
Grain mixture*	39.76
Pasture per day:	
Yearlings	.03
2-year-olds	.05
3-year-olds	.10

The cost of the winter feed was considerably more than the cost summer feed, yet the gain was made chiefly in summer.

ANALYSES OF FEEDS

The feeds used during the winter feeding in these experiments were analyzed by the West Virginia Agricultural Experiment Station. The analyses are shown in Table 7.

*Based on corn at 96 cents a bushel, wheat bran at \$40 a ton, and linseed meal at \$5 a ton.

TABLE 5.—Comparison of Winter and Summer Gains, in Pounds, First Two Years of Experiment.

Lot	First Year				Second Year				Th Ye
	Winter		Sum- mer	Total Gain	Winter		Sum- mer	Total Gain	
	Ration	Gain	Gain on Pasture		Ration	Gain	Gain on Pasture		
A ₁	Clover hay, silage, and straw	57	113	170	Clover hay, silage, and straw	97	222	319	32
A ₂	Cottonseed meal, silage, and straw	76	115	191	 do	73	244	317	33
A ₃	Mixed hay and grain mixture	117	94	211	 do	89	242	331	36
B ₁	Clover hay, silage, and straw	58	110	168	Cottonseed meal, silage, and straw	73	243	316	34
B ₂	Cottonseed meal, silage, and straw	85	113	198	 do	91	267	358	32
B ₃	Mixed hay and grain mixture	109	111	220	 do ..	72	271	343	34
C ₁	Clover hay, silage, and straw	61	127	188	Mixed hay, silage and straw	40	295	335	38
C ₂	Cottonseed meal, silage, and straw	76	98	174	 do	46	279	325	39
C ₃	Mixed hay and grain mixture	112	70	182	 do	36	283	319	36

Groups A₁, B₁, and C₁ were fed as Lot I the first winter.

Groups A₂, B₂, and C₂ were fed as Lot II the first winter.

Groups A₃, B₃, and C₃ were fed as Lot III the first winter.

During the second winter all A groups constituted Lot I, B groups Lot II, and groups Lot III.

TABLE 6.—Cost per Steer of Winter Feed and Summer Pasture, and Cost per Pound of Total Gain.

Lots	Total Gain per Steer, Three Years in Pounds	Cost of Feed per Steer							Cost of Feed per Pound of Gain in Cents
		Winter 1922-23	Summer 1923	Winter 1923-24	Summer 1924	Winter 1924-25	Summer 1925	Total	
A ₁	815	\$ 8.42	\$7.08	\$12.48	\$12.05	\$15.33	\$14.10	\$69.46	8.5
A ₂	842	8.34	7.08	12.48	12.05	15.33	14.10	69.38	8.2
A ₃	904	18.49	7.08	12.48	12.05	15.33	14.10	79.53	8.8
B ₁	828	8.42	7.08	11.61	12.05	15.33	14.10	68.59	8.3
B ₂	877	8.34	7.08	11.61	12.05	15.33	14.10	68.51	7.8
B ₃	912	18.49	7.08	11.61	12.05	15.33	14.10	78.66	8.6
C ₁	903	8.42	7.08	12.78	12.05	15.33	14.10	69.76	7.7
C ₂	897	8.34	7.08	12.78	12.05	15.33	14.10	69.68	7.8
C ₃	869	18.49	7.08	12.78	12.05	15.33	14.10	79.83	9.2

TABLE 7.—Analyses of Feeds, Reported in Percentages.

Feed	Year	Water	Ash	Protein	Fiber	Nitro- gen-Free Extract	Fat
lage	1922-23	64.07	1.06	2.64	5.92	24.87	1.44
	1923-24	60.50	3.15	3.06	7.43	24.37	1.49
over hay	1922-23	5.60	4.77	8.81	40.70	38.32	1.80
	1923-24	6.34	5.20	9.61	34.14	42.55	2.16
ixed hay	1922-23	5.90	4.96	8.64	35.54	42.75	2.21
	1923-24	5.10	4.04	6.14	31.51	50.58	2.63
heat straw	1922-23	4.87	4.03	4.48	41.66	43.68	1.28
	1923-24	5.08	3.49	4.08	42.27	43.44	1.64
orn	1922-23	8.60	1.23	9.98	2.58	73.20	4.41
nseed meal	1922-23	7.93	4.86	35.76	8.22	36.11	7.12
ottonseed meal	1922-23	8.44	5.94	34.28	12.95	32.02	6.37
	1923-24	8.14	6.56	36.46	11.42	30.78	6.64
an	1922-23	7.91	6.60	15.76	10.61	53.64	5.48

CONCLUSIONS

From a study of the growth curves shown in Figures 4 and 5 it may be seen that a loss in weight during the last two months of the grazing periods occurred both in 1923 and 1924. In other words, the average weight of the 90 steers on October 10, 1923, was practically the same as it was six months later, or April 18, 1924. This suggests a point worthy of more study and investigation. This loss of weight after frost comes in the fall and before putting the cattle to winter quarters should undoubtedly be avoided. The solution may lie either in supplementing this late fall pasture with grain or in moving the cattle into winter quarters earlier.

As a rule the lots of calves and yearlings which made the least winter gains made the greatest summer gains, and conversely the lots gaining most in winter gained least in summer on pasture.

Differences in gains made by calves and yearlings during the winters, 1922-23 and 1923-24 brought about by the rations fed were minimized during the summers of 1923 and 1924 when they were on pasture.

There were relatively little differences between the average annual gains of the different lots of calves and yearlings at the end of the first and second summer grazing periods. When these lots of calves and yearlings were then fed the same winter ration as two-year-old steers and finished on pasture as three-year-old steers all lots sold in Jersey City at the same price per pound. Therefore, the cost of wintering rations, fed in this experiment, is of relatively greater importance than the kind of ration when fed to calves and yearlings that are to be finished on pasture as three-year-old steers.

Fig. 4.—Gains of Steers During Winter and Summer, December 22, 1922, to December 17, 1923.

3. 5.—Gains of Steers During Winter and Summer, December 19, 1923, to December 15, 1924.

FERRETED FACTS

Fourteen years (1914-28) of experimental investigations as to feeding of beef cattle on the Tuckwiller Farm show conclusively:

1.—That the cost of winter feeding is the most important factor in the economy of beef production for the area represented by this work. (See Figure 1.)

2.—That the use of corn silage will lower the cost of winter feeding and when fed along with the ordinary farm roughages will enable the farmer to feed more cattle for a longer period than he can on the same feed if fed in a dry state alone.

3.—That corn silage with a good leguminous roughage makes a satisfactory and economical wintering ration for cattle of any age including breeding cows.

4.—That winter gains exceeding 75 pounds on three-year-old steers are excessive unless the cattle are extremely thin when placed in winter quarters, or it is desired to market them as early as July.

You Are Invited

Farmers who live in the Greenbrier Valley section or whose business or pleasure brings them within proximity of Lewisburg are cordially invited to visit the Tuckwiller Farm and see at first hand the cooperative experimental work that is being conducted there with beef cattle.

A three-year experiment with three-year-old steers has just been completed, in which two grades of steers, good and medium, were compared, and grass alone for summer feeding contrasted with grass supplemented by grain. Results of this work are being prepared and will be published at an early date.

Starting in the fall of 1928 further work with grain feeding will be continued for a three-year period. Younger cattle will be used and a study of the time at which to begin grain feeding on grass will be made.

The Tuckwiller Farm is readily accessible at all seasons of the year being located on the Midland Trail 4 miles west of Lewisburg and 106 miles east of Charleston. It is suggested that a visit to the farm would make a good tour or vacation trip for a group of farmers who might arrange to make the trip together. Any group desiring to visit the farms and see this experimental work may obtain information as to the times at which winter feeding will begin and end, summer feeding begin, and final summer weights be taken, by writing to the Animal Husbandry Department of the West Virginia Agricultural Experiment Station at Morgantown.

Beef Cattle In West Virginia

The raising of beef cattle has a very definite place on many West Virginia farms as an important farm enterprise. The profitableness of the enterprise, however, depends upon how well the farmer understands the fundamental principles of feeding, care, and management and is able to apply them.

The West Virginia College of Agriculture is striving through the work on its Experiment Station to discover facts about the raising of beef cattle that will be of help to the farmers in the state in making the enterprise more successful and profitable.

These facts are disseminated in three major ways: (1) By the teaching staff of the College through resident instruction to students; (2) Through the work of Extension Division and its field representatives—the livestock specialists and county agricultural agents; and (3) Through the means of publications which are distributed free to those interested.

If you have any special problems, in handling your beef cattle, consult your county agricultural agent, or write to the College for suggestions and aid. One of the following publications of the Experiment Station may contain the information you need:

Bul. 186, Effect of Winter Rations on Pasture Gains of Beef Calves and Yearlings.

Bul. 190, Feeding Experiments With Grade Beef Cows.

Bul. 191, Effect of Winter Rations on Pasture Gains of Two-Year-Old Steers.

Cir. 40, A brief extract of bulletin 191 (8 pages).

Bulletins and circulars on other farm problems are also available for distribution. A complete list of available publications will be issued about January 1, 1929. Write for it. Address your request to

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