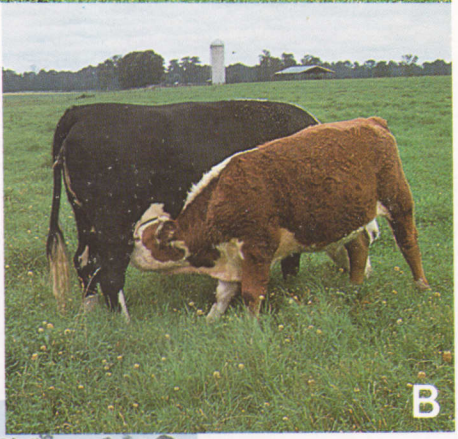
Crop and Beef Cattle Production Systems



BULLETIN 478
MARCH 1976

AGRICULTURAL EXPERIMENT STATION / AUBURN UNIVERSITY
R. DENNIS ROUSE, Director
AUBURN, ALABAMA

CONTENTS

First Printing 5M, March 1976

Crop and Beef Cattle Production Systems

R. R. HARRIS, V. L. BROWN, C. C. KING,
S. C. BELL, W. B. ANTHONY, and E. M. EVANS*

INTRODUCTION

GROWTH OF THE CATTLE INDUSTRY in Alabama during the last 30 years has been substantial. More than 5 million acres in Alabama are now devoted to beef cattle production, and the State ranks 16th in the Nation in beef cow numbers. The production phase has been based primarily on the cow-calf enterprise and the sale of calves at weaning.

Several factors have contributed to Alabama's rapid change in agriculture from a cash crop to a balanced livestock-row crop economy. A long growing season and abundant rainfall make forage production a practical competitor for land use. Total rainfall is adequate, but erratic distribution during the warm season often limits the yield of cash crops. Much of the land used in beef cattle production has too much slope or is otherwise subject to considerable erosion when cultivated.

Acreage controls of cash crops accompanied by incentive programs to establish permanent sods for erosion control have stimulated conversion of land to cattle production. Production potential of these converted acres was increased by introduction of deep rooted warm season perennials, such as Coastal bermudagrass and bahiagrass, continued improvement of summer and winter annual grasses and legumes, and increased knowledge of forage management and fertility requirements. Such developments added to the attractiveness of cattle farming.

The relative merits of individual crops are usually thoroughly tested in plot comparisons before they are used in cattle research. Then it is necessary to determine how well these crops fit into

* Respectively, Professor, Department of Animal and Dairy Sciences; Head, Department of Research Operations, formerly Superintendent, Lower Coastal Plain Substation; Professor, Department of Agronomy and Soils; Professor, Department of Agricultural Economics and Rural Sociology; Professor, Department of Animal and Dairy Sciences; and Associate Professor, Department of Agronomy and Soils.

practical cattle production enterprises. This requires evaluation in crop sequences or, in other cases, the potential of the crop for production of grazing or stored feed.

Considerable debate has continued in recent years on whether the cow-calf enterprise can compete successfully with cash crops for the use of highly productive land. Many have maintained that economic returns are too low to warrant intensive management. The concept of beef production has changed, however, due to increased cost of and competition for land, and land owners now recognize that production per land unit must be improved.

Although previous work[1,2] showed that total confinement of beef brood cows was not economical (under conditions of the test), some aspects of confinement indicate potential for improving production efficiency. Carrying capacity per land unit can be greatly increased when forage is harvested and fed to confined animals, and feed can be apportioned according to nutritional needs.

An experiment with four treatments representing widely different systems of handling the cow-calf enterprise was initiated in 1969 to determine how different intensities of production practices and management affect output and net returns. These varied from systems of semi-confinement or confinement management during part of the year that released land for production of cash crops to systems with minimum outlay for equipment or production costs. Accurate records were kept of each crop, showing all inputs and production of stored feed or grazing days per land unit.

Since economic conditions change, efforts were made to record all production costs and returns in a manner that would permit cattle producers to substitute current prices and different production data. Thus, they can arrive at an estimate of land needs, stocking rates, and costs and returns applicable to the cattle enterprise.

EXPERIMENTAL METHODS

The four combination beef cattle-crop production systems studied were adaptable to soils of widely different productivity, but

[1] HARRIS, R. R., V. L. BROWN, W. B. ANTHONY, AND C. C. KING, JR. 1970. Confined Feeding of Brood Cows, Auburn Univ. (Ala.) Agr. Exp. Sta. Bull. 411.

[2] BELL, S. C., E. VAUGHN, AND V. L. BROWN. 1972. An Economic Analysis of Two Confinement Systems vs. A Conventional System of Beef Cow-Calf Production, Auburn Univ. (Ala.) Agr. Exp. Sta. Bull. 428.

required varying levels of management for optimal success. One rather intensive management system ("A") involved coordinate production of row crops, forage, and cattle on highly productive land. An intermediate system ("B") emphasized legume-grass grazing for cattle production. Two other intermediate systems ("C" and "D") utilized Coastal bermudagrass for grazing and hay. Cows in system C received protein supplement with hay during the winter period while cows of system D were fed hay but no protein supplement.

Test animals selected were cows of Angus-Hereford breeding, between the ages of 2 and 4 years, and which had predicted performance capability at maturity of weaning a 550-pound calf at 270 days. Approximately two-thirds of these cows were raised on the Lower Coastal Plain Substation and the remainder purchased as bred heifers from a single producer in Missouri. Cattle from each source were equitably distributed among treatment groups. All cows were bred to performance tested Polled Hereford bulls. Four bulls were used in a 14-day rotational breeding schedule so that all cow groups were exposed to each bull for the same number of days during the breeding season. Females in treatment groups A and B were bred to calve from October through January and those in treatments C and D were bred to calve from December through March. The use of different calving seasons was an attempt to adapt animal requirements to projected feed production.

Thirty cows were assigned to each treatment outlined below:

A. An intensive system that involved coordinate production of corn, soybeans, and cool-season annual grazing on 45 acres of highly productive land.

B. An intermediate system that emphasized legume-grass grazing (15 acres of tall fescue-clover and 30 of Coastal bermudagrass-clover).

C. An intermediate system that utilized Coastal bermudagrass for grazing and hay (30 acres). Hay plus a liquid protein supplement was fed during the winter season.

D. The same treatment as C except that no protein supplement was fed to cows.

Thirty cows were maintained in each treatment group at all times. Any cow removed from test for any reason was replaced immediately from a pool of comparable females kept for that purpose. Cows were weighed October 1 and April 1 each year.

All harvested feeds except corn silage were weighed at time of feeding. Corn silage consumption was determined indirectly from the amount required annually to refill the silo. The liquid protein-mineral supplement fed to cows in system C was provided free choice in a lick-wheel feeder. This feeder was calibrated so that liquid level could be measured with a dip stick and thence converted to pounds. Readings of the liquid level were made at least three times weekly.

Calves were castrated, vaccinated, and otherwise treated according to good management practices. Calves were weighed on October 1, April 1, and at 205 ± 14 days of age. They could be weaned at 205 days of age or, if feed supply and calf performance warranted, continued on test to a maximum age of 270 days. If they were continued past 205 days of age, all calves in a particular group were weighed every 28 days subsequent to that date. Weaning weight data were adjusted for sex and age of dam differences using the following adjustment factors:

A. Heifer to steer equivalent – multiply by 1.05

B.

Age of dam	*factor*
2 years	1.15
3 years	1.10
4 years	1.05
5+ years	1.00

Calves were evaluated at weaning according to stocker grade, slaughter grade, and price. Usually calves were kept for further research, although 29 percent of them were sold immediately after weaning. Shrink in liveweight from farm to sale was obtained for calves that were sold. This shrinkage factor was applied to the weaning weights of all calves to more accurately estimate actual market weight and value.

System A

Forty-five productive acres and a 3-acre feeding area were assigned to this treatment group. Two 20-acre fields were used rotationally for production of soybeans and for silage followed by cool-season grazing. Crops were alternated between fields to maximize land use and minimize plant disease problems. Five acres planted alternately to cool- and warm-season annual forages served as a creep grazing area for the calves during times when their dams were confined to the feedlot.

Twenty acres of corn were planted about May 1. Atrazine was

applied at the rate of 2.5 pounds technical per acre each year. The seeding rate was intended to give a plant population of 16,000 to 20,000 plants per acre, but actual plant stands ranged from about 14,000 to 16,000. The corn hybrid used was Funk's G Brand 795 W-1. Amounts of lime, P, and K, which were applied according to soil test recommendations, and N applied are shown in Appendix Table 1. Sufficient acreage of corn was harvested to yield approximately 180 tons of silage (35 percent DM). Remaining corn was harvested in early October as grain for a cash crop.

The area on which corn silage was grown was planted between September 1 and 15 each year in oats, ryegrass, and crimson clover. Oats were seeded at the rate of 3 bushels per acre, ryegrass at 15 pounds per acre, and crimson clover at 20 pounds per acre. Lime, P, and K were applied according to soil test recommendations, Appendix Table 1. Commercial nitrogen was applied to winter forages in split applications at the acre rate of 60 pounds at seeding and 60 pounds in February. Surplus growth was harvested as hay.

The area where corn was harvested as mature grain was seeded immediately to the oats, ryegrass, clover mixture.

Twenty acres of soybeans (Bragg variety) were planted about June 1 each year at the rate of 1 bushel per acre. Treflan at the rate of 1 pound per acre was applied and incorporated prior to planting. Lime, P, and K were applied according to soil test recommendations, Appendix Table 1. Following soybean harvest, this 20-acre area was planted to Wren's Abruzzi rye at the rate of 100 pounds seed per acre. This pasture was grazed alternately with the other 20-acre field until April 1-15 when the land was prepared for planting to corn.

A 3-acre feedlot area contained the upright silo and bunk facilities for feeding the cows when the field areas were in row crops or had inadequate grazing for both cows and calves.

All cattle grazed when forage was plentiful, but calves were given priority on grazing. Cows and calves were removed from grazing approximately May 15. When confined to the 3-acre feeding lot, cows received cottonseed meal (CSM) and corn silage.

Creep grazing for calves was furnished by 5 acres planted to a small grain-legume mixture during the cool season and to pearl-millet planted in early summer. At times when cool season graz-

ing was not available, a creep grain mixture was provided. The composition of this creep mixture was as follows:

Ingredient	*Percent*
Ground shelled corn	65
Ground bermudagrass hay	15
Cottonseed meal (41%)	8
Urea	1
Cane molasses	10
Salt	0.5
Dicalcium phosphate	0.5

Silage was stored in an upright, concrete stave silo with an approximate capacity of 200 tons. This silo was equipped with an automatic unloader and auger system to deliver silage to the feed bunk. The system was manually controlled and was not designed to weigh ensilage upon removal from the silo; however, daily silage feedings were reasonably quantitative. The system was run at about the same speed from day to day, as measured by electrical current load, and the auger was calibrated to deliver a certain amount of silage to the trough per unit of time. The silo was refilled annually with all material being weighed into the silo, thus annual silage usage could be estimated indirectly by replacement. The covered feeding bunk was 30 feet long and open on both sides. A concrete apron, for cattle to stand on during feeding, surrounded the trough.

System B

Forty-five acres were involved in production system B. Thirty acres of well-drained soil were established in Coastal bermudagrass, and half of this area was overseeded to annual winter legumes each fall. Overseeding was alternated between the two 15-acre areas each year. Crimson clover was seeded at the rate of 15 pounds per acre for the first 2 years. Five pounds of Yuchi arrowleaf clover per acre were seeded along with 15 pounds of crimson clover seed the last 2 test years. The overseeded area received approximately 100 pounds of N from ammonium nitrate (NH_4NO_3) per acre in three applications, Appendix Table 1. The other 15 acres received about 150 pounds of N per acre from NH_4NO_3 in four applications. Lime, P, and K were applied according to soil test recommendations, Appendix Table 1. Surplus summer forage was harvested as hay to be fed during the winter. Hay produced in excess of feed requirements was sold.

Fifteen acres of lower-lying land were planted to Kentucky 31 tall fescue in 16-inch rows and overseeded with Regal ladino clover. The fescue was seeded at 10 pounds per acre and Regal ladino was broadcast at 4 pounds per acre. This area was fenced separately to enable summer rest of the fescue and to give calves priority for grazing when available forage was short. After the second year this area was essentially a pure stand of tall fescue. Nitrogen at the rate of approximately 120 pounds per acre (60 pounds in the fall and 60 pounds in the spring) was applied to the fescue. Lime, P, and K were applied by soil test recommendation, Appendix Table 1.

During early fall and again in spring, cows and calves in this group usually had grazing from either fescue-clover or clover in bermudagrass sod. They were fed Coastal bermudagrass hay plus CSM during winter when grazing was inadequate. When the supply of grazing was limited, cows with calves were given first priority.

Coastal bermudagrass was grazed during spring-summer and surplus growth was harvested as hay for winter feeding.

Systems C and D

The two 30-acre areas of these two systems were established to Coastal bermudagrass in 1969. Mineral fertilizer and lime were applied according to soil test and nitrogen at the rate of approximately 200 pounds of N per acre, Appendix Table 1. Surplus forage was harvested as hay and fed to the cattle during Coastal's non-productive period.

The 60 cows in treatment groups C and D grazed together during summer but were divided into two subgroups of 30 cows each for winter (November 1-April 1) feeding. All cows received Coastal bermudagrass hay that was harvested either from surplus growth on pasture or from an area reserved for hay production. However, subgroup C was self-fed a liquid protein supplement[3] and subgroup D received hay only.

RESULTS

System A

CORN SILAGE. Approximately one-half of the 20 acres of corn was harvested each year to provide silage for the cattle in system

[3] Pro-lix, manufactured by the Pro-Lix Companies, Aliceville, Alabama, was provided gratis for this study.

A, Table 1. The acreage cut for silage varied depending on amount of carryover silage from the previous year and the yield per acre for the current year. Silage yields were good except for 1970 when southern corn leaf blight caused by *Helminthosporium maydis* greatly reduced production. The 10.7-ton per acre yield in 1970 was about two-thirds of the 15 to 16 tons per acre produced the other 3 years. Except for 1970, percent dry matter (DM) of the silage varied from 34 to 36 percent, which was close to the recommended 35 percent DM. The condition of the dis-

TABLE 1. ACREAGE, YIELD, AND PRODUCTION OF CROPS FROM SYSTEM A, 1970-73

Year	Individual crop data				
	Corn for silage				
	Acres harvested	Tons/acre at 35 pct. dry matter	Total production, tons at 35 pct. dry matter	Percent dry matter of silage at harvest	Percent ear in silage
1970	8.6	10.7	92	29.4	25.0
1971	10.0	14.7	147	34.3	42.9
1972	9.5	16.5	157	33.9	49.1
1973	8.2	15.1	124	36.0	50.0
Mean	9.1	14.2	129	33.4	41.8
	Corn for grain				
	Acres harvested	Yield/acre, bushels	Total production, bushels		
1970	11.4	28.3	322		
1971	10.0	81.3	816		
1972	10.5	76.7	805		
1973	11.8	71.3	844		
Mean	10.9	63.7	697		
	Soybeans for grain				
	Acres harvested	Yield/acre, bushels	Total production, bushels		
1970	20	35.3	706		
1971	20	37.5	750		
1972	20	13.5	270		
1973	20	17.0	340		
Mean	20	25.8	516		
	Hay from cool season grazing				
	Acres harvested	Yield/acre, tons	Total production, tons		
1970	20	0.77	15.4		
1971	20	.46	9.2		
1972	20	0	0		
1973	20	0	0		
Mean	20	.31	6.2		

eased corn in 1970 caused it to be harvested when the DM content was 29 percent. Percent ear was good during 1971, 1972, and 1973, ranging from 43 to 50 percent. The 1970 corn crop was only 25 percent ear.

CORN GRAIN. Corn grain yields followed a pattern similar to that of corn silage, Table 1. Because of southern corn leaf blight, 1970 grain yields were only about one-third of the 1971, 1972, and 1973 yields, which ranged from 71 to 81 bushels per acre. These data confirm that southern corn leaf blight was more damaging to grain yields than to silage yields.

Rainfall during the critical period of late June and July was good each year so that moisture was not a seriously limiting factor

TABLE 2. RAINFALL BY 10-DAY PERIODS AT THE EXPERIMENTAL AREA, 1970-73

Month	Inches of rain			
	1970	1971	1972	1973
April				
First 10 days	0.25	0.92	.0 48	2.09
Second 10 days	1.58	.00	.71	1.12
Remainder of month	.48	3.57	2.11	6.19
May				
First 10 days	1.27	1.71	1.08	1.38
Second 10 days	.15	2.43	.10	.21
Remainder of month	4.04	1.50	.52	4.60
June				
First 10 days	1.82	2.74	.00	1.23
Second 10 days	.00	1.18	3.19	1.42
Remainder of month	4.58	1.82	1.69	1.37
July				
First 10 days	1.43	1.30	2.67	.58
Second 10 days	.67	2.66	.34	1.00
Remainder of month	4.53	7.81	1.87	2.70
August				
First 10 days	7.15	.37	1.65	2.07
Second 10 days	.36	.07	.36	.31
Remainder of month	.80	.44	.06	.46
September				
First 10 days	.35	2.47	.17	.65
Second 10 days	.03	1.79	.75	.70
Remainder of month	.25	.51	1.87	.70
October				
First 10 days	.44	.05	.00	.00
Second 10 days	4.38	.08	.00	.83
Remainder of month	1.58	.08	1.61	.59
November				
First 10 days	.59	.42	.71	.82
Second 10 days	1.19	.00	2.14	.08
Remainder of month	.00	1.53	2.03	2.54

in corn grain and silage production, Table 2. None of the years had more than one 10-day period during late June and July when rainfall was less than 1 inch.

SOYBEANS. Soybean production varied much more than did that of corn. Yields of 35 and 37 bushels per acre were produced in 1970 and 1971, respectively, while 1972 and 1973 yields were only 14 and 17 bushels, Table 1. Lack of moisture during the critical period of late August and September were responsible for the poor yields in 1972 and 1973, Table 2. In 1972, late August-September had three 10-day periods when less than ½ inch of rain was recorded, while the same period in 1973 suffered two such 10-day drought periods.

Hay was not an important item in system A. Light hay harvests of small grain, ryegrass, and crimson clover were made in 1970 and 1971, but none was harvested during the last 2 years, Table 1.

System B

No row crop production was involved with system B; however, surplus Coastal bermudagrass growth was saved for hay each year, Table 3. The amount harvested annually ranged from about 50 to 55 tons in 1970-72 and 113 tons in 1973. Each year the amount of hay harvested from system B exceeded the quantity needed to winter this group of cattle. Fall and winter grazing furnished by the 15 acres in tall fescue-white clover and the spring grazing furnished by the Yuchi arrowleaf and crimson clovers overseeded on the Coastal reduced the hay required.

TABLE 3. ACREAGE, YIELD, AND PRODUCTION OF HAY FROM SYSTEM B, 1970-73

Year	Area harvested	Yield per acre	Total production
	Acres	*Tons*	*Tons*
1970	30	1.59	47.8
1971	30	1.94	58.3
1972	30	1.85	55.4
1973	30	3.77	113.1
Mean	30	2.29	68.6

System C and D

Coastal bermudagrass hay production from surplus grazing was low each year, 0.4 to 1.1 tons per acre, Table 4. In none of the years was sufficient surplus hay harvested to meet the wintering needs of cattle in systems C and D. This probably reflects the

TABLE 4. ACREAGE, YIELD, AND PRODUCTION OF HAY FROM SYSTEMS C AND D, 1970-73

Year	Area harvested	Yield per acre	Total production
	Acres	*Tons*	*Tons*
1970	60	1.06	63.6
1971	60	.96	58.2
1972	60	.39	23.4
1973	60	1.13	67.8
Mean	60	.89	53.4

higher stocking rate of systems C and D (one cow and calf per acre) as compared with system B. Also the stand of Coastal bermudagrass was only 1 year old when the experiment was initiated so it was less productive than the 2-year-old stand of system B. The 1972 production of only 23 tons was partially the result of fall army worm damage to one cutting of hay.

Feed Requirements

Amounts of each feedstuff required annually by the 30 cow-calf pairs in each system are reported in Table 5. Daily feed allowances per cow are given in Table 6. Cows in system A were fed an average of 65 pounds of corn silage during the 157 days when

TABLE 5. HARVESTED AND PURCHASED FEED REQUIRED, BY SYSTEM[1]

Feedstuff	Amount, by system			
	A	B	C	D
Coastal bermuda hay, lb.	15,297[2]	65,301	105,382	105,496
Corn silage, tons	152[3]	-----	-----	-----
Cottonseed meal, lb.	4,564	4,292	-----	-----
Liquid supplement, lb.	-----	-----	7,598	-----
Creep mixture, lb.	20,086	-----	-----	-----
Mineral mix (Hi Mg), lb.	658	108	-----	-----

[1] 30 cows per system; 4-year means (1969-73).
[2] Rye-ryegrass-crimson clover hay; cut after grazed.
[3] Amount required to refill silo; not weighed directly as silage was fed (see text).

TABLE 6. DAILY FEED ALLOWANCES PER COW, BY SYSTEM[1]

Feedstuff	Amount, by system			
	A	B	C	D
Days grazed	208	225	177	177
Days fed harvested feed	157	140	188	188
Coastal bermuda hay, lb.	-----	15.7	18.6	18.6
Corn silage, lb.	65.0	-----	-----	-----
Cottonseed meal, lb.	1.0	1.0	-----	-----
Liquid supplement, lb.	-----	-----	1.6	-----

[1] 4-year-means, 1969-73.

TABLE 7. CONSUMPTION OF LIQUID PROTEIN SUPPLEMENT, BY YEARS

Month	Consumption, by year									
	1969-70		1970-71		1971-72		1972-73		Average	
	Days fed	Amt. /day	Days fed	Amt. /day	Days fed	Amt. /day	Days fed	Amt. /day	Days fed	Amt. /day
	No.	*Lb.*	*No.*	*Lb.*	*No.*	*Lb.*	*No.*	*Lb.*	*No.*	*Lb.*
November	27	1.51	29	2.31	29	2.26	29	2.25	28	2.09
December	31	2.24	31	2.40	31	1.66	31	1.71	31	2.00
January	31	1.69	31	1.63	31	1.49	31	1.82	31	1.66
February	28	1.40	28	0.89	29	1.54	28	1.40	28	1.31
March	31	1.64	31	1.59	27	1.06	31	0.75	30	1.27
April	26	0.52	29	0.79	0	0	0	0	14	0.66
Total days	174		179		146		150		162	
Av./day, lb.		1.52		1.55		1.62		1.58		1.58
Amt./cow/ year, lb.	265		277		237		237		256	

they were fed silage with cottonseed meal (CSM). Each cow in system B was fed an average of about 16 pounds of Coastal bermudagrass hay with 1 pound of CSM daily during their 140-day feeding period. The fescue-clover and clover overseeded on Coastal provided a slightly longer grazing season for the system B cows than on any other system, Table 6. The distribution of grazing provided by the different swards is shown in Appendix Table 2.

Even though cows in system C consumed an average of 1.6 pounds daily of liquid protein supplement, they were fed the same amount of hay as those in system D, Table 6. Intake of the liquid supplement was heaviest during November (2.09 pounds daily), leveled off during December and January (2.00 and 1.66 pounds daily), declined somewhat for February (1.31 pounds daily), and then dropped slightly during March (1.27 pounds daily) as spring grass became available, Table 7. The mean daily consumption for the entire winter season was 1.58 pounds during the 4-year study. Consumption values were consistent from season to season, averaging 1.52, 1.55, 1.62, and 1.58 pounds daily for the 4 consecutive years. The liquid supplement was fed for an average of 162 days during the winter, with total consumption averaging 256 pounds each.

Annual feed allowances on a per cow basis are shown in Table 8. Slightly more than 5 tons of corn silage were fed per cow unit under system A and about 3,500 pounds of hay per cow unit in systems C and D. Those in system B were fed about 2,200 pounds of hay per cow annually.

TABLE 8. ANNUAL FEED ALLOWANCES PER COW, BY SYSTEM[1]

Feedstuff	Amount, by system			
	A	B	C	D
Coastal bermuda hay, lb.	-----	2,177	3,513	3,516
Corn silage, tons	5.07	-----	-----	-----
Cottonseed meal, lb.	157	140	-----	-----
Liquid supplement, lb.	-----	-----	256	-----

[1] Based on 30 cows per system, 4-year means (1969-73).

Cattle Performance

Calf weight at 205 days of age was significantly affected by age of dam, sex of calf, and treatment. Calves suckling 2-year-old cows were the lightest at 205 days and those nursing 5-, 6-, and 7-year-old cows were the heaviest, Table 9. As would be expected, calf weight differences became progressively smaller with advancing age of the test cows. Average calf weight at 205 days was 405 pounds for steers and 384 pounds for heifers. This 21-pound difference compares favorably with the adjustment factor of 25 pounds that is commonly used to convert heifer weight data to steer equivalents. Calf weights at 205 days adjusted for sex and age of dam differences averaged 511, 454, 372, and 348 pounds for treatments A, B, C, and D, respectively. These all differed significantly from each other ($LSD_{.01}$ = 18.4 pounds).

Calves were weaned at progressively older ages during each year of the study, with the average being 250, 267, 269, and 271 days for 1969-72, respectively. Calves from systems A and B were weaned at an older age than those from systems C and D (271 and 267 vs. 260 and 258 days of age, respectively).

Similar to weight at 205 days of age, actual weaning weight was influenced by age of dam, sex of calf, and treatment, Table 9. As before, the more mature cows produced the heaviest calves and heifers weighed less than steers. Actual weaning weights averaged 604, 520, 400, and 373 pounds, respectively, for systems A, B, C, and D. These weaning weights were all significantly different ($LSD_{.01}$ = 24 pounds). In addition, an analysis of performance by cows from the two sources indicated that cows raised on the Substation were better able to adapt to nutritional stress than those purchased from out of state. In system D where stress was more pronounced, calves from station-raised females were heavier at weaning than those from purchased cows (402 vs. 366 pounds).

TABLE 9. CALF PERFORMANCE DATA, BY YEARS, SOURCE OF COW, SEX OF CALF, COW AGE, AND TREATMENT[1]

Item	Calves	Cow weight		Calf weight[2]			Weaning age, days	Actual weaning weight	Selling price[3] per cwt.	Estimated grades[4]	
		Nov. 1	Apr. 1	205-day	Adjusted 205-day	Adjusted weaning				Stocker	Slaughter
	No.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*No.*	*Lb.*	*Dol.*		
Year											
1969	111	935	892	390	417	488	250	455	31.57	12.4	10.2
1970	108	927	839	391	418	508	267	474	33.50	12.3	10.3
1971	109	914	815	392	419	517	269	483	42.44	11.7	10.0
1972	104	935	829	404	431	519	271	485	55.60	12.1	10.2
Cow source											
LCP	292	1,018	897	401	424	516	267	487	40.22	12.2	10.5
Mo.	140	977	886	416	431	499	256	482	40.84	12.2	10.4
Sex of calf											
Male	213	928	844	405	422	508	263	486	43.37	12.2	10.1
Female	219	928	843	384	421	507	265	462	38.18	12.1	10.3
Cow age											
2 years	19	609	643	326	383	489	274	415	41.83	11.8	8.9
3 years	43	843	764	378	424	515	266	458	40.69	11.9	9.7
4 years	104	974	868	403	433	517	265	481	40.59	12.1	10.3
5 years	114	1,002	905	417	427	504	261	492	40.73	12.4	10.6
6 years	91	1,053	921	420	430	509	258	497	40.59	12.4	10.7
7 years	61	1,085	962	420	431	513	262	501	40.22	12.4	10.7
Treatment (system)											
A	109	1,035	1,023	480	511	643	271	604	38.89	12.6	12.5
B	108	962	828	425	454	556	267	520	39.45	12.3	10.9
C	107	865	771	347	372	430	260	400	41.88	11.9	9.0
D	108	849	753	324	348	402	258	373	42.89	11.7	8.3
$LSD_{.05}$	------	82	36	13.9	13.8	17.7	6.4	18.0	1.32	0.2	0.4
$LSD_{.01}$	------	111	49	18.6	18.4	23.7	8.6	24.0	1.77	0.3	0.5

[1] Data reported for cow source are unadjusted means; all other values shown are least squares means.
[2] Calf weight at 205 days of age and at weaning were adjusted to steer equivalent and for age of dam (factors listed in text).
[3] Actual selling price at auction for some calves at weaning; others had sale price estimated based on individual grade, weight, and price received from those that were sold.
[4] High Standard = 8, low Good = 9, average Good = 10, high Good = 11, low Choice = 12.

The average sale price increased annually because of the general inflationary trend during the 4 test years (1969-72). Steer calves sold for an average of $43.37 per hundredweight and heifers brought $38.18. Treatment also had a significant effect on sale price of these calves. For example, calves from systems A and B averaged $38.89 and $39.45 per hundredweight, respectively, which was about $2 to $3 per hundredweight less than those reared on systems C and D ($41.88 and $42.89). During the period of this study, light, non-fat calves brought higher prices per hundredweight than heavier, fatter calves.

The stocker grade of calves at weaning averaged 12.6, 12.3, 11.9, and 11.7, respectively, for systems A, B, C, and D. Even though the differences between values were statistically significant ($P < .05$) there were no practical differences because all calves graded low Choice. This lack of difference in stocker grade among the systems verifies that the treatment groups of cows were comparable since stocker grade is based primarily on conformation.

There were some real differences in slaughter grade among calves from the experimental systems, Table 9. The slaughter grade of calves averaged low Choice, high Good, low Good, and high Standard, respectively, for the four systems. These differences reflect availability of feed on the various treatments since slaughter grade primarily evaluates degree of fatness.

Overall, calves gained similarly before and after 205 days of age (ADG = 1.64 and 1.63 pounds, respectively). The largest differences in rate of gain were related to sex and treatment. Heifer calves gained at an average daily rate post 205 days of 1.66 pounds, compared with 1.61 pounds for steers. Rate of gain to 205 days of age favored the steers, 1.71 vs. 1.57 pounds. Post-205-day average daily gains were 2.15, 1.79, 1.42, and 1.15 pounds for systems A, B, C, and D. Apparently these gains directly reflect availability of feed for the calves. However, the reason for the difference in post-205-day gains for calves from systems C and D is not known. Calves from these two systems gained at about the same rate up to 205 days of age, 1.39 and 1.31 pounds, respectively.

Cows in this experiment averaged about 90 percent calf crop weaned and there were no differences among systems. Total numbers of calves weaned during the 4 years were 109, 108, 107, and 108, respectively, for systems A, B, C, and D. Cows in systems A and B had a slightly higher calving rate than those in systems C

TABLE 10. BODY WEIGHT CHANGES IN COWS THAT CALVED, BY YEAR, AGE, AND TREATMENT[1]

Item	No. cows	Weight changes		
		Fall to spring (Oct. 1 to Mar. 31)	Spring to fall (Apr. 1 to Sept. 30)	Annual net
		Lb.	*Lb.*	*Lb.*
Year				
1969	110	− 41	+100	+ 59
1970	108	− 90	+146	+ 56
1971	109	−103	+187	+ 84
1972	104	−110	+172	+ 62
Mean		− 86	+151	+ 65
Cow age				
2 years	19	+ 29	+196	+225
3 years	43	− 87	+172	+ 85
4 years	104	−110	+148	+ 38
5 years	114	−101	+136	+ 35
6 years	91	−127	+131	+ 4
7 years	61	−119	+126	+ 7
Mean		−104	+143	+ 39
Treatment (system)[2]				
A	109	− 16[a]	+125[a]	+109[b]
B	108	−136[c]	+220[b]	+ 84[b]
C	107	− 94[b]	+129[a]	+ 35[a]
D	108	− 96[b]	+132[a]	+ 36[a]
		− 85	+151	+ 66

[1] Fall weights were taken October 1 and spring weights April 1. Values reported are least squares means.
[2] Values with unlike superscripts differ ($P<.05$).

and D (95 vs. 92 percent). The mortality rate at parturition was slightly higher for the dams in systems A and B, however, so the number of calves weaned during the 4-year test was practically the same on all systems.

In this experiment, cows that were suckling calves lost an average of 86 pounds body weight between October 1 and March 31, Table 10. Usually this loss included that at time of parturition since few cows had calved annually by the October 1 weigh day. Age of cow and treatment significantly affected body weight in the fall (October 1) and spring (April 1) and change in weight from fall to spring. As a general rule, winter weight loss of these cows from age 3 through 7 years averaged about 10 percent of their fall weight.

Cows in system A grazed cool-season annual pastures during the winter, which explains why they lost an average of only 16 pounds body weight. In contrast, cows in system B lost an average of 136 pounds during winter. These cows received grass hay

TABLE 11. NUMBER OF COWS CALVING AND AVERAGE CALVING DATES, BY YEARS

System	Calving data, by year									
	1969-70[1]		1970-71		1971-72		1972-73		1973-74	
	No.	Date	No.	Date	No.	Date	No.	Date	No.	Date
A	28	Nov. 22	28	Nov. 14	30	Nov. 7	29	Nov. 5	30	Oct. 31
B	30	Dec. 5	28	Nov. 14	27	Nov. 3	29	Nov. 1	26	Oct. 24
C	28	Dec. 29	28	Dec. 30	27	Dec. 27	27	Dec. 31	27	Dec. 27
D	29	Jan. 4	27	Jan. 3	29	Jan. 11	25	Jan. 13	27	Dec. 31

[1] Initial calving of experimental cows resulting from matings which occurred prior to assignment to this study.

with protein supplement and had limited access to fescue-clover grazing. Cows which had access to grass hay and free choice liquid protein supplement lost the same amount of weight as those fed only the hay, 94 vs. 96 pounds.

Cows generally gained weight between April 1 and October 1, Table 10. Younger cows gained the most because they were still growing. Cows in system B gained about 100 pounds more during the warm season than those from the other three systems (220 vs. 125, 129, and 132 pounds). However, it should be remembered that system B cows had lost the most weight during the preceding winter period, Table 10.

Perhaps the most significant value would be the net annual change in body weight, Table 10. Cows gained considerable weight as 2 year olds (225 pounds), but progressively less until at 6 and 7 years of age they had an annual net change in body weight of less than 10 pounds. However, treatment did have a significant effect on net annual weight change, so that cows in systems A and B gained an average of about 90 pounds yearly contrasted to about 35 pounds for cows in systems C and D, Table 10. These annual weight changes are directly related to available feed in the various systems.

The average calving date for cows in each of the experimental systems is reported by years in Table 11. Data for 1969-70 are included for reference purposes only because cows were already bred when assigned to this test in the fall of 1969. Cows in systems A and B averaged calving in early November, whereas those in C and D calved in late December or early January. Calving seasons were designed to be October-January and December-March, respectively. These data show that treatment conditions imposed did not affect calving rate nor season of calving.

During November-December 1970, three lactating cows in system A died from grass tetany. As soon as a tentative diagnosis was made, a mineral mixture containing 16 percent magnesium was provided free choice to cattle in system A. No cattle died thereafter and the practice of providing a high-magnesium mineral mixture was continued whenever cattle were on the cool-season annual pastures.

ECONOMIC ANALYSIS

All calf weights were adjusted by age of dam and sex of calf. Sale value of calves was the adjusted weaning weight, minus

actual shrink, multiplied by market price of calf at time of weaning. Total receipts from each system also included the value of crops such as soybeans, corn, and hay that were harvested and not fed.

The cash expenses included all items purchased, such as feed, seed, fertilizer, gas, oil, veterinary fees, medicine, and seasonal labor, plus an interest charge on operating capital. The non-cash expenses covered depreciation charge for all capital items, such as machinery and silo, and an interest charge on these capital items. Also included in non-cash expenses was an interest charge on the breeding livestock, cows and bulls.

Market prices each year were used in determining value of the calves, corn, and soybeans; therefore, these increased most years. Prices of fertilizer, seed, hay, and other inputs were held constant during the 4-year study. Some of these items were not purchased, so there wasn't a good cost figure available; also, the price of most input items did not vary much during the 4 years. Even in 1973, the year of large price increases, the increase occurred after planting season and affected output prices more than input prices.

TABLE 12. COSTS AND RETURNS OF BEEF AND CROP PRODUCTION, BY TYPE OF SYSTEM, 1970

Item	Data, by system			
	A	B	C	D
Calf performance and sale data				
Number weaned	27	30	26	28
Adjusted sales weight,[1] lb.	588	504	417	391
Average sale price per cwt.	$ 31.64	$ 31.63	$ 31.12	$ 32.31
Average adjusted sale value[2]	$ 186.04	$ 159.10	$ 128.21	$ 125.36
Receipts				
Value of calves	$5,023.08	$4,773.00	$3,333.46	$3,510.08
Value of soybeans	2,083.80	0	0	0
Value of surplus hay	342.50	450.00	0	0
Value of corn grain	334.88	0	0	0
Total receipts	$7,784.26	$5,223.00	$3,333.46	$3,510.08
Expenses				
Cash expenses, including costs of producing crops, hay, and pasture	$3,874.44	$1,737.98	$1,907.89	$1,580.32
Non-cash expenses, including depreciation, interest, taxes, and insurance	1,443.20	953.55	851.70	851.70
Total expenses	$5,317.64	$2,692.29	$2,759.59	$2,432.02
Return to operator's labor, land, and mgt.	$2,466.62	$2,530.71	$ 573.87	$1,078.06
Per acre return	$ 54.81	$ 56.24	$ 19.13	$ 35.94

[1] Weaning weight adjusted to steer equivalent and for age of dam differences, and then corrected for shrink from farm to sale.

[2] Because of averaging data for calves, average adjusted sale value does not always equal product of weight times price.

Costs and Returns

System A had the highest gross return every year of the test because of sale of crops and heavier weaning weights of calves, tables 12, 13, 14, and 15. Although expenses of this system were almost double those of the other systems, its average net return per acre of $93.02 was the highest of all the systems, Table 16. This net return is the return to operator's labor, management, and land.

TABLE 13. COSTS AND RETURNS OF BEEF AND CROP PRODUCTION, BY TYPE OF SYSTEM, 1971

Item	Data, by system			
	A	B	C	D
Calf performance and sale data				
Number weaned	26	27	28	27
Adjusted sales weight,[1] lb.	600	528	412	393
Average sale price per cwt.	$ 29.44	$ 31.10	$ 34.36	$ 34.75
Average adjusted sale value	$ 176.64	$ 163.90	$ 140.84	$ 135.18
Receipts				
Value of calves	$4,592.62	$4,425.30	$3,943.52	$3,649.86
Value of soybeans	2,248.80	0	0	0
Value of surplus hay	231.00	614.00	0	0
Value of corn grain	1,021.12	0	0	0
Total receipts	$8,093.54	$5,039.30	$3,943.52	$3,649.86
Expenses				
Cash expenses, including costs of producing crops, hay, and pasture	$3,793.32	$1,591.18	$2,419.45	$2,042.97
Non-cash expenses, including depreciation, interest, taxes, and insurance	1,443.20	953.55	851.70	851.70
Total expenses	$5,236.52	$2,544.73	$3,271.15	$2,894.67
Return to operator's labor, land, and mgt.	$2,857.04	$2,494.57	$ 672.37	$ 755.26
Per acre return	$ 63.49	$ 55.43	$ 22.41	$ 25.17

[1] Weaning weight adjusted to steer equivalent and for age of dam differences, and then corrected for shrink from farm to sale.

System B, with an average net return per acre of $89.50, had the highest return by far of any system that did not include crops (corn or soybeans), Table 16. In 2 out of the 4 years, system B had a slightly higher net return per acre than system A. The high net return of system B indicated that winter grazing of fescue and annual clovers overseeded on Coastal was profitable. This practice increased the average value of the calves $37.29 per head above system C (no winter grazing but cows were fed protein

TABLE 14. COSTS AND RETURNS OF BEEF AND CROP PRODUCTION, BY TYPE OF SYSTEM, 1972

Item	Data, by system			
	A	B	C	D
Calf performance and sale data				
Number weaned	30	26	26	29
Adjusted sales weight,[1] lb.	639	544	396	388
Average sale price per cwt.	$ 38.14	$ 39.52	$ 45.86	$ 46.51
Average adjusted sale value	$ 243.71	$ 214.99	$ 181.61	$ 180.46
Receipts				
Value of calves	$7,311.30	$5,589.74	$4,721.86	$5,233.34
Value of soybeans	808.50	0	0	0
Value of surplus hay	396.25	347.50	0	0
Value of corn grain	1,006.25	0	0	0
Total receipts	$9,522.30	$5,937.24	$4,721.86	$5,233.34
Expenses				
Cash expenses, including costs of producing crops, hay, and pasture	$4,285.35	$1,624.69	$2,562.99	$2,076.75
Non-cash expenses, including depreciation, interest, taxes, and insurance	1,443.20	953.45	851.70	851.70
Total expenses	$5,728.55	$2,578.14	$3,414.69	$2,928.45
Return to operator's labor, land, and mgt.	$3,793.75	$3,359.10	$1,307.17	$2,304.89
Per acre return	$ 84.31	$ 74.65	$ 43.57	$ 76.83

[1] Weaning weight adjusted to steer equivalent and for age of dam differences, and then corrected for shrink from farm to sale.

supplement) and $44.74 above system D (neither winter grazing nor protein supplement).

Although system C had higher receipts from sale of heavier calves, system D had higher net returns per acre every year except 1973 when only 24 calves were sold. Also the 4-year average returns favored system D over system C ($52.70 vs. $46.14). The heavier calf weaning weights of system C over system D did not offset the increased cost of protein supplement. Thus, on the average system D had an advantage over system C even though system C had heavier calves and slightly more receipts per acre.

Systems C and D had increasing costs every year, with the amount of purchased hay contributing the largest share of this increase, Appendix tables 5 and 6. Systems A and B costs did not vary much during the 4-year study, Appendix tables 3 and 4.

Using labor requirements based on enterprise budgets developed through research, there were approximately 670 hours of labor required for system A, 540 hours for system B, 475 hours for

TABLE 15. COSTS AND RETURNS OF BEEF AND CROP PRODUCTION, BY TYPE OF SYSTEM, 1973

Item	Data, by system			
	A	B	C	D
Calf performance and sale data				
Number weaned	26	27	27	24
Adjusted sales weight,[1] lb.	623	543	425	388
Average sale price per cwt.	$ 54.21	$ 54.68	$ 55.70	$ 56.16
Average adjusted sale value	$ 337.73	$ 296.91	$ 236.72	$ 217.90
Receipts				
Value of calves	$ 8,780.98	$ 8,105.13	$6,391.44	$5,237.52
Value of soybeans	2,155.60	0	0	0
Value of surplus hay	0	2,379.00	638.10	633.30
Value of corn grain	2,742.02	0	0	0
Total receipts	$13,678.60	$10,484.13	$7,029.54	$5,870.82
Expenses				
Cash expenses, including costs of producing crops, hay, and pasture	$ 4,609.75	$ 1,804.02	$3,235.68	$2,817.80
Non-cash expenses, including depreciation, interest, taxes, and insurance	1,443.20	953.45	851.70	851.70
Total expenses	$ 6,052.95	$ 2,757.47	$4,087.38	$3,669.50
Return to operator's labor, land, and mgt.	$ 7,620.65	$ 7,726.66	$2,942.16	$2,186.32
Per acre return	$ 169.34	$ 171.70	$ 98.07	$ 72.88

[1] Weaning weight adjusted to steer equivalent and for age of dam differences, and then corrected for shrink from farm to sale.

system C, and 450 hours for system D. With land valued at $300 per acre for system A and $200 per acre for systems B, C, and D, additional analyses were made.

Using these estimates of labor and land values and an 8 percent rate for calculating an interest charge for land, system B with $6.12 per hour returns paid the highest returns to operator's labor, Table 16. System A required more labor because of the crops and paid a lower return ($4.65 per hour) than system B. System C had a lower return per hour of labor than system D, $1.90 compared to $2.45 per hour of labor, Table 16.

TABLE 16. COSTS AND RETURNS OF BEEF AND CROP PRODUCTION, BY TYPE OF SYSTEM, 4-YEAR AVERAGE

Item	Data, by system			
	A	B	C	D
Calf performance and sale data				
Number weaned	27.25	27.50	26.75	27.00
Adjusted sales weight,[1] lb.	612.50	529.75	412.50	390.00
Average sale price per cwt.	$ 38.36	$ 39.23	$ 41.76	$ 42.42
Average adjusted sale value	$ 235.89	$ 209.55	$ 172.26	$ 164.81
Receipts				
Value of calves	$6,427.00	$5,723.29	$4,607.96	$4,407.70
Value of soybeans	1,824.18	0	0	0
Value of surplus hay	242.44	947.62	159.53	154.58
Value of corn grain	1,276.07	0	0	0
Total receipts	$9,769.69	$6,670.91	$4,767.49	$4,562.28
Expenses				
Cash expenses, including costs of producing crops, hay, and pasture	$4,140.74	$1,689.65	$2,531.50	$2,129.46
Non-cash expenses, including depreciation, interest, taxes, and insurance	1,443.20	953.55	851.70	851.70
Total expenses	$5,583.94	$2,643.20	$3,383.20	$2,981.16
Return to operator's labor, land, and mgt.	$4,185.75	$4,027.71	$1,384.29	$1,581.70
Per acre return	$ 93.02	$ 89.50	$ 46.14	$ 52.70
Return per hour of operator labor	$ 4.65	$ 6.12	$ 1.90	$ 2.45

[1] Weaning weight adjusted to steer equivalent and for age of dam differences, and then corrected for shrink from farm to sale.

DISCUSSION

Corn yields during this study were consistently about 70 to 80 bushels of grain and about 15 tons of silage per acre. In contrast, soybean yields were erratic and directly related to rainfall during the critical period.

Cows grazing Coastal bermudagrass with sod-seeded clover or a tall fescue-clover combination (system B) were fed only about 60 percent as much hay during the wintering period (October-November) as those grazing Coastal alone (systems C and D). Furthermore, the surplus Coastal in the combination system produced 2.3 tons of hay per acre annually, as compared with 0.9 ton per acre for the single forage system. Stocking rates were one cow-calf unit per acre for the Coastal alone and one cow-calf unit per 1.5 acres for the Coastal-fescue combination. During the 4 years of this study, the fescue-Coastal combination (system B) produced more hay each year than was required to winter the

cows, whereas the Coastal only system (C and D) produced about half enough to feed its cows during the winter period. However, differences in intensity of stocking rate should be emphasized.

The station-raised females in this study raised heavier calves than those purchased from out of state. The locally-produced cows were more adaptable to stress conditions as evidenced by the fact that their calves were considerably heavier, and this difference became greater as degree of stress increased.

Age of dam affected calf weaning weight, but the difference due to cow age became progressively smaller as cows approached maturity (7 years of age). Sex of calf had an effect on weaning weight in that heifer calves averaged 24 pounds less than steers treated similarly. The greatest effect on calf weaning weight was shown by treatment (systems), which is probably a reflection of available feed. Adjusted weaning weights averaged 643, 556, 430, and 402 pounds, respectively, for systems A, B, C, and D, with an LSD $_{.01}$ of 24 pounds.

Steer calves had a higher market price than heifers ($0.43 vs. $0.38 per pound). Also, in this study calves with average weights above 550 pounds brought 3 cents less per pound than calves with average weights between 400 and 450 pounds ($0.39 vs. $0.42).

The stocker grades of calves at weaning time were comparable (low Choice) for all systems, but slaughter grades were different. These differences were expected since slaughter grade is an indication of fatness, which reflects availability of feed for the different systems.

Calves within a system gained at approximately the same rate from birth to 205 days of age and from 205 days to actual weaning age (260-270 days of age). The largest differences in post-205-day rate of gain were related to sex and treatment (system). The differences due to sex were small and of little practical significance. Post-205-day average daily gains were 2.15, 1.79, 1.42, and 1.15 pounds, respectively, for systems A, B, C, and D. Again, these gains probably reflect availability of feed for the calves.

Cows assigned to this experiment averaged about 90 percent calf crop weaned, and there were no differences among systems. Cows between the ages of 3 and 7 years that were nursing calves averaged losing about 10 percent of their fall weight during the

winter period. From spring until fall they gained more than enough to offset the winter weight loss, therefore there was a net gain annually. This net annual change in body weight became progressively less with maturity so that at 6 and 7 years of age cows had a net change of about 10 pounds annually.

Neither calving rate nor season (date) of calving was affected by treatments imposed in this experiment. Apparently all nutritional regimes were adequate to support normal reproduction.

The monetary returns to operator's labor, management, and land averaged $93, $90, $46, and $53 per acre, respectively, for systems A, B, C, and D. These returns are reasonably competitive with alternative land use and indicate that the beef cow-calf enterprise can be justified on highly productive land provided intensive management is used.

SUMMARY

Four combination beef cattle-crop production systems requiring widely different inputs and degrees of management were compared during a 4-year study. The most practical all-beef cattle system combined 1 acre per cow of clover seeded in Coastal bermudagrass sod and an additional 0.5 acre of tall fescue-clover. This system emphasized legume-grass grazing, but it also produced enough surplus forage, harvested as hay, to winter the lactating cow.

Another system optimally adapted to highly productive land involved coordinate production of corn for silage or grain, soybeans for grain, and rye-ryegrass-clover grazing. Even though the expenses in this system were almost double those of any other, net returns per acre were the highest of the four systems studied. These results indicate that the beef cattle enterprise is competitive for use of highly productive land if intensive management is included.

The other two systems in this experiment emphasized Coastal bermudagrass grazing. When stocked at the rate of one cow-calf unit per acre, Coastal swards did not produce enough surplus forage (harvested as hay) to feed the cow during the winter period. These latter two systems were low input systems and easy to operate, but returns to operator's labor, management, and land were only about 60 percent as much as for the first two systems described above.

ACKNOWLEDGMENT

Contributions of J. A. McGuire, Department of Research Data Analysis, in analyzing the data from this project are acknowledged by the authors.

APPENDIX TABLE 1. RECORD OF SOIL TEST RESULTS AND FERTILIZER AND LIME APPLIED FOR CROP AND BEEF CATTLE PRODUCTION SYSTEMS, LOWER COASTAL PLAIN SUBSTATION

Season and crop	Soil test results/acre				Fertilizer and lime applied/acre			
	pH	P	K	Mg	N	P_2O_5	K_2O	Lime
		Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Tons*
GROUP A								
A1								
1969 summer, corn	5.7	45(M)	136(H)	60(H)	100	70	70	
1969-70 winter, SG, RG, & C[1]					115	---	---	1
1970 summer, soybeans					0	48	24	
1970-71 winter, rye					75	---	---	
1971 summer, corn					110	60	40	
1971-72 winter, SG, RG, & C[1]					100	---	---	
1972 summer, soybeans	5.5	39(M)	70(M)	(H)	0	48	48	¾
1972-73 winter, rye					68	---	---	
1973 summer, corn					150	48	48	
A2								
1969 summer, soybeans	5.7	36(M)	152(H)	66(H)	0	70	70	
1969-70 winter, rye					60	---	---	1
1970 summer, corn					100	60	40	
1970-71 winter, SG, RG, & C[1]					100	---	---	
1971 summer, soybeans					0	48	24	
1971-72 winter, rye					50	---	---	
1972 summer, corn	5.6	30(M)	110(H)	(H)	116	48	48	1
1972-73 winter, SG, RG, & C[1]					168	---	---	
1973 summer, soybeans					0	40	0	
A4 (creep area)								
1969-70 winter, oats	6.2	39(M)	116(M)	48(H)	115	42	42	
1970 summer, millet					50	---	---	
1970-71 winter, oats					75	42	42	
1971 summer, millet					50	---	---	
1971-72 winter, oats					100	42	42	
1972 summer, millet	5.4	65(H)	144(H)	(H)	114	32	32	1
1972-73 winter, oats					168	---	---	
1973 summer, millet					50	35	35	

Continued

APPENDIX TABLE 1 *(Cont.)*. RECORD OF SOIL TEST RESULTS AND FERTILIZER AND LIME APPLIED FOR CROP AND BEEF CATTLE PRODUCTION SYSTEMS, LOWER COASTAL PLAIN SUBSTATION

Season and crop	Soil test results/acre				Fertilizer and lime applied/acre			
	pH	P	K	Mg	N	P_2O_5	K_2O	Lime
		Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Tons*
GROUP B								
B1 (Coastal)								
1969 summer	5.5	73(H)	172(H)	60(H)	100	70	70	
1970 E; 15A with clover					150	42	42	1
1970 W; 15A w/o clover					200	42	42	1
1971 E; 15A with clover					100	42	42	
1971 W; 15A w/o clover					150	42	42	
1972 E; 15A w/o clover	6.0	72(H)	161(H)	(H)	150	42	42	
1972 W; 15A with clover					100	42	42	
1973 E; 15A with clover					100	42	42	
1973 W; 15A w/o clover					150	42	42	
B2 (fescue-white clover)								
1969	6.0	42(M)	136(H)	102(H)	120	64	32	
1970					60	80	40	
1971					100	80	40	
1972	5.9	80(H)	144(H)	(H)	100	31	31	
1973					130	35	35	
GROUP C								
1969, Coastal bermuda	6.0	75(H)	250(H)	78(H)	100	70	70	
1970, Coastal bermuda					200	42	42	
1971, Coastal bermuda					150	42	42	
1972, Coastal bermuda	5.5	65(H)	160(H)	(H)	150	25	50	
1973, Coastal bermuda					200	25	50	
GROUP D								
1969, Coastal bermuda	5.9	31(M)	156(H)	54(H)	100	70	70	
1970, Coastal bermuda					200	42	42	
1971, Coastal bermuda					150	49	49	
1972, Coastal bermuda	5.7	65(H)	165(VH)	(H)	150	---	---	
1973, Coastal bermuda					200	80	40	

[1] Small grain, ryegrass, and clover.

APPENDIX TABLE 2. CROP PERFORMANCE AND HARVEST RECORDS[1]

Field and acreage	Season	Crop	Days grazed	Feed harvested, annual av.
SYSTEM A				
Field 1, 20 acres	winter, spring	oats-RG-clover	89	6.2 tons oat hay[2]
	summer	soybeans	----	25.8 bu./acre
Field 2, 20 acres	winter, spring	rye	55	
	summer	corn	----	14.8 tons/acre silage,[3] 63.7 bu. grain
Field 4, 5 acres	winter, spring	oats-RG-clover	30	
	summer	millet	37	
SYSTEM B				
Field 1, 15 acres	winter, spring	fescue-Regal	70	
	summer	fescue-Regal	98	
Field 2, 15 acres	winter, spring	Coastal-clover	45	
Field 2 & 3, 30 acres	summer	Coastal	139	68.35 tons
SYSTEMS C & D				
60 acres	spring, summer	Coastal	181 (5/2-10/31)	0.9 ton/acre

[1] Values reported are 4-year means unless otherwise indicated.
[2] Oat hay was harvested only during 2 of the 4 years.
[3] Silage yield was 14.83 tons per acre of 33.58 percent DM material that contained 39.27 percent grain on dry basis.

APPENDIX TABLE 3. COSTS AND RETURNS OF SYSTEM A, 1970-73

Item	Amount, by year			
	1970	1971	1972	1973
Receipts				
Calves	$5,023.08	$4,592.64	$7,311.30	$ 8,780.98
Soybeans	2,083.80	2,246.80	808.50	2,155.60
Corn	334.88	1,021.12	1,006.25	2,742.02
Hay	342.50	231.00	0	0
Straw	0	0	396.25	0
Total receipts	$7,784.26	$8,093.56	$9,522.30	$13,678.60
Cash expenses				
Cottonseed meal	$ 185.40	$ 189.36	$ 223.25	$ 380.85
Calf creep	572.50	481.42	823.05	830.81
Soybeans	615.20	615.20	640.22	578.66
Oats, ryegrass, and clover	644.17	616.00	616.00	743.39
Rye	396.66	424.80	377.94	411.40
Corn silage	791.32	810.80	808.08	875.89
Millet	119.42	148.50	145.13	107.38
Oats	180.75	157.60	173.73	174.46
Mineral mix (Hi Mg)	0	0	23.62	17.50
Interest, 8% for 6 months	30.42	26.83	41.85	48.47
Common expense items[1]	140.40	140.40	140.40	140.40
Transportation	47.25	45.50	52.50	45.50
Marketing commission, 3% of calf sales	150.95	137.55	219.58	260.04
Total cash expenses	$3,874.44	$3,793.32	$4,285.35	$ 4,614.75
Non-cash expenses				
Silo and feeding facilities	$ 198.00	$ 198.00	$ 198.00	$ 198.00
Machinery depreciation	443.80	443.80	443.80	443.80
Interest, insurance, housing, and taxes	205.40	205.40	205.40	205.40
Bull ($700 @ 8% for 1 year)	56.00	56.00	56.00	56.00
Cows ($225 @ 8% for 1 year × 30 cows)	540.00	540.00	540.00	540.00
Total non-cash expenses	$1,443.20	$1,443.20	$1,443.20	$ 1,443.20
Total expenses	$5,317.64	$5,236.52	$5,728.55	$ 6,057.95
Returns to operator's land, labor, and management	$2,466.62	$2,857.04	$3,793.75	$ 7,620.65
Per acre return	$ 54.81	$ 63.49	$ 84.30	$ 169.34

[1] Common expense items for all systems:

Veterinary and medicine	30 head	@	$2.00	= $ 60.00
Spray materials	30 head	@	.50	= 15.00
Salt and minerals	30 head	@	1.00	= 30.00
Tractor and equipment use other than pasture and hay	30 head	@	1.00	= 30.00
Interest 8% 6 months				= 5.40
TOTAL				$140.40

APPENDIX TABLE 4. COSTS AND RETURNS OF SYSTEM B, 1970-73

Item	Amount, by year			
	1970	1971	1972	1973
Receipts				
Calves	$4,773.00	$4,425.30	$5,589.74	$ 8,105.13
Surplus hay	450.00	614.00	347.50	2,379.00
Total receipts	$5,223.00	$5,039.30	$5,937.24	$10,484.13
Cash expenses				
Cottonseed meal	$ 195.30	$ 202.82	$ 192.60	$ 311.19
Fescue	336.00	336.00	336.00	325.10
Coastal and clover	396.86	326.70	326.70	326.70
Coastal	467.07	396.90	396.90	396.90
Mineral mix (Hi Mg)	0	0	3.50	3.50
Interest, 8% for 6 months	7.81	8.11	15.40	12.48
Common expense items[1]	140.40	140.40	140.40	140.40
Transportation	52.50	47.25	45.50	47.25
Marketing commission, 3% of calf sales	142.90	133.00	167.69	240.50
Total cash expenses	$1,738.84	$1,591.18	$1,624.69	$ 1,804.02
Non-cash expenses				
Machinery Depreciation	$ 70.95	$ 70.95	$ 70.95	$ 70.95
Interest, insurance, housing, and taxes	34.05	34.05	34.05	34.05
Depreciation-Coastal (30 acres, 1/15 of establishment cost)	112.50	112.50	112.50	112.50
Depreciation-fescue (15 acres, 1/15 of establishment cost)	45.35	45.35	45.35	45.35
Interest (½ establishment cost @ 8%)	94.60	94.60	94.60	94.60
Bull ($700 @ 8% interest for 1 year)	56.00	56.00	56.00	56.00
Cows ($225 @ 8% interest for 1 year × 30 cows)	540.00	540.00	540.00	540.00
Total non-cash expenses	$ 953.45	$ 953.45	$ 953.45	$ 953.45
Total expenses	$2,692.29	$2,544.73	$2,578.14	$ 2,757.47
Return to operator's land, labor, and management	$2,530.71	$2,494.57	$3,359.10	$ 7,726.66
Per acre return	$ 56.24	$ 55.43	$ 74.64	$ 171.70

[1] Common expense items for all systems:

Veterinary and medicine	30 head	@ $2.00	=	$ 60.00
Spray materials	30 head	@ .50	=	15.00
Salt and minerals	30 head	@ 1.00	=	30.00
Tractor and equipment use other than pasture and hay	30 head	@ 1.00	=	30.00
Interest 8% 6 months			=	5.40
TOTAL				$140.40

APPENDIX TABLE 5. COSTS AND RETURNS OF SYSTEM C, 1970-73

Item	Amount, by year			
	1970	1971	1972	1973
Receipts				
Calves	$3,333.46	$3,943.52	$4,721.86	$6,391.44
Excess hay	0	0	0	638.10
Total receipts	$3,333.46	$3,943.52	$4,721.86	$7,029.54
Cash expenses				
Coastal pasture	$ 913.30	$ 793.80	$ 793.80	$ 909.69
Prolix	322.80	377.40	291.10	451.17
Hay	357.50	887.25	1,043.75	1,398.00
Interest, 8% for 6 months	27.22	52.65	106.80	73.97
Common expense items[1]	140.40	140.40	140.40	140.40
Transportation	45.50	49.00	45.50	47.25
Marketing commission, 3% of calf sales	101.17	118.95	141.64	215.20
Total cash expenses	$1,907.89	$2,419.45	$2,562.99	$3,235.68
Non-cash expenses				
Machinery Depreciation	$ 51.00	$ 51.00	$ 51.00	$ 51.00
Interest, insurance, housing, and taxes	24.60	24.60	24.60	24.60
Depreciation-pasture (1/15 of establishment cost)	112.60	112.60	112.60	112.60
Interest (½ of establishment cost @ 8%)	67.50	67.50	67.50	67.50
Bull ($700 @ 8% interest for 1 year)	56.00	56.00	56.00	56.00
Cows ($225 @ 8% interest for 1 year × 30 cows)	540.00	540.00	540.00	540.00
Total non-cash expenses	$ 851.70	$ 851.70	$ 851.70	$ 851.70
Total expenses	$2,759.59	$3,271.15	$3,414.69	$4,087.38
Return to operator's land, labor, and management	$ 573.87	$ 672.37	$1,307.17	$2,942.16
Per acre return	$ 19.13	$ 22.41	$ 43.57	$ 98.07

[1] Common expense items for all systems:

Veterinary and medicine	30 head	@ $2.00	=	$ 60.00
Spray materials	30 head	@ .50	=	15.00
Salt and minerals	30 head	@ 1.00	=	30.00
Tractor and equipment use other than pasture and hay	30 head	@ 1.00	=	30.00
Interest 8% 6 months			=	5.40
TOTAL				$140.40

APPENDIX TABLE 6. COSTS AND RETURNS OF SYSTEM D, 1970-73

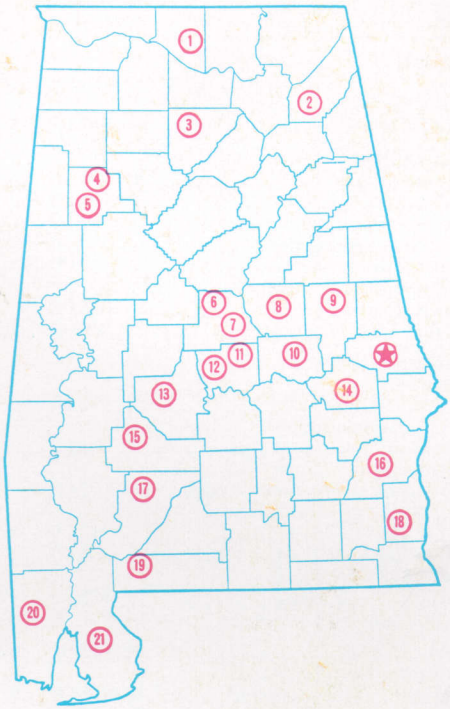
Item	Amount, by year			
	1970	1971	1972	1973
Receipts				
Calves	$3,510.08	$3,649.89	$5,233.32	$5,237.52
Excess hay	0	0	0	618.30
Total receipts	$3,510.08	$3,649.89	$5,233.32	$5,855.82
Cash expenses				
Coastal pasture	$ 913.30	$ 819.90	$ 643.50	$ 995.28
Hay	357.50	887.25	1,043.75	1,417.80
Interest, 8% for 6 months	14.30	37.55	41.75	56.71
Common expense items[1]	140.40	140.40	140.40	140.40
Transportation	49.00	47.25	50.75	42.00
Marketing commission, 3% of calf sales	105.82	110.62	150.60	165.61
Total cash expenses	$1,580.32	$2,042.97	$2,076.75	$2,817.80
Non-cash expenses				
Machinery Depreciation	$ 51.00	$ 51.00	$ 51.00	$ 51.00
Interest, insurance, housing, and taxes	24.60	24.60	24.60	24.60
Depreciation-pasture (1/15 of establishment cost)	112.60	112.60	112.60	112.60
Interest (½ of establishment cost @ 8%)	67.50	67.50	67.50	67.50
Bull ($700 @ 8% for 1 year)	56.00	56.00	56.00	56.00
Cows ($225 @ 8% for 1 year × 30 cows)	540.00	540.00	540.00	540.00
Total non-cash expenses	$ 851.70	$ 851.70	$ 851.70	$ 851.70
Total expenses	$2,432.02	$2,894.67	$2,928.45	$3,669.50
Return to operator's land, labor, and management	$1,078.06	$ 755.22	$2,304.87	$2,186.32
Per acre return	$ 35.94	$ 25.17	$ 76.83	$ 72.88

[1] Common expense items for all systems:

Veterinary and medicine	30 head	@ $2.00	=	$ 60.00
Spray materials	30 head	@ .50	=	15.00
Salt and minerals	30 head	@ 1.00	=	30.00
Tractor and equipment use other than pasture and hay	30 head	@ 1.00	=	30.00
Interest 8% 6 months			=	5.40
TOTAL				$140.40

Alabama's Agricultural Experiment Station System
AUBURN UNIVERSITY

With an agricultural research unit in every major soil area, Auburn University serves the needs of field crop, livestock, forestry, and horticultural producers in each region in Alabama. Every citizen of the State has a stake in this research program, since any advantage from new and more economical ways of producing and handling farm products directly benefits the consuming public.



Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Thorsby Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
8. Forestry Unit, Coosa County.
9. Piedmont Substation, Camp Hill.
10. Plant Breeding Unit, Tallassee.
11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. Tuskegee Experiment Field, Tuskegee.
15. Lower Coastal Plain Substation, Camden.
16. Forestry Unit, Barbour County.
17. Monroeville Experiment Field, Monroeville.
18. Wiregrass Substation, Headland.
19. Brewton Experiment Field, Brewton.
20. Ornamental Horticulture Field Station, Spring Hill.
21. Gulf Coast Substation, Fairhope.