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Beef Cow Grazing Systems Compared on Eutaw Clay

forages evaluated include

FESCUE
DALLISGRASS
CALEY PEAS
WHITE CLOVER
COASTAL BERMUDAGRASS

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BEEF COW GRAZING SYSTEMS COMPARED ON EUTAW CLAY

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DALLISGRASS-WHITE CLOVER pasture is the common forage system used for beef cattle in the Black Belt of Alabama. However, its relatively low carrying capacity and long unproductive period during the winter are major weaknesses. Although dallisgrass-white clover pastures generally provide forage in late winter, spring, summer, and early fall, feed is required from another source (usually hay) during November, December, January, and February.

One possible method of reducing winter hay feeding (both amount and days of feeding) is to use accumulated growth of tall fescue for winter grazing. The extent that use of fescue would reduce the hay requirement of a dallisgrass-white clover pasture was investigated in Auburn University Agricultural Experiment Station research. Two systems replacing one-fourth and one-half of the dallisgrass-white clover allocation per cow and calf with fescue were compared with a dallisgrass-legume system. In addition, a system utilizing the greater productivity of Coastal bermudagrass was tried as a way to overcome the lack of carrying capacity of dallisgrass-white clover.

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DESCRIPTION OF EXPERIMENT

Performance of beef cows and their calves was compared under four grazing systems at the Black Belt Substation, Marion Junction, Alabama, over the 4-year period 1965-68. The experimental site was on Eutaw clay, a poorly-drained, acid soil. Of the forages tested, dallisgrass is best adapted to this soil, followed in order by white clover, caley peas, fescue, and Coastal bermudagrass. The four systems compared and their stocking rates are given below:

System number	*Pasture species*	*Stocking rate per paddock*
1	2 acres dallisgrass, white clover, and caley peas	1 cow and calf
2	2 acres Coastal bermudagrass and caley peas	2 cows and calves
3	1½ acres dallisgrass, white clover, and caley peas plus ½ acre tall fescue	1 cow and calf
4	1 acre dallisgrass, white clover, and caley peas plus 1 acre tall fescue	1 cow and calf

Systems 1, 3, and 4 were replicated four times and System 2 three times. The experimental design was a randomized complete block with one unit missing from the Coastal bermudagrass system (System 2).

Pasture Establishment

Twelve of the 15 paddocks had been used in previous experiments. Three of these that had been established to Coastal bermudagrass in 1956 were used for the current study. Three paddocks were developed in 1963 on new ground adjacent to the older paddocks. The dallisgrass-white clover-caley pea areas and fescue areas were established in 1963. Commercial dallisgrass was seeded in late June 1963 and Kentucky 31 tall fescue, Louisiana S-1 white clover, and caley peas were seeded in the fall of 1963.

Fertilizer Treatments

Soil test results and recommendations to compensate for previous lime and fertilizer treatments were followed initially as outlined in Appendix Table 1. Based on soil test recommendations, average amounts applied yearly to dallisgrass-white clover-caley pea areas were 0-30-40 (N-P-K); to Coastal bermudagrass-caley peas, 140-20-50; and to fescue, 100-20-30.

The experimental plan called for fertilizing the dallisgrass-white clover-caley pea pastures with nitrogen if growth of legumes was

not good the previous season. Legume growth was good each year, however, so no nitrogen was added to the dallisgrass-white clover-caley pea areas.

The fescue pastures were fertilized annually with 50 pounds of N per acre from ammonium nitrate in late summer and again in late winter.

The Coastal bermudagrass-caley pea sward was fertilized annually with three applications of 40 to 50 pounds of N per acre. The higher rate was used when caley pea growth during the previous spring was less than desired.

Pasture Management

Stocking rate was one cow and her calf (in season) per 2-acre paddock, except Coastal bermudagrass was stocked with two cows and calves per 2-acre paddock. Management of each system is outlined below:

System 1. Dallisgrass-white clover-caley peas. Surplus forage was harvested for hay. Caley peas were not managed for seed production but were seeded annually. Cows and their calves remained on the pastures during spring, summer, and fall. When forage was inadequate during the grazing season, cows and calves were fed hay while on pasture. During the winter, cows and calves were fed hay and supplement in a holding area.

System 2. Coastal bermudagrass and caley peas. Cows and calves remained on the paddocks from the beginning of the caley pea grazing season until the following fall when they were removed to allow planting of caley peas. Peas were not managed for seed production but were seeded annually. Any excess forage was harvested for hay. Hay and supplement were fed in a holding area when forage was inadequate during winter. In some years there were short periods of inadequate grazing in spring and summer, and cattle were fed hay on pasture.

Systems 3 and 4. Dallisgrass-white clover-caley peas and fescue. The fescue area was separated from the remainder of the paddock by a cross fence so it could be managed for accumulation of growth. Animals did not graze the fescue from about July 1 to December 1. The accumulated forage was grazed beginning December 1 until forage became inadequate. Animals were then moved to a holding area and fed hay and supplement until spring

growth became adequate to carry them. Cows and calves remained on the pastures during spring, summer, and fall. When forage was inadequate during the grazing season, animals were fed hay while on pasture. Surplus forage—dallisgrass-white clover or fescue—was harvested for hay, but fescue was allowed to mature in spring before cutting for hay.

Animal Management

Cows of English beef-type breeding, bred to calve in late fall, were used in the study. The original group of 30 cows with calves at side was purchased January 30, 1964. Calves on these cows were grown to weaning in 1964. In the fall of 1964, 18 cows were selected from the original 30. About half of these calves were sired prior to buying cows and the other half sired by a Station Hereford bull. Insofar as possible, each crop of calves was from cows calving between October 1 and December 1. Calves were weaned and sold in July and August and weight adjusted to 255 days of age. In addition, an adjustment was made for sex of calf and age of dam.

Cows were milked prior to assignment and the milk production data, sire of calf, age of calf, sex of calf, and age and weight of dam were used in allotting cows to a grazing system.

Insofar as possible, cows were bred on test (while in the holding area). Cows that bred were retained for use the next season. Since only one bull was placed in the holding area per season, after the first year calves for any one year were by the same sire. Replacement cows were added as required to maintain sufficient experimental units. A total of 37 cows was used 1 or more years during the 4-year experiment. Purchased cows were used to initiate the experiment, but replacements came from a pool of cows maintained for research use.

Each year the cows were re-allotted around November 15 to paddocks on the basis of previously mentioned criteria. Cows were rotated among systems from year to year to minimize cow variation. At this time all cows without calves were replaced.

Milk production data on the cows were obtained by the oxytocin procedure. In addition to the pre-allotment milking, cows were milked near the end of the first 28-day fescue grazing period and again after all cows were on spring grazing. For the weaning milk-out, the cows were divided into two or three groups depending on weaning dates.

Data Collected

To characterize the pastures and to measure and explain animal performance on the pastures, the following data were collected:

1. Forage notes each 28 days:
   (a) botanical estimates
   (b) per cent ground cover
   (c) height of forage
   (d) quality estimate
2. Hay harvested from paddocks
3. Amount of hay and supplement fed per system
4. Grazing days, chronologically
5. 28-day calf weight (weighed when dams were weighed)
6. Calf weaning data:
   (a) live weight
   (b) slaughter grade
   (c) market weight
   (d) market value
7. 28-day cow weights (throughout test period)
8. Cow milk production
9. Sward dry matter digestibility (by the plant chromogens technique) to provide two measures each of fescue, dallisgrass, white clover, caley peas, and Coastal bermudagrass
10. Fiscal records: cost of establishment, fertilizer and seed inputs, machinery and labor for pasture establishment and maintenance, veterinary fees and drugs for cattle, and purchase and sale records.

RESULTS AND DISCUSSION

Forages

Botanical composition. The botanical composition of System 1 pasture and the dallisgrass-white clover-caley pea portion of systems 3 and 4 were almost identical, Figure 1. In March white clover and caley peas predominated. By April caley peas had begun to decline and dallisgrass had begun to grow. In May white clover still made up half of the forage, with dallisgrass accounting for about one-third and small amounts of caley peas and weeds the remainder. White clover declined to 15 to 20 per cent of the

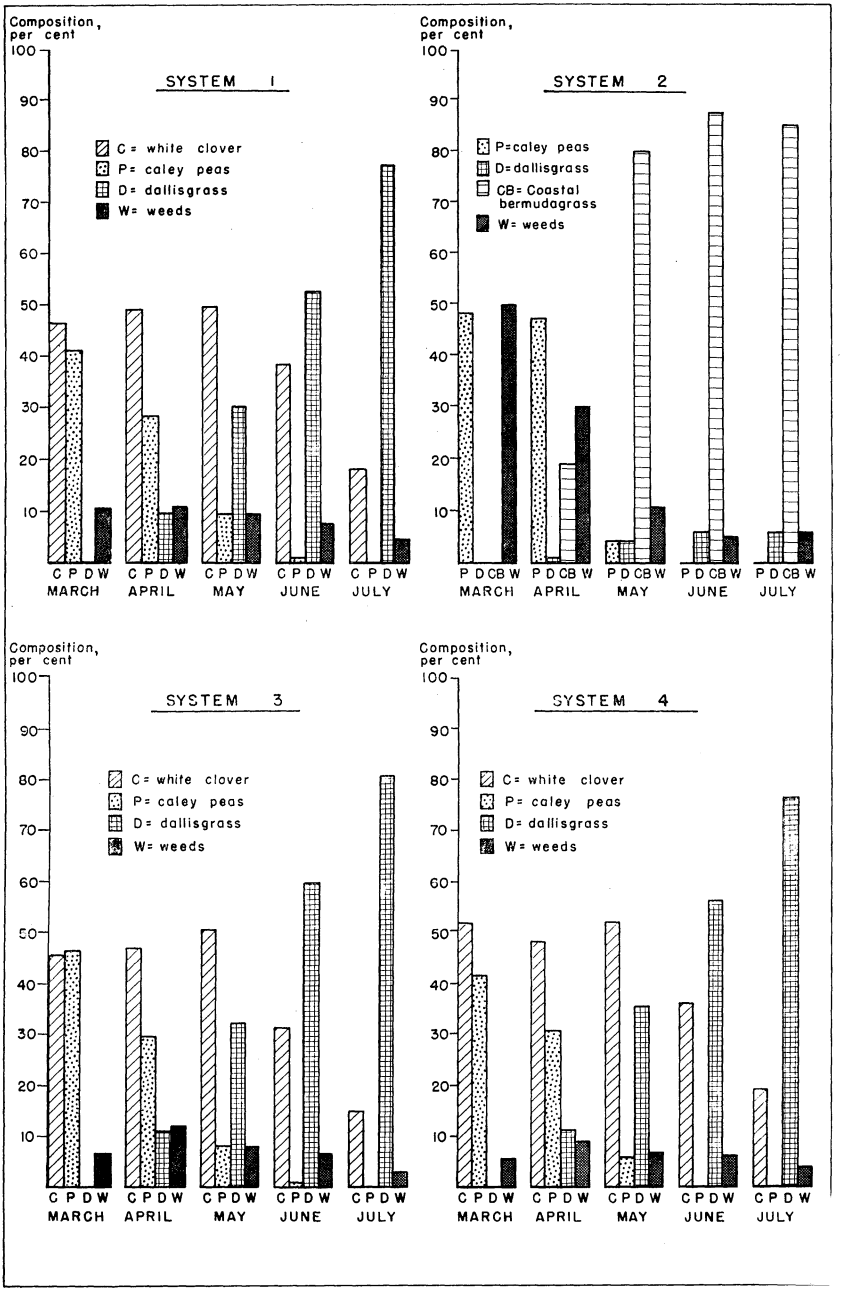


FIG. 1. Botanical composition of sward compared among the four systems.

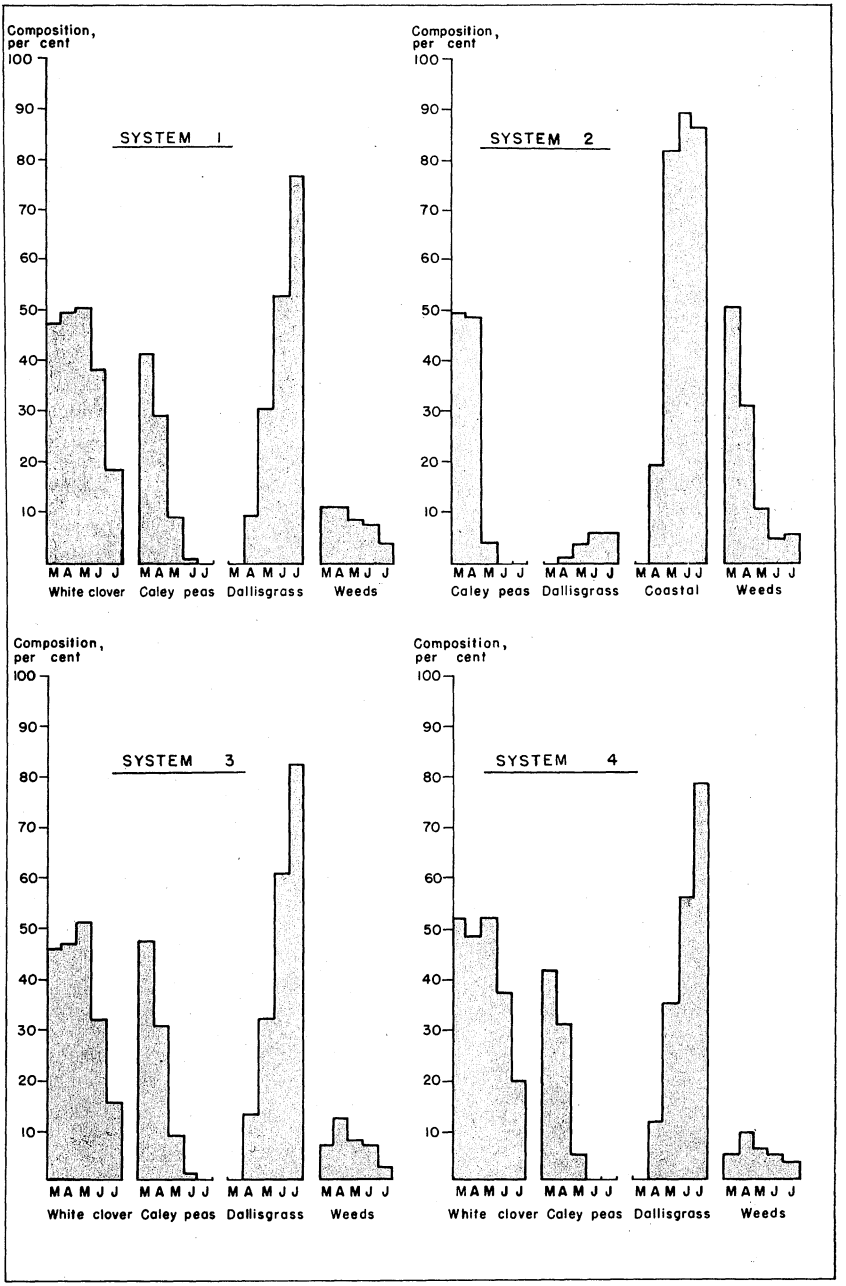


FIG. 2. Monthly trends in botanical composition of species among systems.

sward in July and dallisgrass accounted for most of the remainder.

The accumulated fescue growth on systems 3 and 4 averaged 95 per cent fescue and 5 per cent weeds. It was grazed off during December and January and regrowth was 98 per cent fescue and 2 per cent weeds. Fescue was not grazed from July 1 to December 1 since summer rest increases fall growth.

In March the sward of System 2 was equally divided between caley peas and weeds (primarily wild barley), Figure 1. Although weeds are usually objectionable, the wild barley made possible earlier stocking of Coastal bermudagrass-caley peas pasture. In April caley peas remained at about 50 per cent, but wild barley had decreased to 30 per cent and Coastal bermudagrass was up to 20 per cent of the sward. Then in May, June, and July, Coastal was by far the dominating species, making up 80 to 90 per cent of the sward.

Weeds made up a small percentage of any of the swards, except for March and April in System 2, Figure 2. As in all other cases, wild barley was the primary weed in this sward. Management to obtain and maintain stands of the scheduled species was gen-

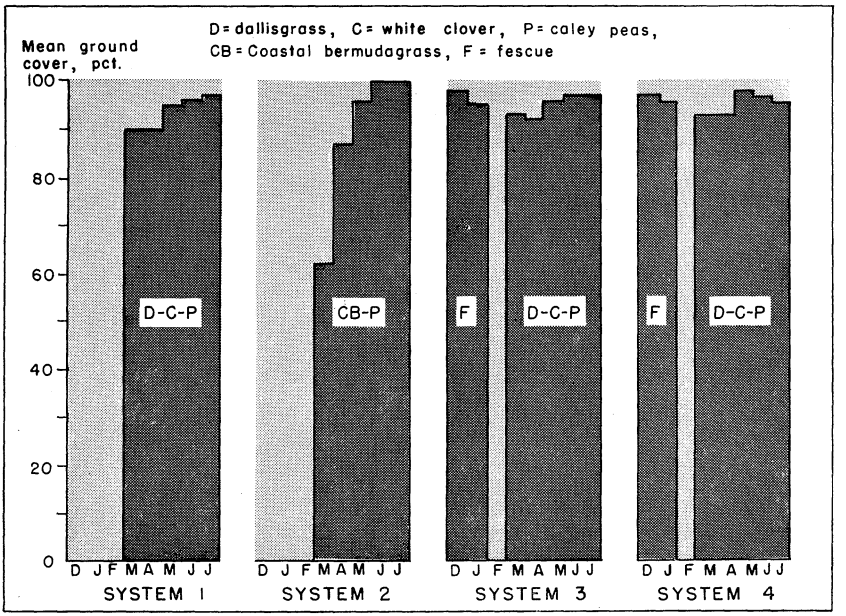


FIG. 3. Per cent ground cover of the systems during winter, spring, summer.

erally successful, as illustrated by results with System 1. In this system, percentage white clover for the fourth year (1968) during March, April, May, June, and July, respectively, was 55, 60, 56, 38, and 8, as compared with 47, 50, 51, 38, and 18 per cent for the 4-year average.

Agronomic traits. Ground cover by the forages was excellent during the grazing season, falling below 90 per cent only during March and April for System 2, Figure 3. Estimated quality rating of the forages showed a general decrease in quality as the season progressed, Figure 4. The dallisgrass-white clover-caley peas in systems 1, 3, and 4 generally rated very good or excellent. Fescue portions of systems 3 and 4 were rated good. As the caley peas and wild barley matured, quality rating of System 2 declined from very good to fair. However, the rating increased to good as Coastal bermudagrass production increased.

Forage height varied greatly depending on the predominating species, weather, and grazing pressure, Figure 5. For System 1, height increased from about 3 inches in February to 7 inches in July. The dallisgrass-white clover portion of System 3 generally

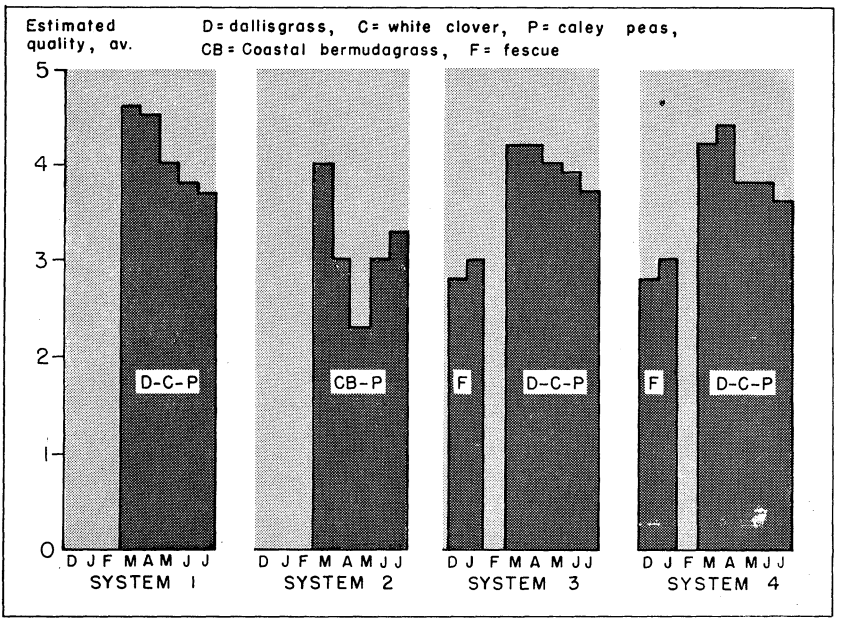


FIG. 4. Sward quality rating of the four systems in winter, spring, summer. Quality scale: 1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent.

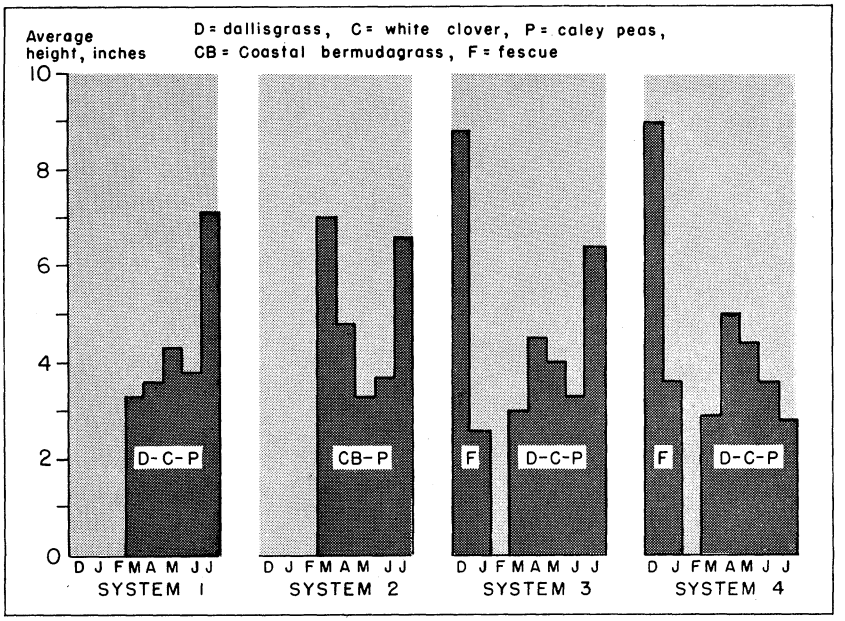


FIG. 5. Forage height of the four systems during winter, spring, summer.

followed the same trend; in System 4, however, the extra grazing pressure on the acre of dallisgrass-white clover caused height to peak at 5 inches in April and then decline. The fescue in systems 3 and 4 was 9 inches tall when grazing began in December but rapidly decreased to about 3 inches in January. System 2 showed

TABLE 1. FORAGE DIGESTIBILITY AS DETERMINED BY THE CHROMOGENS TECHNIQUE

Forage or feed	Digestibility[1], by forage systems[2]			
	System 1, D-C-P	System 2, CB-P	System 3, D-C-P + ½ acre fescue	System 4, D-C-P + 1 acre fescue
	Per cent	*Per cent*	*Per cent*	*Per cent*
Hay-cottonseed meal	57.5 (1)	56.7 (1)		
Caley peas-white clover	65.1 (4)		68.0 (2)	72.1 (2)
Dallisgrass-white clover	67.3 (3)		68.4 (1)	62.5 (1)
Dallisgrass	63.4 (3)		62.9 (3)	65.0 (3)
Wild barley-caley peas		64.0 (4)		
Coastal bermudagrass		64.9 (3)		
Tall fescue			65.1 (4)	65.4 (4)

[1] Number in parenthesis to right of each digestibility indicates number of years averaged to get per cent digestibility.

[2] Abbreviations: D = dallisgrass, C = white clover, P = caley peas, and CB = Coastal bermudagrass.

an early season decline in height of forage, but it increased in June and July as Coastal bermudagrass became dominant.

Digestibility of forages. An attempt was made to measure dry matter digestibility at intervals of the year to represent the major species in the sward. These determinations were made by the plant chromogens technique. The data collected over the 4 years of the experiment, Table 1, reveal no important digestibility differences among the swards and support the conclusions stated later for animal performance.

Grazing Season

Weather. The grazing season was influenced by prevailing rainfall and temperature. A description of weather conditions during the study period aids in interpretation of the results. The average yearly rainfall of 50.40 inches during 1965-68 is equal to the long time average of 50.17 inches, Table 2. Wide fluctuations occurred between and within years, however, with 1965 and 1968 being drier than normal and 1966 and 1967 wetter than normal. Each of the 4 years had periods of inadequate rainfall for good forage production during the growing season. Notable dry periods were April and May in 1965; May, June, and July in 1966; March and April in 1967; and March, May, June, August, and September in 1968.

Average maximum and minimum monthly temperatures devi-

TABLE 2. MONTHLY RAINFALL AT THE BLACK BELT SUBSTATION, 1965-68

Month	Rainfall by months										Normal, in.
	1965		1966		1967		1968		Mean		
	In.	Pct. of normal	In.	Pct. of normal	In.	Pct. of normal	In.	Pct. of normal	In.	Pct. of normal	
Jan.	5.36	135	6.46	163	3.59	90	4.07	103	4.87	123	3.97
Feb.	4.21	85	9.72	196	4.61	93	1.55	31	5.02	101	4.97
Mar.	5.82	87	4.20	63	2.34	35	2.65	40	3.75	56	6.67
Apr.	1.58	27	5.39	93	1.41	24	6.39	111	3.69	64	5.78
May	.18	05	2.62	74	4.44	126	1.41	40	2.16	61	3.53
June	6.50	169	1.90	49	3.80	99	1.76	46	3.49	91	3.84
July	5.40	95	3.24	57	6.13	108	6.40	112	5.29	93	5.69
Aug.	3.92	123	10.12	317	8.20	257	1.70	53	5.98	187	3.19
Sept.	5.53	203	4.39	161	2.99	110	.93	34	3.46	127	2.72
Oct.	1.21	71	4.32	253	5.20	304	1.07	63	2.95	173	1.71
Nov.	1.55	48	4.67	143	3.06	94	4.89	150	3.54	109	3.26
Dec.	3.58	74	5.47	113	7.07	146	8.61	178	6.18	128	4.83
TOTAL	44.84	89	62.50	125	52.84	105	41.43	83	50.40	100	50.17

TABLE 3. AVERAGE MONTHLY MAXIMUM AND MINIMUM TEMPERATURES AT THE BLACK BELT SUBSTATION, 1965-68

Month	Temperature, degrees F									
	Average maximum					Average minimum				
	1965	1966	1967	1968	Mean	1965	1966	1967	1968	Mean
Jan.	61.8	51.7	58.1	55.5	56.8	37.0	33.1	35.9	33.3	34.8
Feb.	61.3	60.2	56.3	53.7	57.9	37.0	38.3	35.2	29.1	34.9
Mar.	63.4	67.1	74.8	68.2	68.4	43.0	42.6	47.4	39.4	43.1
Apr.	79.6	78.5	82.4	78.0	79.6	55.7	52.7	56.4	52.3	54.3
May	88.8	81.9	83.4	83.0	84.3	59.6	59.9	58.0	58.4	59.0
June	88.5	88.0	89.8	93.4	89.9	66.4	62.8	65.6	66.2	65.2
July	90.7	94.5	87.6	91.0	91.0	69.3	69.9	66.3	68.2	68.4
Aug.	91.0	89.8	85.9	92.8	89.9	68.6	64.8	66.6	68.7	67.2
Sept.	86.5	84.5	80.3	87.7	84.8	66.1	63.1	58.9	61.2	62.3
Oct.	76.0	75.6	76.5	79.6	76.9	51.4	50.6	47.2	52.0	50.3
Nov.	70.4	68.9	66.0	64.2	67.4	47.7	42.8	38.9	40.7	42.5
Dec.	61.5	58.4	62.1	56.3	59.6	35.9	36.7	42.0	33.3	37.0

ated much less from the normal than did average monthly rainfall, Table 3. December, January, and February are generally too cold for significant plant growth. The cool season species tested (caley peas, white clover, and fescue) usually make good growth in October, November, March, and April if moisture is adequate, but are restricted by maturity and hot weather in May through September. Dallisgrass is productive from April through October. Coastal bermudagrass requires warm temperatures and makes little growth until late May or early June. When moisture is adequate Coastal is highly productive in June, July, and August; production then tapers off during September and October when temperatures often drop below 60°.

Beginning and end of grazing season. The 4-year average beginning dates of spring grazing for systems 1, 2, 3, and 4, respectively, were March 9, April 2, March 8, and March 3, Table 4. Systems 3 and 4 (with ½ and 1 acre of fescue, respectively) also furnished grazing from December 1 to middle to late January

TABLE 4. BEGINNING DATE OF SPRING GRAZING FOR THE FOUR PASTURE SYSTEMS

System	Beginning date of spring grazing				
	1965	1966	1967	1968	Mean
1. Dallisgrass-white clover-caley peas	3-3	3-23	2-26	3-12	3-9
2. Coastal bermudagrass-caley peas	3-29	4-12	3-23	4-5	4-2
3. Dallisgrass-white clover-caley peas + ½ acre fescue	3-3	3-15	3-3	3-12	3-8
4. Dallisgrass-white clover-caley peas + 1 acre fescue	2-19	3-2	3-6	3-12	3-3

TABLE 5. DAYS OF HAY FEEDING REQUIRED FOR THE FOUR SYSTEMS

System	Days fed hay		
	Winter[1]	Summer[2]	Total
	No.	*No.*	*No.*
1. 2 acres dallisgrass-white clover-caley peas	98	10	108
2. 1 acre Coastal bermudagrass-caley peas	122	22	144
3. 1½ acres dallisgrass-white clover-caley peas + ½ acre fescue	65	15	80
4. 1 acre dallisgrass-white clover-caley peas + 1 acre fescue	46	34	80

[1] Fed while in holding area.
[2] Fed while on pasture.

each year. However, in none of the 4 years was there sufficient accumulated fescue growth on December 1 to eliminate the need for feeding stored feed.

After the pastures were stocked for spring grazing the cows and calves remained on pasture. In some instances hay was fed during spring and summer when grazing was not sufficient. After the calves were weaned, cows remained on their respective pastures for the remainder of the season. The cows were weighed when the calves were weaned, but not later in the season.

The number of days when grazing was insufficient, necessitating feeding hay, was greatest for System 2 and least for systems 3 and 4, Table 5. Fescue (in both systems 3 and 4) replaced 64 hay feeding days when compared to the Coastal bermudagrass-caley pea system and 28 days when compared to the dallisgrass-white clover-caley pea system. System 4, with its acre of fescue per cow and calf, required hay feeding the least number of days in the winter. Since it required the most days of hay feeding in the summer, its winter advantage was lost. However, some cattlemen may prefer summer feeding since weather conditions usually make feeding hay more difficult and disagreeable in winter. Nevertheless, none of the systems tested came near to eliminating the need for feeding stored roughages.

Hay production and consumption. Hay harvested from surplus grazing varied from 1,800 to 3,500 pounds per acre among the various systems, Table 6. The amount consumed was directly related to number of days that hay was fed. Systems 1 and 3 produced more hay and systems 2 and 4 less than was required by the cows and calves in these systems. The year-to-year hay yield fluctuated quite a bit, so deficits and surpluses occurred within

TABLE 6. HAY PRODUCTION AND CONSUMPTION PER COW FOR THE FOUR SYSTEMS

System	Hay produced 4-yr. av.	Hay consumed 4-yr. av.	Net hay supply[1]				
			1965	1966	1967	1968	4-yr. av.
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1. 2 acres dallisgrass-white clover-caley peas	3,513	2,526	9	290	—161	3,811	987
2. 1 acre Coastal bermudagrass-caley peas	2,771	3,386	—361	—1,785	1,137	—1,450	—615
3. 1½ acres dallisgrass-white clover-caley peas + ½ acre fescue	2,254	1,939	860	—295	—1,083	1,777	315
4. 1 acre dallisgrass-white clover-caley peas + 1 acre fescue	1,797	1,804	1,053	—953	470	—600	—7

[1] Production less amount fed in system.

each system. Of the 4 years, deficits occurred 1, 3, 2, and 2 years, respectively, for systems 1, 2, 3, and 4.

Cow-Calf Grazing Days

During the period December through July, the dallisgrass-white clover-caley pea sward provided grazing an average of 129 days and required 100 days hay feeding off the paddock. The last hay feeding occurred in mid-March, Table 7. When ½ acre of the 2-acre paddock was seeded to tall fescue, grazing time was 165 days and hay feeding was 66 days. Increasing tall fescue to 1 acre further reduced the hay feeding days and increased grazing days.

The Coastal bermudagrass-caley pea sward (System 2) required more feeding days off pasture and provided fewer grazing days than any of the other swards. The cattle were fed off this system an average of 122 days. They grazed the paddock an average of 106 days. Cows assigned to this sward were fed hay in a holding area from December through early April.

Data in Table 7 clearly indicate that substituting fescue for part of the land area normally established to dallisgrass-white clover-peas reduced hay feeding days when the same stocking rate was used (one cow with calf on 2 acres). Putting half of the pasture land in tall fescue reduced hay feeding days more than when one-fourth of the area was in fescue. Although the Coastal sward required more hay feeding days than the other pastures,

TABLE 7. DAYS FED OFF PASTURE AND DAYS GRAZED BY TREATMENT, BY PERIOD, 1965-68 AVERAGE

Period[2]	System 1[1]		System 2[1]		System 3[1]		System 4[1]	
	Off pasture	On pasture	Off pasture	On pasture	Off pasture	On pasture	Off pasture	On pasture
	Days	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*	*Days*
1. Dec.	28	0	28	0	4	23	1	27
2. Jan.	28	0	28	0	25	4	13	15
3. Feb.	30	0	30	0	26	4	24	6
4. Mar.	14	11	25	0	11	14	9	16
5. Apr.	0	35	11	23	0	35	0	35
6. May	0	28	0	28	0	28	0	28
7. June	0	27	0	27	0	28	0	27
8. July	0	28	0	28	0	29	0	28
TOTAL	100	129	122	106	66	165	47	182

[1] System 1 = dallisgrass-white clover-caley peas, System 2 = Coastal bermudagrass-caley peas, System 3 = dallisgrass-white clover-caley peas + ½ acre fescue, and System 4 = dallisgrass-white clover-caley peas + 1 acre fescue.

[2] Approximate period dates.

it had twice the stocking rate of the other swards. Therefore, actual carrying capacity (cow days) was considerably greater for Coastal-caley peas than for any of the other swards.

Calf Performance

Calf weight per cow. Market weight of calves was lowest for the Coastal bermudagrass-caley pea sward, Table 8. For any one year this difference was not significant, but when calves were pooled for all years, those from System 2 (Coastal) were lighter

TABLE 8. MARKET WEIGHT OF CALVES AT WEANING AS AFFECTED BY PASTURE TREATMENT[1 2]

System	Calf market weights				
	1965	1966	1967	1968	Mean
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1. 2 acres dallisgrass-white clover-caley peas	478a	467a	487a	505a	484a
2. 1 acre Coastal bermudagrass-caley peas	458a	416a	424a	465a	441b
3. 1½ acres dallisgrass-white clover-caley peas + ½ acre fescue	471a	468a	469a	503a	478a
4. 1 acre dallisgrass-white clover-caley peas + 1 acre fescue	478a	454a	468a	503a	476a
Mean	470	447	458	491	466

[1] Means within a column with like letter(s) are not significantly different.

[2] 250 days of age; adjusted for sex of calf and age of dam.

TABLE 9. MARKET WEIGHTS PER 2-ACRE PADDOCK OF CALVES AT WEANING AS AFFECTED BY PASTURE TREATMENT[1] [2]

System	Calf market weights				
	1965	1966	1967	1968	Mean
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1. 2 acres dallisgrass-white clover-caley peas	478b	467b	487b	505b	484b
2. 2 acres Coastal bermudagrass-caley peas	916a	832a	849a	929a	882a
3. 1½ acres dallisgrass-white clover-caley peas + ½ acre fescue	471b	468b	469b	503b	478b
4. 1 acre dallisgrass-white clover-caley peas + 1 acre fescue	478b	454b	468b	503b	476b
Mean	564	537	550	589	560

[1] Means within a column with like letter(s) are not significantly different.
[2] 250 days of age; adjusted for sex of calf and age of dam.

in weight than those from the other three systems. No differences in market weights were measured among calves from systems 1, 3, and 4. At the .10 level of probability there was a difference between years with the 491-pound average for 1968 being greater than the 447-pound average for 1966. The relative calf performance of each system was essentially the same from year to year since the interaction between pasture systems and years was non-significant.

Calf weight per acre. There was a large and consistently higher weight per 2-acre paddock for the calves from System 2 than for the other systems, Table 9. This weight advantage for System 2 was significant for each year of the test, reflecting the higher stocking rate on Coastal bermudagrass. No calf weight differences

TABLE 10. AVERAGE DAILY GAIN OF CALVES AS AFFECTED BY SEASON AND PASTURE TREATMENTS[1]

System	Daily gain		
	Winter	Summer	Total
	Lb.	*Lb.*	*Lb.*
1. 2 acres dallisgrass-white clover-caley peas	1.17	2.09	1.70
2. 1 acre Coastal bermudagrass-caley peas	1.16	1.83	1.47
3. 1½ acres dallisgrass-white clover-caley peas + ½ acre fescue	1.32	2.02	1.65
4. 1 acre dallisgrass-white clover-caley peas + 1 acre fescue	1.47	1.90	1.66

[1] Differences were not significant (P = .05 per cent).

were measured among systems 1, 3, and 4 on a per paddock basis. At the .10 level of probability there was a difference between years with the 589-pound average for 1968 being greater than the 537-pound average for 1966. Average daily gains did not differ significantly among treatments, Table 10.

Slaughter grades. Calves on cows grazing the Coastal bermudagrass-caley pea sward weaned at a significantly lower slaughter finish than the calves from the other swards, Table 11. The average slaughter grade of all calves was Good, but those on systems 1, 3, and 4 averaged high Good and those on System 2 averaged low Good. The lower slaughter grade for the calves on the Coastal bermudagrass-caley pea sward resulted in part from an apparent deficiency of high quality forage for selection by the calves.

TABLE 11. STEER SLAUGHTER GRADES BY TREATMENT, 1965-68 AVERAGE

Treatment	Years	Calves per treatment	Average slaughter grade[1]	
			Numerical score	Grade
	No.	*No.*		
1. 2 acres dallisgrass-white clover-caley peas	4	16	11.2a	high Good
2. 2 acres Coastal bermudagrass-caley peas	4	24	9.8b	low Good
3. 1½ acres dallisgrass-white clover-caley peas + ½ acre fescue	4	16	10.6a	high Good
4. 1 acre dallisgrass-white clover-caley peas + 1 acre fescue	4	16	10.8a	high Good

[1] Values having the same letter(s) are not significantly different at a 5 per cent level of probability.

Cow Performance

Cow changes in live weight. Average live weight changes of brood cows assigned to each system for the December to July interval are summarized for the 4 years in Table 12. Cows assigned to Coastal bermudagrass-caley peas gained significantly less than cows on the other swards. The accumulated weight changes are reported by monthly intervals since this represents a more meaningful appraisal of cow weight changes. For the dallisgrass-white clover-caley pea sward (System 1) and for both swards with fescue (systems 3 and 4), the cows were in positive weight balance be-

TABLE 12. COW WEIGHT CHANGE BY TREATMENT AND BY PERIOD, 1965-68 AVERAGE

Period (approximate)	Cow weight change, by forage systems[1]			
	System 1, D-C-P	System 2, CB-P	System 3, D-C-P + ½ acre fescue	System 4, D-C-P + 1 acre fescue
	Lb.	*Lb.*	*Lb.*	*Lb.*
1. December	23	7	1	32
2. January	2	−31	22	60
3. February	−1	−4	−11	−1
4. March	−11	−11	0	7
5. April	66	33	57	56
6. May	31	17	28	36
7. June	37	36	30	28
8. July	8	12	11	12

[1] Abbreviations: D = dallisgrass, C = white clover, P = caley peas, and CB = Coastal bermuda.

ginning in April, Table 13. In contrast, cows on System 2 remained in negative weight balance through April. Thus, by the end of July the average positive weight gain was only 56 pounds for cows on the Coastal bermudagrass-caley pea sward.

Stocking rate always affects cow weight gain, especially when the pasture is overgrazed. It is probable that one cow per acre on System 2 represented a stressed stocking that adversely affected cow gain. Since the interval covered by the data in tables 12 and 13 was only 8 months, cows on all swards had 4 additional months during their non-productive season to restore body weight. The cows remained on the grazing paddocks until De-

TABLE 13. ACCUMULATED WEIGHT CHANGE BY COW, BY TREATMENT AND BY PERIOD, 1965-68 AVERAGE

Period	Accumulated cow weight change, by forage systems[1]			
	System 1, D-C-P	System 2, CB-P	System 3, D-C-P + ½ acre fescue	System 4, D-C-P + 1 acre fescue
	Lb.	*Lb.*	*Lb.*	*Lb.*
1. December	23	7	1	32
2. January	−11	−25	−23	−28
3. February	−9	−29	−35	−26
4. March	−33	−39	−35	−20
5. April	33	−5	22	36
6. May	64	12	50	72
7. June	100	48	80	100
8. July	104	56	86	107

[1] Abbreviations: D = dallisgrass, C = white clover, P = caley peas, and CB = Coastal bermuda.

cember. Cows were not weighed after calves were weaned, but weight increase was apparent.

Milk Production

There were no major differences among the systems with respect to milk production of cows, Table 14. Average production of cows on all swards was uniform. The somewhat lower production reported for cows on Coastal bermudagrass-caley peas at the time calves were weaned is accounted for by two cows that were already dry. The fact that these cows were dry when the calves were weaned most likely was not specifically related to the forage system. Over the years the Experiment Station has collected numerous data concerning milk production of beef cows. In this research, it was not unusual for a few calves to become weaned before they were actually separated from dams at about 250 days of age. It is concluded that all the swards were of sufficient quality to support average milk production by the beef cows.

TABLE 14. PRODUCTION OF 4 PER CENT FCM, 24-HOUR BASIS, BY SEASON

System	Initial[1] production	4-year average daily production		
		Winter	Spring	Weaning
	Lb.	*Lb.*	*Lb.*	*Lb.*
1. 2 acres dallisgrass-white clover-caley peas	11.1	9.6	9.7	8.7
2. 1 acre Coastal bermudagrass-caley peas	12.1	9.5	8.3	6.9
3. 1½ acres dallisgrass-white clover-caley peas + ½ acre fescue	12.1	10.3	8.8	8.4
4. 1 acre dallisgrass-white clover-caley peas + 1 acre fescue	12.4	10.8	8.0	9.3
AVERAGE	11.9	10.0	8.7	8.3

[1] Initial production figures are 1965-66 averages, while all others represent averages of 1964-67.

Total Digestible Nutrients Per Acre Through Grazing

The Coastal bermudagrass-caley pea sward (System 2) produced more forage per acre and supported twice the stocking rate of any of the other systems. This means, of course, that the Coastal forage produced more energy per acre through photosynthesis than any other sward. Another way of expressing this difference is to compare the TDN consumed per acre by the grazing

animals. The TDN used by the cows was computed using the procedure by Neville,[1] and that consumed by the calves was calculated using the procedure developed by Winchester[2]. The 4-year average TDN production per acre for each system was as follows:

System 1 Dallisgrass-white clover-caley peas	1,450 lb.
System 2 Coastal bermuda-caley peas	2,118 lb.
System 3 Dallisgrass-white clover-caley peas-½ acre fescue	1,360 lb.
System 4 Dallisgrass-white clover-caley peas-1 acre fescue	1,382 lb.

These data reveal the great superiority of System 2 over the other swards in terms of TDN production. Despite its superiority in terms of productivity, Coastal bermuda apparently lacked sufficient nutritive value to support high individual animal performance. Therefore, high forage production proved insufficient to support high individual animal performance. The Coastal bermudagrass sward did produce two animals of weaning age, whereas each of the other swards produced only one. Although not as profitable as the other systems under conditions of this experiment, this far greater productivity per acre should not be completely discounted. Under other systems of comparison, the superiority of Coastal bermudagrass for dry matter production could show practical advantage.

Economic Analysis

Costs and returns for the four different systems are reported in Table 15. The gross returns are based on adjusted market weight and sale of calves. Neither cull cows nor death loss was taken into consideration when calculating returns. Excess forage was baled and the hay not required for feeding was credited to each system as sale of excess forage.

System 2, Coastal bermudagrass-caley peas, had much higher gross returns than any of the other systems, $231.63 compared with the next highest return of $132.87. This higher gross return was because System 2 maintained two cows and the other systems had only one. But on the expense side, annual costs for the Coastal bermudagrass-caley peas were much higher than for any of the other systems. These high annual costs resulted primarily

[1] NEVILLE, W. E., JR. 1971. Effect of Age at Calving on Energy Requirements of Lactating Hereford Cows. J. Anim. Sci. Vol. 32, No. 2.

[2] USDA Tech. Bull. 1071, July 1953.

TABLE 15. COSTS AND RETURNS OF BEEF CATTLE PRODUCTION BY TYPE OF GRAZING SYSTEM, 4-YEAR AVERAGE

Item	System			
	1	2	3	4
Final corrected market value of calves sold	$122.59	$225.94	$122.82	$121.45
Value of excess hay $20/ton	10.28	5.69	6.59	3.81
Total returns	132.87	231.63	129.41	125.25
Annual costs				
Fertilizer (mixed)	12.81	12.01	10.60	9.80
Ammonium nitrate	0	28.14	5.04	10.07
Haul and apply ammonium nitrate $7.50/ton	0	3.21	.56	1.12
Seed—caley peas @ $.08/lb. and white clover @ $1.10/lb.	7.62	8.40	6.02	4.01
Hay expenses				
Cut, rake, and bale $.20/bale	11.31	16.57	7.71	6.92
Hauling $2.10/ton	3.68	5.83	2.36	1.87
Feed				
Hay $25/ton	.50	22.46	4.31	4.85
Protein supplement	7.76	20.05	5.30	3.70
Salt	.90	1.80	.90	.90
Veterinary $2.00/cow unit	2.00	4.00	2.00	2.00
Commission, yardage, and hauling	4.13	8.25	4.13	4.13
Electricity $1.00/cow	1.00	2.00	1.00	1.00
Total annual costs	51.71	132.72	49.92	50.37
Returns above annual costs per plot	81.16	98.91	79.49	74.88
Returns above annual costs per acre	40.58	49.45	39.74	37.44
Non-cash costs per acre				
Pasture depreciation	4.00	5.00	4.00	4.00
Bull charge $8.00/cow	4.00	8.00	4.00	4.00
Interest on investment @ 6%[1]	17.10	23.10	17.10	17.10
Dep. on bldgs., fences, mach., and equip.	2.75	2.75	2.75	2.75
Taxes, property	.50	.50	.50	.50
Total non-cash costs	28.35	39.35	28.35	28.35
Returns to operator's labor and mgt./acre	12.23	10.10	11.39	9.09
Returns to operator's labor and mgt./cow	24.46	10.10	22.78	18.18

[1] Prices used for capital investment were: cow—$200/head, land—$150/acre, buildings and fences—$15/acre, machinery and equipment—$20/acre.

from the expense of baling hay produced and buying hay and protein supplement. The cows in System 2 were fed hay 144 days per year compared with 108 days for System 1 and 80 days each for systems 3 and 4. Another cost item contributing to the high expenses for System 2 was $28.14 for ammonium nitrate. This is based on $65 per ton undelivered and not applied.

When comparing returns above annual cash expenses, System 2 looked fairly good with approximately $10 advantage over the other three systems. But non-cash costs were much higher for System 2 because of increased investment for two cows compared with only one cow for the other systems. Also the establishment

cost of Coastal bermudagrass was $1 per acre higher on a prorated life of the pastures.

The important returns to consider, especially for a long period, are returns to operator's labor and management. There was little difference among the four treatments when returns to operator's labor and management were compared on a per acre basis. Although there was no real difference between systems 1 and 3, System 3 required 28 days less hay feeding per year than System 1. Returns under System 2 were $2.13 less than System 1. System 4, with 1 acre of fescue and 1 acre of dallisgrass-white clover-caley peas, had the lowest return on a per acre basis, $9.09.

These data indicate that System 2 was paying a lower return to labor than the other three systems because there was an extra cow to feed and care for with this system.

Another way of comparing returns is on a per cow basis. On this basis, System 2 had a much lower return to operator's labor and management—only $10.10 compared with $24.46 for System 1 and $22.78 for System 3. Again the system with 1 acre of fescue and 1 acre of dallisgrass-white clover-caley peas (System 4) had a lower return than all dallisgrass-white clover-caley peas or ½ acre fescue and 1½ acres dallisgrass-white clover-caley peas. In comparing returns per cow, it is noted that System 2 had a lower labor requirement than the others because only 1 acre of land was required per cow while the other systems required 2 acres per cow.

Another disadvantage of System 2 was a wider annual variation. This went from a high of $25.26 returns to operator's labor and management per acre in 1967 to a low of −$6.85 in 1966. Annual comparisons of the four systems are reported in Appendix Tables 2 to 5.

Based on this 4-year test, fescue is not an economical substitute for winter feeding of hay for maintenance of the brood cow and calf. Dallisgrass-white clover-caley peas without any fescue gave the highest return to operator's labor and management on a per acre and a per cow basis. Net returns declined as the proportion of dallisgrass-white clover-caley peas decreased and proportion of fescue increased.

Value of the excess forage was a major item, especially in System 1 where it amounted to $10.28 of the $12.23 total returns to operator's labor and management per acre. This indicates strongly

the importance of utilizing all forage produced either as grazing or hay.

How different grazing systems affected reproduction of brood cows was not taken into consideration because cows that did not calve were replaced with cows that had calves. Therefore, these data would have to be adjusted to an expected calving percentage before the net returns could be computed for a herd of cattle. Assuming each system would have the same per cent calf crop, then System 1 would still give the highest returns unless cost of nitrogen was low enough to make System 2 comparable.

SUMMARY AND CONCLUSIONS

1. Pasture systems replacing one-fourth and one-half of the normal dallisgrass-white clover-caley pea allocation per cow and calf (2 acres) with tall fescue each reduced the required hay feeding period by 28 days. The reduction was 64 days when compared with a Coastal bermudagrass-caley pea system. However, feeding stored roughages was necessary each year for all four systems.

2. A system utilizing Coastal bermudagrass-caley peas at twice the stocking rate of dallisgrass-white clover-caley peas—with or without tall fescue—produced significantly more weight gain (880 vs. approximately 480 pounds) per 2-acre paddock. However, the calves were significantly lighter (440 vs. approximately 480 pounds).

3. The botanical compositions of the dallisgrass-white clover-caley pea portion of systems 1, 3, and 4 were almost identical. White clover made up about 50 per cent of the sward during March, April, and May, but decreased to 40 per cent in June and 20 per cent in July.

4. Coastal bermudagrass constituted only about 20 per cent of the sward of System 2 in April, but dominated in May, June, and July, making up from 80 to 90 per cent of the sward.

5. Dry matter digestibility as determined by the plant chromogens technique revealed no important differences among the swards.

6. The 4-year average beginning date of spring grazing for systems 1, 2, 3, and 4, respectively, was March 9, April 2, March 8, and March 3.

7. Cows assigned to the Coastal bermudagrass sward gained significantly less than cows on the other pastures. For systems 1, 3, and 4, the cows were in positive weight balance beginning in April; but cows on Coastal bermudagrass-caley peas remained in negative weight balance through April.

8. The computed TDN used by the grazing animals revealed a great superiority of Coastal bermudagrass-caley peas over the other swards. Despite its superior productivity, however, this system did not support high individual animal performance.

9. There was not a great deal of difference among the four treatments when comparing returns to operator's labor and management on a per acre basis.

10. On a per cow basis System 2 had a much lower return to operator's labor and management than did systems 1 and 3. Return to System 4 was intermediate between these extremes.

11. Value of the excess forage was a major item, especially in System 1, emphasizing the importance of using all forage produced, either in grazing or hay.

APPENDIX

APPENDIX TABLE 1. SOIL TEST RESULTS AND CORRECTIVE TREATMENT APPLIED TO COMPENSATE FOR PREVIOUS LIME AND FERTILIZER TREATMENTS

Paddock no.	System no.	Soil test results[1]			Corrective treatment		
		pH	P/acre	K/acre	Lime/acre	P/acre	K/acre
			Lb.	*Lb.*	*Tons*	*Lb.*	*Lb.*
1	3	5.7	33	123	2	70	100
2	1	5.0	3	149	5	106	100
3	4	5.0	14	91	5	88	199
4	3	5.3	25	141	3	70	100
5	4	5.4	22	176	3	70	50
6	1	5.4	28	159	3	70	50
7	2	5.4	24	173	3	70	50
8	3	5.4	25	212	3	70	50
9	2	5.3	12	129	3	88	100
10	4	5.2	25	176	3	70	50
11	2	5.9	22	144	2	70	100
12	1	5.7	22	201	2	70	50
13	1	5.3	5	191	3	106	50
14	4	5.3	5	191	3	106	50
15	3	5.3	5	191	3	106	50

[1] Samples taken in May 1963.

APPENDIX TABLE 2. COSTS AND RETURNS OF BEEF CATTLE PRODUCTION BY TYPE OF GRAZING SYSTEM, 1964-65

Item	System			
	1	2	3	4
Final corrected market value of calves sold	$110.60	$209.02	$110.57	$109.49
Value of excess hay $20/ton	.09	0	8.60	10.53
Total returns	110.69	209.02	119.17	120.02
Annual costs				
Fertilizer (mixed)	11.73	11.73	10.45	10.25
Ammonium nitrate	0	25.92	5.59	11.18
Haul and apply ammonium nitrate $7.50/ton	0	2.70	.56	1.12
Seed—caley peas @ $.08/lb. and white clover @ $1.10/lb.	6.40	6.40	4.80	3.20
Hay expenses				
Cut, rake, and bale $.20/bale	7.70	20.47	7.70	8.45
Hauling $2.10/ton	2.59	7.41	2.40	2.31
Feed				
Hay $25/ton	0	9.02	0	0
Protein supplement	6.62	16.99	3.25	1.73
Salt	.90	1.80	.90	.10
Veterinary $2.00/cow unit	2.00	4.00	2.00	7.00
Commission, yardage, and hauling	4.00	8.00	4.00	4.00
Electricity $1.00/cow	1.00	2.00	1.00	1.00
Total annual costs	42.94	116.44	42.65	46.14
Returns above annual costs per plot	67.75	92.58	76.52	73.88
Returns above annual costs per acre	33.87	46.28	38.26	36.94
Non-cash costs per acre				
Pasture depreciation	4.00	5.00	4.00	4.00
Bull charge $8.00/cow	4.00	8.00	4.00	4.00
Interest on investment @ 6%[1]	17.10	23.10	17.10	17.10
Dep. on bldgs., fences, mach., and equip.	2.75	2.75	2.75	2.75
Taxes, property	.50	.50	.50	.50
Total non-cash costs	28.35	39.35	28.35	28.35
Returns to operator's labor and mgt./acre	5.52	6.93	9.91	8.59
Returns to operator's labor and mgt./cow	11.04	6.93	19.82	17.18

[1] Prices used for capital investment were: cow—$200/head, land—$150/acre, buildings and fences—$15/acre, machinery and equipment—$20/acre.

APPENDIX TABLE 3. COSTS AND RETURNS OF BEEF CATTLE PRODUCTION BY TYPE OF GRAZING SYSTEM, 1965-66

Item	System			
	1	2	3	4
Final corrected market value of calves sold	$116.79	$209.04	$117.63	$112.88
Value of excess hay $20/ton	2.90	0	0	0
Total returns	119.69	209.04	117.63	112.88
Annual costs				
Fertilizer (mixed)	12.18	12.18	10.87	10.07
Ammonium nitrate	0	30.83	5.14	10.28
Haul and apply ammonium nitrate $7.50/ton	0	3.38	.56	1.12
Seed—caley peas @ $.08/lb. and white clover @ $1.10/lb.	8.10	6.40	7.27	4.85
Hay expenses				
Cut, rake, and bale $.20/bale	9.15	9.00	5.95	3.90
Hauling $2.10/ton	3.08	3.26	1.96	1.02
Feed				
Hay $25/ton	0	44.59	3.69	11.91
Protein supplement	7.62	18.60	5.82	4.54
Salt	.90	1.80	.90	.90
Veterinary $2.00/cow unit	2.00	4.00	2.00	2.00
Commission, yardage, and hauling	4.00	8.00	4.00	4.00
Electricity $1.00/cow	1.00	7.00	1.00	1.00
Total annual costs	48.03	144.04	49.16	55.59
Returns above annual costs per plot	71.66	65.00	68.47	57.29
Returns above annual costs per acre	35.83	32.50	34.23	28.64
Non-cash costs per acre				
Pasture depreciation	4.00	5.00	4.00	4.00
Bull charge $8.00/cow	4.00	8.00	4.00	4.00
Interest on investment @ 6%[1]	17.10	23.10	17.10	17.10
Dep. on bldgs., fences, mach., and equip.	2.75	2.75	2.75	2.75
Taxes, property	.50	.50	.50	.50
Total non-cash costs	28.35	39.35	28.35	28.35
Returns to operator's labor and mgt./acre	7.48	—6.85	5.88	.29
Returns to operator's labor and mgt./cow	14.96	—6.85	11.76	.58

[1] Prices used for capital investment were: cow—$200/head, land—$150/acre, buildings and fences—$15/acre, machinery and equipment—$20/acre.

APPENDIX TABLE 4. COSTS AND RETURNS OF BEEF CATTLE PRODUCTION BY TYPE OF GRAZING SYSTEM, 1966-67

Item	System			
	1	2	3	4
Final corrected market value of calves sold	$128.86	$227.84	$126.54	$128.50
Value of excess hay $20/ton	0	22.75	0	4.70
Total returns	128.86	250.59	126.54	133.20
Annual costs				
Fertilizer (mixed)	17.20	10.72	10.70	8.79
Ammonium nitrate	0	28.60	4.88	9.75
Haul and apply ammonium nitrate $7.50/ton	0	3.38	.56	1.12
Seed—caley peas @ $.08/lb. and white clover @ $1.10/lb.	8.00	9.60	6.00	4.00
Hay expenses				
Cut, rake, and bale $.20/bale	7.00	22.40	4.20	10.72
Hauling $2.10/ton	2.31	8.19	1.03	2.73
Feed				
Hay $25/ton	2.01	0	13.54	0
Protein supplement	7.93	22.67	6.51	5.35
Salt	.90	1.80	.90	.90
Veterinary $2.00/cow unit	2.00	4.00	2.00	2.00
Commission, yardage, and hauling	4.00	8.00	4.00	4.00
Electricity $1.00/cow	1.00	2.00	1.00	1.00
Total annual costs	52.35	121.36	55.32	50.36
Returns above annual costs per plot	76.51	129.23	71.22	82.84
Returns above annual costs per acre	38.25	64.61	35.61	41.42
Non-cash costs per acre				
Pasture depreciation	4.00	5.00	4.00	4.00
Bull charge $8.00/cow	4.00	8.00	4.00	4.00
Interest on investment @ 6%[1]	17.10	23.10	17.10	17.10
Dep. on bldgs., fences, mach., and equip.	2.75	2.75	2.75	2.75
Taxes, property	.50	.50	.50	.50
Total non-cash costs	28.35	39.35	28.35	28.35
Returns to operator's labor and mgt./acre	9.90	25.26	7.26	13.07
Returns to operator's labor and mgt./cow	19.80	25.26	14.52	26.14

[1] Prices used for capital investment were: cow—$200/head, land—$150/acre, buildings and fences—$15/acre, machinery and equipment—$20/acre.

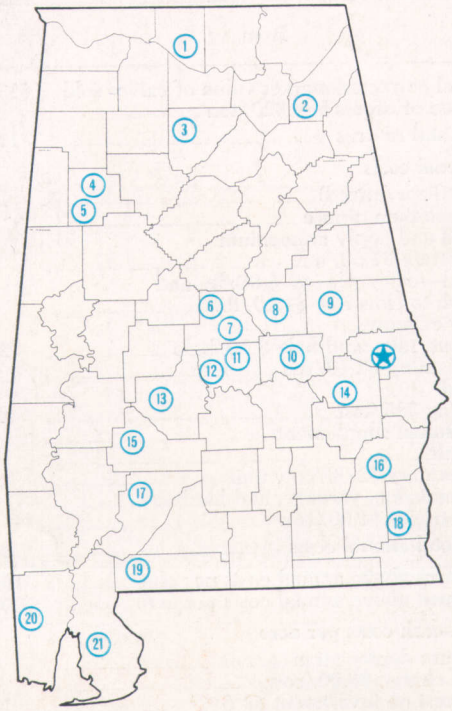
APPENDIX TABLE 5. COSTS AND RETURNS OF BEEF CATTLE PRODUCTION BY TYPE OF GRAZING SYSTEM, 1967-68

Item	System			
	1	2	3	4
Final corrected market value of calves sold	$134.12	$257.86	$136.52	$134.91
Value of excess hay $20/ton	38.11	0	17.77	0
Total returns	172.23	257.86	154.29	134.91
Annual costs				
Fertilizer (mixed)	10.12	13.40	10.38	10.08
Ammonium nitrate	0	27.22	4.54	9.08
Haul and apply ammonium nitrate $7.50/ton	0	3.38	.56	1.12
Seed—caley peas @ $.08/lb. and white clover @ $1.10/lb.	8.00	11.20	6.00	4.00
Hay expenses				
Cut, rake, and bale $.20/bale	21.40	14.40	13.00	4.60
Hauling $2.10/ton	6.72	4.48	4.07	1.43
Feed				
Hay $25/ton	0	36.25	0	7.50
Protein supplement	8.87	21.92	5.63	3.20
Salt	.90	1.80	.90	.90
Veterinary $2.00/cow unit	2.00	4.00	2.00	2.00
Commission, yardage, and hauling	4.50	9.00	4.50	4.50
Electricity $1.00/cow	1.00	2.00	1.00	1.00
Total annual costs	63.51	149.05	52.58	49.41
Returns above annual costs per plot	108.72	108.81	101.71	85.50
Returns above annual costs per acre	54.36	54.40	50.85	42.75
Non-cash costs per acre				
Pasture depreciation	4.00	5.00	4.00	4.00
Bull charge $8.00/cow	4.00	8.00	4.00	4.00
Interest on investment @ 6%[1]	17.10	23.10	17.10	17.10
Dep. on bldgs., fences, mach., and equip.	2.75	2.75	2.75	2.75
Taxes, property	.50	.50	.50	.50
Total non-cash costs	28.35	39.35	28.35	28.35
Returns to operator's labor and mgt./acre	26.01	15.05	22.50	14.40
Returns to operator's labor and mgt./cow	52.02	15.05	43.00	28.80

[1] Prices used for capital investment were: cow—$200/head, land—$150/acre, buildings and fences—$15/acre, machinery and equipment—$20/acre.

AGRICULTURAL EXPERIMENT STATION SYSTEM OF ALABAMA'S LAND-GRANT 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.