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Chapter 9

FORAGE AND ANIMAL PRODUCTION PROGRAMS FOR EAST TEXAS

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Chapter 9

FORAGE AND ANIMAL PRODUCTION PROGRAMS FOR EAST TEXAS

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THE EAST TEXAS AREA

Climate

Climatic conditions determine to a large extent the forage species which can be grown in a given geographic area. Seasonal precipitation and temperature patterns influence forage production and may affect forage quality. The geographic area with which this chapter is concerned is bounded on the east by Louisiana, on the north by Oklahoma, on the south by the Coastal Prairie and on the west by the Blackland Prairie. This area may be described as warm, temperate, and humid.

Average monthly rainfall for several locations in the area is summarized in Table 9-1 (Griffiths and Orton, 1968). Generally, rainfall tends to be higher in the eastern and southern parts of the area (> 50 inches) and lower in the western portion (35 inches). Rainfall may exceed 2-1/2 inches monthly, but distribution may lead to 1-3 months of drouth conditions, especially during summer months.

Table 9-1. Mean monthly rainfall (inches) at selected locations in East Texas.

	Month												
Location	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Lindale	3.93	3.66	3.93	5.02	5.52	3.50	3.25	3.00	2.73	3.24	4.23	4.92	47.13
Nacogdoches	4.45	4.19	3.75	4.66	5.33	3.31	3.56	2.68	2.96	3.24	4.70	5.22	48.09
Marshall	4.72	3.99	4.40	4.43	5.26	3.30	3.28	2.54	2.79	3.23	4.42	5.02	47.15
Texarkana	4.83	4.03	4.73	5.28	4.88	4.02	3.84	3.07	2.72	2.97	4.32	4.55	49.24

The effectiveness of precipitation is influenced by evapotranspiration losses from the plant and by temperature. Table 9-2 shows the mean monthly temperatures

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Table 9-2. Mean monthly evaporation (inches) from free water surface and mean monthly temperature, 1967-1971, Daingerfield, Morris County, Texas 1/

	Month											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Mean Evap.	2.53	3.39	5.47	6.47	8.22	9.84	10.26	10.11	7.04	5.68	3.53	3.30
Mean Temp.	47.97	49.52	57.10	68.18	73.14	81.34	83.72	83.52	77.18	68.10	56.30	51.46

1/ Data from Griffiths and Orton (1968)

and evaporation rates of water from a standard weather bureau pan for the period 1967 through 1971 at Daingerfield (Morris County). Although other factors affect evaporative loss, temperature and evaporative loss are closely correlated (r = 0.96). Thus, during the period May through September, 46.5 inches of evaporation occurs, while 30.4 inches of evaporation occurs during the period October through April.

While evaporative losses are highest from May through September, rainfall is at its lowest. Thirty-eight percent of the annual rainfall at Lindale occurs during the months May through September, while 62 percent of the annual rainfall occurs during the period October through April (Griffiths and Orton, 1968). In addition to affecting moisture losses from evapotranspiration, temperature also is important from the standpoint of animal performance.

Duble, Lancaster and Holt (1971) have shown that growth rate of 600-pound Hereford x Brahman heifers is related to temperature (r = -0.72) when forage availability is not limiting and when in vitro digestibility of the available forage exceeds 58 percent.

From a climatological standpoint, the months of June, July, August, and September have least precipitation and maximum evaporative losses and are most inimical to animal performance. The period of October through May provides greater monthly rainfall and minimum evaporative losses, and has mean temperatures at or slightly below the thermoneutral zone for cattle.

Soils and Vegetation

A more complete description of the soils of East Texas and their management problems are presented in Chapter 4, Fertilization of Forages. In general, most of the soils are fine sands and fine sandy loams which are light colored and low in

organic matter. And, like those of many humid areas, the soils are low in natural fertility and are slightly to strongly acid.

The Pineywoods area as described by Gould (1962) contains about 15 million acres of pine-hardwood forested land. The predominant timber species include loblolly, longleaf, shortleaf, and slash pines, in addition to various merchantable hardwoods such as oak, hickory, walnut, and maple. The forage plants which are considered to be native to this region do not make significant contributions in providing pasture for cattle. Introduced grasses such as bermudagrasses, dallisgrass, bahiagrass, vaseygrass, lovegrass, and carpetgrass, and certain species of legumes are the dominant forages used in improved pastures. Common bermudagrass has adapted so well to this environment that it has become an invader under certain improved pasture conditions. The principal grass invaders present on abandoned, unfertilized lands are broomsedge, three-awn, and smutgrass.

Livestock Enterprises

Beef cattle are the predominant livestock enterprise, comprising nearly 94 percent of all cattle in the East Texas area. Dairy cattle account for approximately 6 percent of all cattle.

Beef Cattle - Cow-Calf

The Texas Crop and Livestock Reporting Service (1971) (1971 Texas Livestock Statistics) indicated that the East Texas area had 1,519,000 cattle on January 1, 1971. Of this number 1,046,000 or 68.9 percent were cows which had calved, while stocker cattle accounted for the remaining 31.1 percent. Beef cattle operations in East Texas tend to be relatively small with 73.9 percent of the farms owning less than 100 cattle (Census of Agriculture, 1969). Table 9-3 summarizes farm numbers and numbers of cattle owned by farms of various sizes. The farmer is the only one who can adopt new production practices, but the impact of the adoption of a new practice on beef productivity is a function of the number of animals affected by the practice. The complete adoption of a practice by the 6,000 farmers who have less than 50 cows would have about the same impact on the production of beef as the adoption of that same idea by 177 producers who own 500 or more cows per herd.

Table 9-3. Number of cattle per farm and percents of total cattle by farm sizes, 1969.

No. of cattle per farm	No. of farms	Percent of total farms	Cattle number	Percent of total cattle
1-19	1423	9.87	18,475	1.216
20-49	4580	31.79	189,658	12.483
50-99	4649	32.27	374,971	24.68
100-199	2675	18.57	425,869	28.03
200-499	899	6.24	304,930	20.07
500+	177	1.22	205,110	13.50

Beef Cattle - Stocker

While East Texas has not been a major stocker steer area, stocker cattle are becoming more important in the area. According to a recent summary (1971 Texas Livestock Statistics) the East Texas area has about the same number of stockers as are found in Louisiana or Florida, approximately 473,000 on January 1, 1971. Many of the calves produced in the area are moved to other areas for growing and feeding. For example, 39 High Plains and Panhandle counties reported combined totals of 336,000 cows and 1,201,000 stocker cattle.

Stocker cattle operations in East Texas appear to be feasible in conjunction with a cow-calf enterprise, although many ranchers own only stocker cattle.

Dairy Cattle

Although dairy cows comprise only 6 percent of the total cattle in East Texas, they must utilize a high quality forage as a significant part of the diet. Recently Carpenter (1970) showed that substituting winter pasture for concentrates in the diet of young dairy bulls reduced production costs and increased net profit. Ellzey (1969) reported that oats-ryegrass pastures can make a significant contribution to the production of lactating dairy cows, with milk production being related linearly to forage availability.

WARM-SEASON PERENNIAL FORAGES

Dry Matter Production

Warm-season perennial grasses form the nucleus for cow-calf production in East Texas. These species produce significant amounts of dry matter from mid-March to mid-November. Some of the advantages which have prompted widespread utilization of these forages by commercial operators are (1) vigor (their reliable, perennial nature); (2) dry matter production (a per acre production range of 5 to 15 tons exceeds that of most all other forages); (3) soil conservation [both sod-forming (bermudagrasses) and bunch-types (lovegrass) are prevalent].

Sod-Forming Grasses

These types of plants are important in the Pineywoods, primarily because of their stoloniferous and rhizomatous growth habits which favor plant vigor and stand maintenance especially during periods of extreme defoliation (high stocking rates). Coastal bermudagrass may be cut or defoliated as many as 10 times per year or every time top growth reaches 4 to 6 inches without affecting the stand. Yields may be reduced slightly by frequent cutting but not by close or short cutting (Table 9-4). Soil type, however, is an important factor in relating the severity of defoliation to maintenance of stand of a sod-forming grass. These results would not necessarily be duplicated on heavier soils, but in East Texas, the bermudagrasses are especially well adapted for intensive utilization.

Table 9-4. Yields of Coastal bermudagrass from two levels of N at various clipping heights and frequencies. Mt. Pleasant 1961-64[1/]

Inches of top growth at harvest	Clipping height (inches)	Lbs air-dry forage/acre[2/] Lbs N/acre[3/] 120	240	Average
2-4	2	9,200	11,800	10,400
	5	9,000	10,800	9,800
8-10	2	11,400	13,800	12,600
	5	9,000	12,200	10,600
14-16	2	12,200	15,000	13,600
	5	10,400	12,200	11,200

[1/]Holt and Lancaster, 1968
[2/]4-year averages
[3/]All plots fertilized with 0-60-60 in October, and split applications of N after each harvest

There are several varieties and selections of bermudagrasses, some of which have been evaluated for yield in East Texas for more than 20 years (Table 9-5). Selection No. 3 has been one of the highest yielding varieties. However, because of its denser and shorter growth, this variety is less desirable as a hay plant than Coastal (Holt and Lancaster, 1968). Both Suwannee and Midland produce more than Coastal during the initial establishment year, but afterward Coastal outyields these two varieties.

Table 9-5. Forage yields from bermudagrasses in East Texas.

Variety or Selection	Lbs/acre oven-dry forage — Test site and year(s) of test: Mt. Pleasant 1952-1955[1]	Mt. Pleasant 1956-1959[2]	Mt. Pleasant 1958-1960[2]	Mt. Pleasant 1959-1961[2]	Overton 1967[2]	Overton 1971[3]
Coastal	6,980	9,260	8,600	11,920	11,140	14,349
Suwannee		8,500	7,140	8,140		14,209
Zimmerly					9,220	12,787
San Antonio Select					10,280	12,679
Selection No. 3	8,770	10,060		11,700		12,326
Midland				12,160		10,571
Common	4,660	7,880	5,520	9,380	4,180	8,063
NK-37				4,800		

[1]From Holt *et al.* (1958)

[2]From Holt & Lancaster (1968) - Fertilized with 0-60-60 in fall and 30-60 pounds N per acre following each harvest for yearly total of 120-60-60 ($N-P_2O_5-K_2O$).

[3]From Rouquette and Duble (unpublished data, 1971) - Fertilized with 100-100-100 in March and two applications of 75 pounds N per acre each for total of 250-100-100 ($N-P_2O_5-K_2O$).

Seasonal production by period is shown in Table 9-6 for these varieties.

Table 9-6. Distribution of dry matter production by bermudagrass varieties at Overton. 1971.

Variety or selection	Lbs/acre oven-dry forage: May 20	July 6	Aug. 16	Nov. 11	TOTAL
Coastal	2,250	3,331	3,970	4,798	14,349
Suwannee	2,867	3,677	3,470	4,195	14,209
Zimmerly	2,167	3,526	3,254	3,846	12,787
San Antonio Select	2,132	3,221	3,426	3,900	12,679
Selection No. 3	2,428	2,864	2,988	4,046	12,326
Midland	1,820	2,119	3,150	3,482	10,571
Common	1,135	1,834	2,158	2,936	8,063

Coastcross-I bermudagrass, one of the highest quality varieties available to commercial operators, yields slightly less forage than Coastal but considerably more than common (Rouquette, unpublished data). One main disadvantage of Coastcross-I is its lack of winter hardiness. This hybrid has a very limited rhizome system, and a high frequency of winter damage to the plants may occur. Survival is improved by avoiding fall applications of nitrogen and allowing an accumulated growth of approximately 6 inches by the time of first frost. Coastcross-I has had high survival rates with these procedures during 5 winters at The Texas Agricultural Experiment Station at Overton. There are other problems associated with stand maintenance of Coastcross I bermudagrass besides that of winter survival. Compared to either Coastal or common bermudagrass, Coastcross-I makes very slow recovery growth in the spring. Coupled with this slow recovery and the required fertilizer program for intensified pastures in East Texas, common bermudagrass may become an invader and, in essence, a weed. Hence, it appears that a pure stand of Coastcross-I may be difficult to maintain in this region.

The superiority of Coastal over other varieties and species (Table 9-7) is shown from estimates of dry matter production in pastures at Overton (Rouquette and Duble, unpublished data).

Table 9-7. Forage production from perennial grass pastures at Overton. 1972.

Grass[1]	Yield[2] (lbs dry matter/acre)
Coastal bermudagrass	25,590
Coastcross-I bermudagrass	18,175
Common weeping lovegrass	14,795
Common bermudagrass	11,395
Pensacola bahiagrass	10,460

[1]All pastures received yearly total of 200-100-100 ($N-P_2O_5-K_2O$) per acre.

[2]Dry matter yields are 3-year averages from all stocking rate pastures.

The differences between yield from clipped plots (Tables 9-4, 5, 6) versus intensively grazed plots (Table 9-7) are also important. Grazed pastures, due primarily to recycled plant food nutrients via animal excreta, utilize applied fertilizer more efficiently (Matocha et al. (1973) and Rouquette et al. (1973). These data suggest eliminating the use of meadows exclusively for hay.

Forage yields from Pensacola bahiagrass pastures have been lower than those of other grasses (Table 9-7). The low yield of bahiagrass is from lack of growth under drouth-like conditions of mid-summer. Bahiagrass does "green-up" earlier in the spring than Coastal, but this early growth does little more than add color to the topography. Forage production from Coastal rapidly exceeds that of bahiagrass in the spring and for the year.

Bunch-Type Grasses

These grasses grow as individual plants or in "bunches" and are usually void of stolons and rhizomes. Although bunchgrasses grow during the same period as sodgrasses, they need not be competitive for the same niche in an intensified pasture program. Seasonal dry matter yields from three bunchgrasses are shown in Tables 9-8, 9, 10.

Table 9-8. Seasonal distribution of dry matter production from buffelgrass selections at Overton. 1972.

	Lbs/acre oven-dry forage[1]			
Selection	May 29	July 24	Oct. 2	TOTAL
2-1	1,758	4,370	4,719	10,847
416	1,796	4,428	4,374	10,598
331	1,247	4,351	3,826	9,424
BxBW 12	1,687	3,503	3,786	8,976
18-35	1,239	4,031	3,574	8,844
BxBW 88	964	3,603	3,228	7,795
1-20	1,075	3,218	3,079	7,372
BxBW 101	938	2,808	3,284	7,030

[1]Seasonal fertilizer applied was 200-100-100 ($N-P_2O_5-K_2O$) per acre.

Table 9-9. Seasonal distribution of dry matter production from kleingrass selections at Overton. 1972.

	Lbs/acre oven-dry forage[1]			
Selection	May 29	July 25	Oct. 15	TOTAL
PMT 969	6,079	5,071	3,532	14,682
68-14	6,068	5,012	3,508	14,588
67-13	5,123	5,547	3,559	14,229
63-1	4,739	4,977	3,879	13,595
68-12	6,008	3,810	3,233	13,051
K-75	3,420	4,354	4,456	12,230
64-3	3,452	5,250	3,461	12,163
63-2	3,761	3,838	3,842	11,441
63-7	3,363	3,800	3,055	10,218
64-2	2,724	4,310	3,177	10,211
67-11	2,531	4,245	3,094	9,870
64-5	2,417	4,127	2,510	9,054

[1]Fertility rates for season were 200-100-100 ($N-P_2O_5-K_2O$) per acre.

Table 9-10. Seasonal distribution of dry matter yields from weeping lovegrass selections at Overton. 1972.

Selection	Lbs/acre oven-dry forage[1]						One Harvest[2]
	April 6	May 1	May 29	July 20	Nov. 15	TOTAL	Nov. 15
604	1,718	1,191	1,541	6,199	3,070	11,719	16,810
Common	924	941	1,586	4,782	4,131	12,364	14,150
603	1,562	1,241	1,460	5,088	4,276	13,627	11,379
Ermelo	1,406	1,065	1,865	5,233	3,500	13,069	15,448
718	1,105	1,020	1,494	3,984	4,518	12,121	11,350
Morpa	1,449	1,110	1,802	4,974	3,660	12,995	16,301

[1]Average of 3 replications. Fertilized with 200-100-100 ($N-P_2O_5-K_2O$) per acre.

[2]Only one harvest made for season.

Of the three species evaluated, buffelgrass produces the least amount of forage. Because of current problems associated with winter survival, the importance of buffelgrass in East Texas is minor. In order for this species to overwinter it must be allowed to set seed in the fall and remain in this stage of growth until the first killing frost has occurred. Hence, it would have to fit into the East Texas forage system as a standing-hay type crop for wintering cattle.

The potential of forage production from kleingrass (Table 9-9) is such that it needs further evaluation as a pasture plant for East Texas. Lack of success in the establishment of a pure stand has been a major disadvantage. Row plantings of a bunchgrass leave open areas for bermudagrass invasion. Thus, kleingrass and other bunchgrasses should be drilled or broadcast, and fertility rates should be minimum until the stand has been established. The earliness of spring growth, quality characteristics during the summer, and animal acceptability of winter-cured forage provides incentive for refinement of cultural practices for establishing and maintaining a kleingrass sward in East Texas.

Large acreages of common weeping lovegrass were planted in East Texas following the decline of row crops. This grass was planted with expectations that ranged from preventing massive soil erosion to becoming a "wonder-grass" for cattle. Continued misuse of lovegrass, primarily under-utilization during the spring, resulted in immediate

disappointment and eventual abandonment of many of these pastures. Lovegrass is one of the first warm-season perennial grasses to initiate spring growth. Pastures of this species are consistently available for grazing 30 days before the bermudagrasses. It also possesses the ability to make small, but significant, amounts of regrowth during warm, mild winters. Due to the earliness of growth, lovegrass forms a protective canopy over the exposed surface areas and thereby reduces the invasion of common bermudagrass.

Dry matter production under grazed conditions is shown in Table 9-7 and under clipped plots in Table 9-10. Spring growth is rapid, and high stocking rates at that season are necessary to prevent the grass from becoming rank and unpalatable. Under dry conditions, mid-summer regrowth is very slow. During the fall, rapid growth occurs once again and provides good fall and early winter pasturage for cows and calves.

Nutrient Production

Warm-season perennial grasses have the lowest nutritive value per unit dry matter of any class of forage. In general, these grasses are deficient in energy rather than in protein. Deficiencies or surpluses of nutrients depend, however, on the nutritive requirements of the associated class of animal.

Sod-Forming Grasses

Figure 9-1 shows in vitro digestible dry matter (IVDDM) from pastures of Coastal and common bermudagrasses and Pensacola bahiagrass (Duble, 1970). Throughout the season, there is very little difference between the quality characteristics of these three grasses. Both bahiagrass and common bermudagrass tend to be slightly more digestible than Coastal bermudagrass during the fall.

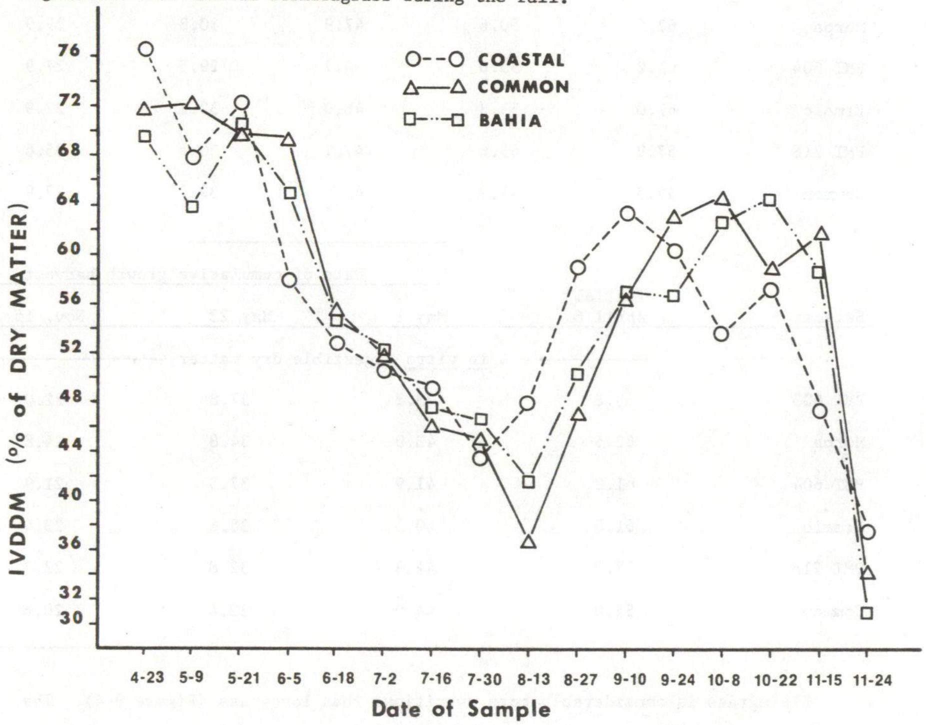

Figure 9-1. Influence of season on nutritive value of selected pasture grasses. Overton.

Coastcross-I bermudagrass is significantly more digestible than the other species evaluated (Figure 9-2). Regardless of the magnitude of quality components of the forage, the nutritive value of warm-season perennial grasses always declines rapidly to a minimum during mid- to late summer and then increases during the fall until frost occurs. Even though this mid-season decline is quite obvious with Coastcross-I, it does not reach as low a level as Coastal.

Bunch-Type Grasses

One of the most widely planted bunchgrasses in the East Texas region, common weeping lovegrass, is one of the lowest quality grasses. The rapidity and duration of quality-decline of lovegrass, although it varies from year to year, is consistently greater than that of grasses such as Coastal (Figure 9-2).

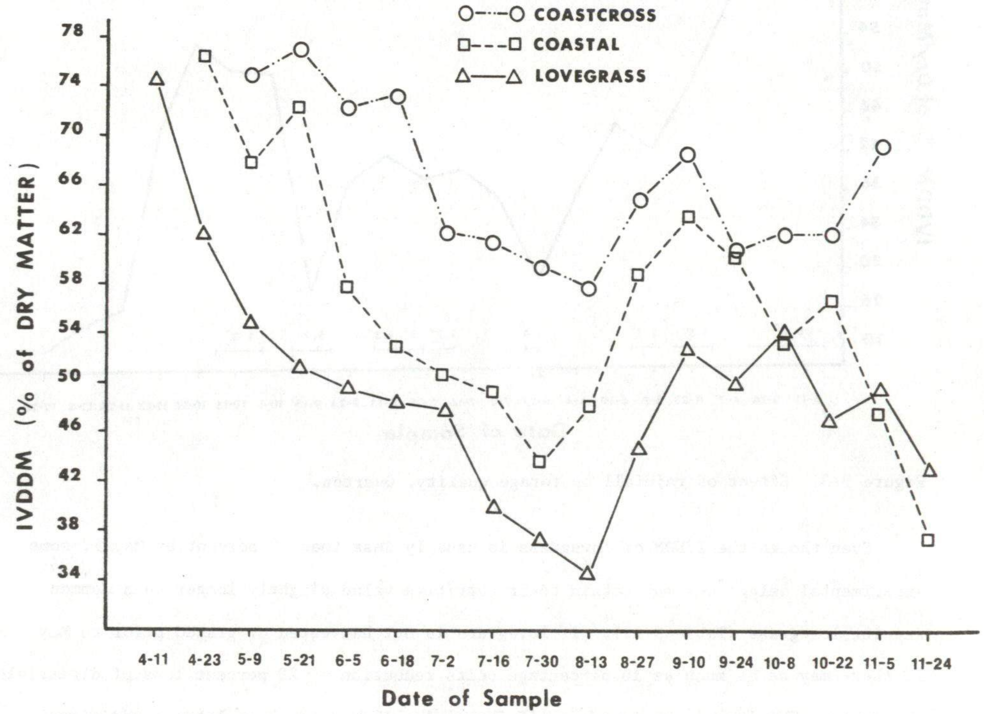

Figure 9-2. Nutritive status of three grasses throughout the growing season. Overton.

One factor affecting quality-decline in all warm-season perennial grasses, but especially lovegrass, is the length of time between rainfall (Figure 9-3). During 1971, frequent rains and cloudy conditions from June 20 to August 14 caused slight increases in digestibility.

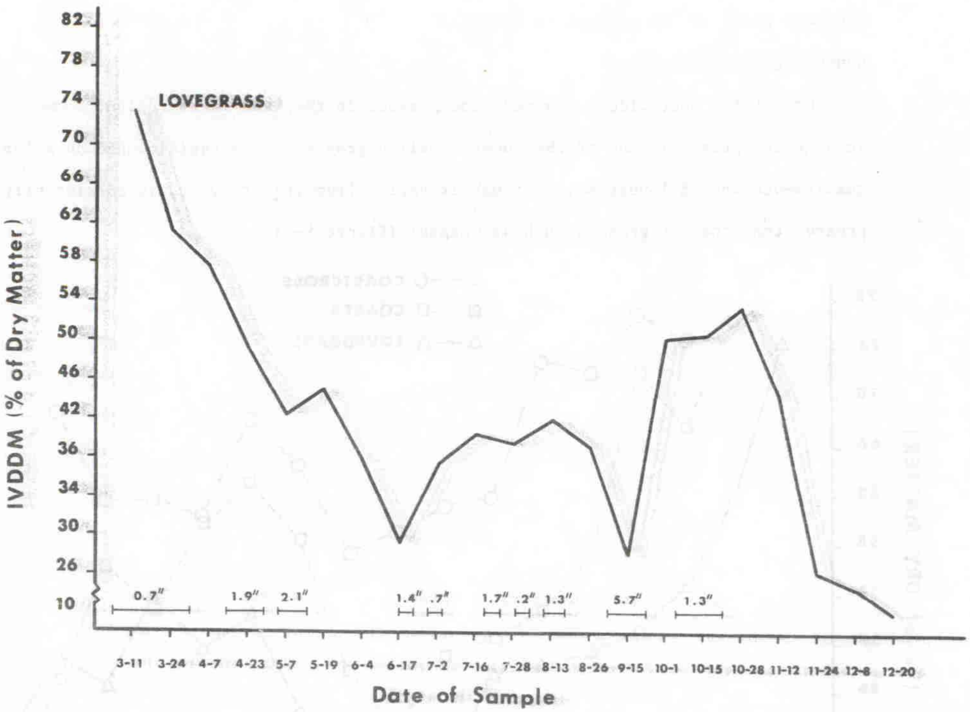

Figure 9-3. Effect of rainfall on forage quality. Overton.

Even though the IVDDM of lovegrass is usually less than 50 percent by May 1, some experimental selections may retain their nutritive value slightly longer than common weeping lovegrass (Table 9-11). If lovegrass is not harvested or grazed prior to May 1, there may be as much as 10 percentage units reduction or 20 percent loss of digestible nutrients. The loss is even greater if forage is allowed to accumulate an additional three weeks (May 23). Accumulated forage differs little in quality among selections by mid-summer (July 20). Hence, economic factors, primarily cost of establishment (seed cost), must be of primary concern in selecting other available lovegrasses in preference to common.

Table 9-11. Nutritive values of regrowth and cumulative growth from various weeping lovegrass selections. Overton. 1972.

Lovegrass selection	Initial April 6	Date of regrowth harvest May 1	May 23	July 20	Nov. 15
	% in vitro digestible dry matter				
PMT 603	63.8	53.3	47.7	32.1	30.0
Morpa	62.5	50.6	47.9	30.8	29.9
PMT 604	61.2	53.6	44.7	29.5	27.9
Ermelo	61.0	53.3	48.0	32.1	27.9
PMT 718	57.9	45.6	47.1	30.4	35.6
Common	55.0	47.9	41.8	32.7	27.9

Selection	Initial April 6	Date of cumulative growth harvest May 1	May 23	Nov. 15
	% *in vitro* digestible dry matter			
PMT 603	63.8	43.2	37.8	22.0
Morpa	62.5	43.0	34.8	24.8
PMT 604	61.2	41.9	37.5	21.9
Ermelo	61.0	40.5	35.8	23.4
PMT 718	57.9	44.3	32.8	22.7
Common	55.0	44.0	32.4	20.6

Kleingrass is considerably more nutritious than lovegrass (Figure 9-4). The quality characteristics of this grass provide it with the potential to replace lovegrass as the predominant bunchgrass for improved pastures in East Texas. However, the problems previously mentioned regarding stand establishment and maintenance have discouraged its widespread acceptance.

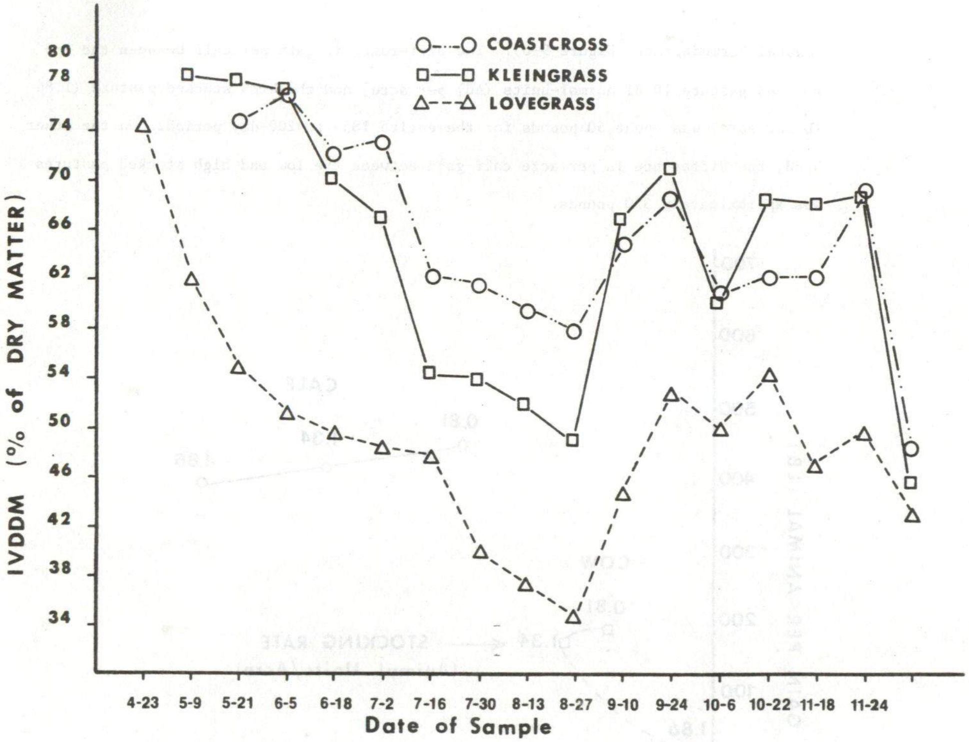

Figure 9-4. Effect of season and species on forage quality. Overton.

Animal Performance

Due to the low nutritive value of the warm-season perennial grasses, individual animal performance of any class of livestock is less from this type of grazed forage than from any other forage. However, the dry matter production potential of these species provides for very high animal production per land area (per acre). This high per acre production cannot be achieved with all classes of livestock, but some classes perform very satisfactorily on a diet of summer grasses.

Various warm-season perennial grasses have been evaluated for forage quality and quantity potentials under various levels of grazing pressures (stocking rates)at

Overton. All pastures received identical fertilization rates of 200-100-100 per acre of N-P_2O_5-K_2O, respectively. During the first year of the grazing trial, 1969, yearling F-1 (Hereford x Brahman) heifers were used to measure animal performance. During subsequent years, F-1 cows and their calves were used as test animals. The heifers, wintered to gain approximately 0.5 pound per day during 1968-69, weighed 585 pounds at the initiation of spring grazing. Coastal bermudagrass pastures produced the greatest liveweight gain per acre (Table 9-12). Even though compensatory gain was a factor involved in individual animal performance and subsequent per acre production, the season-long production from these pastures was impressive for this class of cattle.

Table 9-12. Performance of yearling F-1 (Hereford x Brahman) heifers grazing warm-season grasses. Overton, 1969.[1]

Forage	Stocking rate (animals/acre)	Average daily gain (lbs)	Gain/ animal (lbs)	Gain/ acre (lbs)	No. days on pasture[2]
Coastal bermudagrass	1.2	1.7	334	401	196
	2.0	1.7	275	550	161
Common bermudagrass	1.0	1.4	272	272	195
	1.6	1.6	226	361	141
Pensacola bahiagrass	0.8	1.5	300	240	195
	1.4	1.6	236	330	146
Weeping lovegrass	1.2	1.2	253	303	210
	2.0	1.4	178	356	127

[1]Duble et al. 1970.

[2]Due to dry conditions during the summer months, cattle were completely removed from the heavy stocked pastures.

Results of a two-year study using cows and calves are shown in Table 9-13. Coastal bermudagrass (Figure 9-5) produced sufficient forage to carry nearly two animal units per acre during the growing season. And, at this stocking rate, average daily gain of calves was reduced by only 0.2 pound per day compared to those animals stocked at only one per acre. The importance of the relationship between per animal gain and per acre gain is shown by the single season animal performance data from

Table 9-13. Animal performance from warm-season perennial pastures. Overton, 1972.[1]

Forage	Stocking rate (AU/Ac)[2]	Average daily gain/calf (lbs)	Gain/ calf (lbs)	Calf Gain/ acre (lbs)	No. days on pasture[3]
Coastal bermudagrass	0.96	2.19	427	410	
	1.42	2.12	413	587	195
	1.90	2.00	380	722	
Common bermudagrass	0.71	2.00	390	277	
	1.14	1.95	380	433	195
	1.35	1.92	374	505	
Pensacola bahiagrass	0.68	2.15	419	285	
	1.05	1.92	374	393	195
Common weeping lovegrass	1.19	1.95	201	239	
	1.51	1.95	201	304	103

[1]2-year average.

[2]one animal-unit (AU) equals one cow and calf.

[3]all pastures receive annual rates of 200-100-100 (N-P_2O_5-K_2O).

Figure 9-5. Coastal bermudagrass moderately stocked with cows and calves at Overton.

Coastal bermudagrass (Figure 9-6). The difference in gain per calf between the low stocked pasture [0.81 animal-units (AU) per acre] and the high stocked pasture (1.86 AU per acre) was about 50 pounds for the entire 185- to 200-day period. On the other hand, the difference in per acre calf gain between the low and high stocked pastures was approximately 350 pounds.

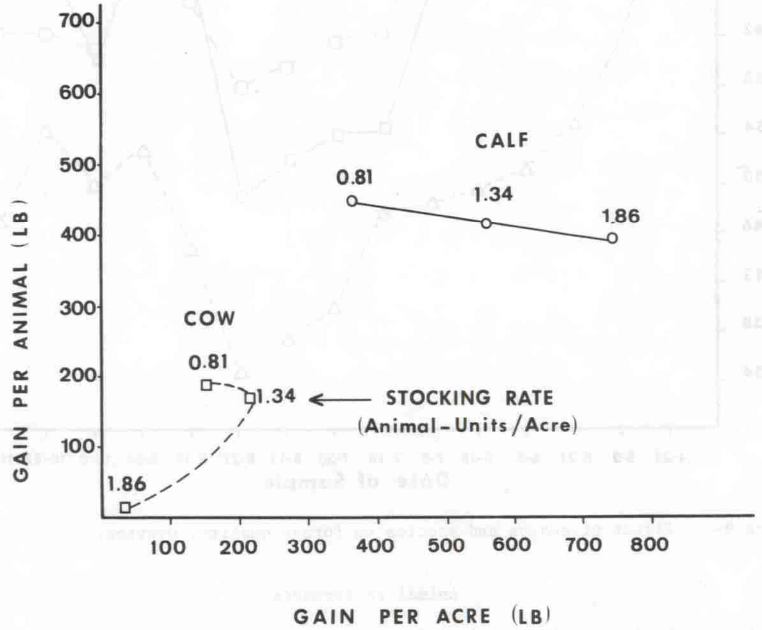

Figure 9-6. Influence of stocking rate on liveweight gains per animal and per acre. Overton.

There are numerous factors to consider in selecting the proper, economic stocking rate for cows and calves. As pointed out by Hildreth and Riewe (1963), the economic optimum stocking rate for young, growing stocker animals is slightly lower than that which produces maximum gain per acre. The same principle holds true for cows and calves. The liveweight production of calves was maximum on the pasture stocked at 1.86 AU per acre. Cow performance, at this same stocking rate, barely exceeded body weight maintenance levels. In this specific illustration in which the cows were retained in the breeding herd and calves were either sold or moved to the next phase of the operator's livestock enterprise, the high-stocked pastures were the most profitable. The difference in average daily gain of cows and calves (Figure 9-7) is due primarily to milk. The supply of milk acts as a "buffer" or "masking effect" for those calves on the high-stocked pastures.

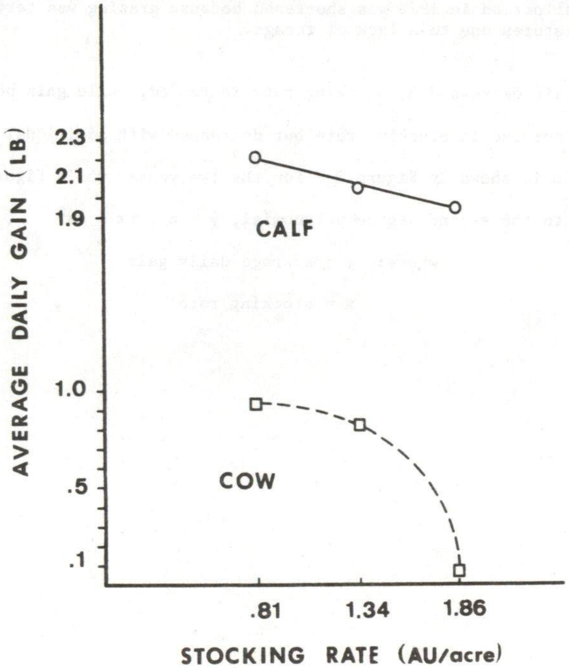

Figure 9-7. Effect of forage availability on cow-calf performance. Overton.

Some of the major factors which must be considered in selecting the proper stocking rate are (1) forage supply for remainder of year (cattle must be stocked at a rate to allow for 12-month feed; this feed source may include standing forage, hay, or

oversown winter pasture); (2) rebreeding performance of cow (adequate quality and quantity of forage are necessary for rebreeding; once cows are bred and safe with calf they may be exposed to more severe stress conditions such as the high-stocked pastures on which cow weight gain is nearly impossible) and, (3) subsequent ownership status of the cow and/or calf (maximum cow weight gain may be a major factor to consider with cattle that are being grazed for immediate resale purposes).

Other factors are involved in matching forage production with animal numbers, but for the most part, the major factor is that of efficiently utilizing forage as it is produced. The bermudagrasses may be grazed for only about 200 days in the East Texas region. During this growing season, there may be sporadic fluctuations in daily or monthly dry matter production. Hence, for a given or set stocking rate, the cattle numbers may match the forage production for only a very short time during the summer months. It becomes readily evident that the most efficient utilization of a warm-season perennial pasture may be achieved with a "fluctuating" or "floating" stocking rate. This does not imply that cattle be bought and sold to achieve this goal, but rather that cattle be congregated or confined during certain periods of "flush" growth. As the increase in forage production allows more cattle to graze a given area, the pasture(s) not being grazed may be harvested as hay. This method of grazing management allows for maximum utilization of the land area since there are no designated "hay meadows" which are never grazed (See Chapter 7, Conserving Hays-from Production to Consumption).

WARM-SEASON ANNUAL FORAGES

Forage-beef production systems must strive to match the nutritive requirements of cattle with the nutrients available from forages. Since the cost of harvesting, storing and feeding is high in relation to the cost of grazing, it becomes necessary to match nutrient needs and nutrient production under grazing systems.

Nutrient requirements of the cow are minimal during the period between the time her calf is weaned and about 30 days prior to her next parturition. It seems logical to cause that period to occur when forage quantity and quality are minimal. In the

East Texas area this can be accomplished by weaning the calf approximately July 1, with the parturition occurring in October. This system utilizes winter pastures which can result in substantially increased weaning weights.

The warm season perennial grasses cannot be expected to provide high quality forage during the months of July, August, and September, which is the first postweaning period for calves weaned July 1. The temporary summer annuals offer a source of pasture for weaned calves which is reasonably high in digestible nutrients.

Clipping studies have generally shown only moderate differences in dry matter production or quality characteristics of millet and sorghum x sudangrass hybrids (Burger and Hittle, 1967; Clapp and Chamblee, 1970).

Millet and certain sorghum x sudangrass hybrids are similar in digestibility (Ademosum, Baumgardt, and Scholl, 1968; Hoveland and Anthony, 1967), but millet is more affected by extreme defoliation than sorghum (Clapp and Chamblee, 1970). In both grazing and plot studies in Florida (Dunavin, 1970) and in plot studies in West Louisiana (Carpenter, 1970), millet was more productive than sorghum x sudangrass hybrids. Either crop is satisfactory for dairy cattle; however, cows grazing millet produce milk with a lower butterfat content (Clark, Hemken, Vandersall, 1965).

Pearl millet has been evaluated in recent studies at Overton as a pasture crop which could potentially provide grazing from June 1 through mid-September, thus filling part of the gap between calf weaning in mid-summer and winter grazing.

A hybrid pearl millet (<u>Pennisetum tryphoides</u>), NK Millet 23, seeded approximately June 1 each year at the rate of 8 pounds per acre on Athens fine sandy loam soil, was grazed in 1971 and 1972. The grass was fertilized with 100 pounds per acre each of N, P_2O_5 and K_2O immediately after seeding. Pastures were mowed to a height of approximately 8 inches in early August and fertilized with 60 pounds of N per acre. The plantings were divided into three pastures for grazing with crossbred steers and heifers at the stocking rates shown in Table 9-14.

Hybrid pearl millet has a high carrying capacity and is capable of producing in excess of 400 pounds of liveweight gain per acre (Table 9-14). Stocking rate has a profound effect on both rate of gain (average daily gain) and gain per acre. In this

Table 9-14. Effect of stocking rate on per acre and per animal gain on pearl millet - Overton, 1971 and 1972.

Grazing pressure	High		Medium		Low	
Year	1971	1972	1971	1972	1971	1972
Stocking rate (animals/acre)	4.31	4.77	3.75	2.83	2.89	1.46
Average daily gain, lb.	.79	.63	1.55	1.86	2.00	2.17
Gain per acre, lb.	249	168	424	295	422	177
Days in trial[1]	73	56	73	56	73	56

[1]The experimental period in 1972 was shortened because grazing was terminated on the high stocked pastures due to a lack of forage.

study, rate of gain decreased as stocking rate increased, while gain per acre increased with the first increase in stocking rate but decreased with additional grazing pressure. This relationship is shown in Figure 9-8 for the two years, while Figure 9-9 presents the data fitted to the second degree polynomial, $y = a + bx + cx^2$

where: y = average daily gain

x = stocking rate

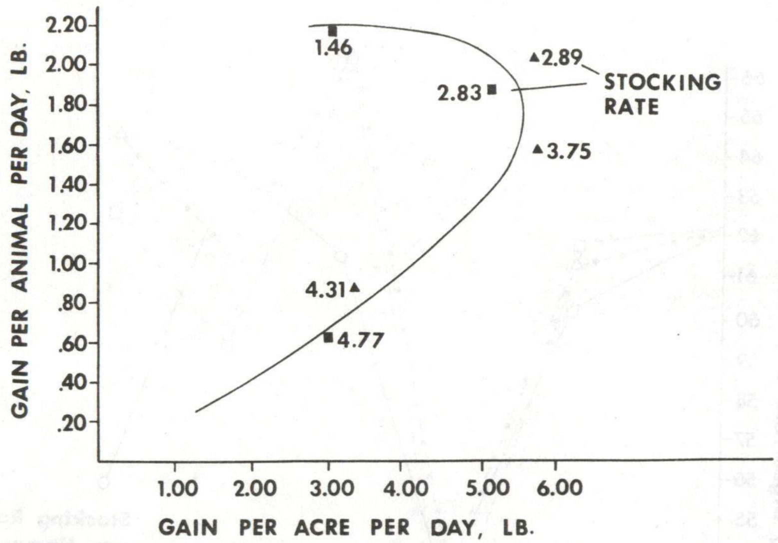

Figure 9-8. Effect of stocking rate on gain per animal and gain per acre of beef steers grazing pearl millet 1971-72.

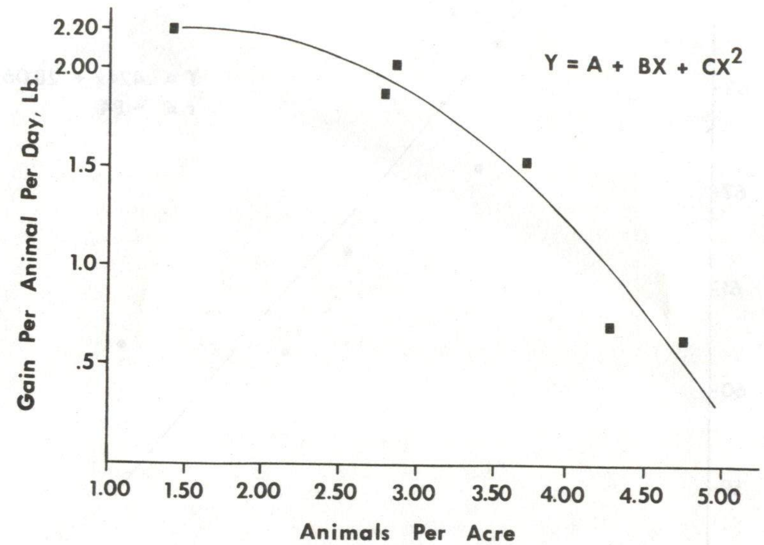

Figure 9-9. Effect of stocking rate on average daily gain of beef cattle grazing pearl millet pasture - 1972.

Results with pearl millet are in agreement with those of Riewe (1969) who reported that the regression of available forage on average daily gain best fit a polynomial. While reduced forage availability with increased stocking rate is the primary cause of lowered animal response, forage quality is also a factor affecting animal performance.

Rate of animal gain on pearl millet is closely related to forage quality as measured by neutral detergent fiber (NDF) content, when forage availability is not limiting (Figure 9-10). Thus, NDF values may provide a basis for predicting the animal performance potential of pearl millet. Digestibility in vitro (Figure 9-11) declined rapidly during the first month of grazing. This decline corresponds to a decline in the leaf:stem ratio of whole plants (Table 9-15). After one month of grazing, all treatments were shredded to 8 to 10 inches. The effect of removing coarse, stemmy material is seen in the change in in vitro digestibility which occurred between July 30 and August 18 (Figure 11). An increase in leaf:stem ratio occurred during this time, but never approached the initial values. Light and medium stocking rates have no

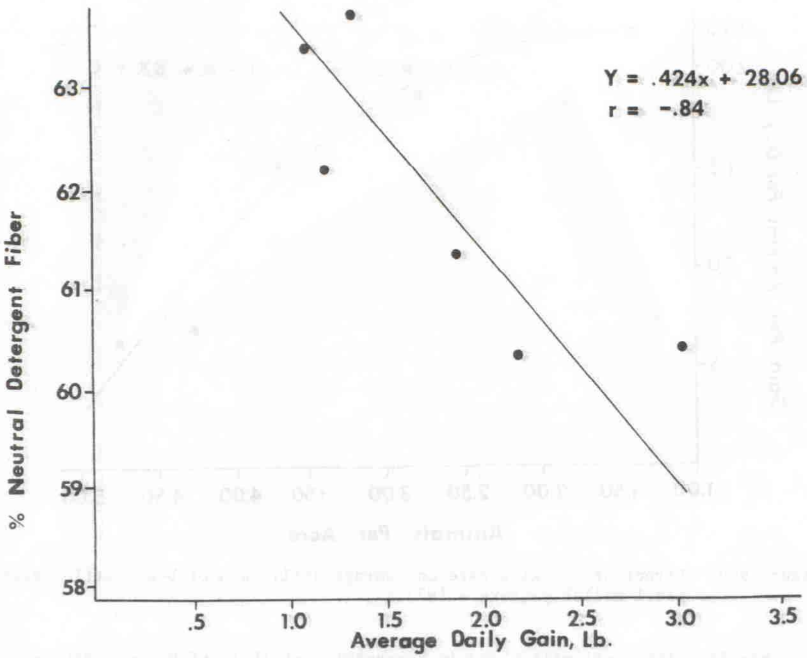

Figure 9-10. Relationship between animal performance and forage quality as measured by neutral detergent fiber

Table 9-15. Effect of stocking rate on leaf:stem ratio of pearl millet - Overton, 1971.

Date	Stocking Rate High	Med.	Low
	Leaf:Stem ratio		
July 2	2.08	2.08	2.08
July 15	1.11	1.01	.97
July 30	.19	.18	.20
August 18[1]	.77	.82	.89
September 3	.60	.96	.67
September 14	.28	.58	.47

[1]Pastures shredded on 8-2-71

apparent effect on digestibility (Figure 9-11), but heavy grazing may reduce digestibility, particularly in the later part of the season.

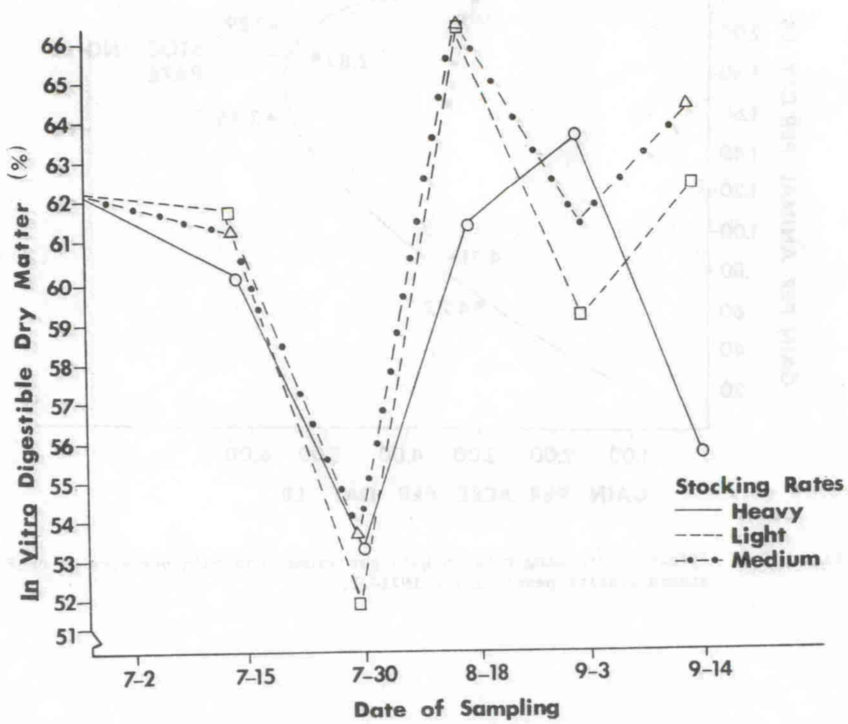

Figure 9-11. Influence of season and stocking rate on in vitro digestibility of pearl millet grazed by beef cattle.

A low stocking rate may reduce both forage production and utilization. In Trial 1, the low stocking rate produced two-thirds as much forage as the medium stocked pasture but only one-half was utilized (Table 9-16).

Table 9-16. Effect of stocking rate on production and utilization of pearl millet - Overton, 1972.

Stocking rate	Total seasonal forage production (lb.)	Forage remaining 9/14 (lb.)	Percent Disappearance[1]
High	10,682	855	92
Medium	10,676	1,797	83
Low	7,068	3,459	51

[1]Includes consumption and waste

Based on the millet grazing studies, the following conclusions are applicable:

1) Pearl millet can be productive in East Texas assuming adequate soil fertility and moisture.

2) Increases in stocking rate increase forage utilization.

3) High stocking rates reduce daily gains. The optimum average stocking rate under the conditions of these studies was 2.8 animals per acre. Heavier stocking rates were required early in the grazing period and lighter stocking rates in the later part.

4) Stocking rate has a limited effect on forage quality; however, high stocking rates tend to lower forage quality and result in poor animal performance.

5) Quality declines rapidly under continuous grazing. Mowing or shredding coarse stemmy material will improve the quality of subsequently available forage.

6) Maximizing either rate of gain or forage utilization will generally be uneconomical. Therefore, the stocking rate selected will be a compromise based on the relative importance attached to these two factors. Animal performance could be more important when grazing millet with replacement females or steers. Mature cows nursing calves could utilize 80 to 90 percent of the forage without reducing calf performance.

In the East Texas region, pearl millet may fit into a forage-livestock system only under special conditions. Some of the problems associated with millet are (1) relatively short grazing period (90 to 120 days); (2) cost of establishment (equivalent to winter pasture); and (3) productive nature of plant. Millet may produce 50 to 75

percent of its seasonal dry matter in a 45- to 60-day period. This rapid growth period induces problems of grazing management (proper stocking rate). Therefore, unless "other" cattle are available for short term grazing, the most efficient utilization of millet involves mechanical harvesting (green chop, silage, hay, etc.).

COOL-SEASON PERENNIAL FORAGES

Those species which fit into this class of forage provide grazing from fall until early summer without being reseeded each year. These plants are dormant during the summer months, and fall regrowth arises from the established root system. The major problem associated with these types of plants in East Texas is that of summer survival. Erratic frequency and distribution of rainfall result in deficiencies or surpluses of growth-promoting moisture. Both of these moisture conditions may prove unfavorable to the summer dormancy of cool-season perennial forages.

Tall fescue, primarily Kentucky 31, is the most widely used cool-season perennial grass in East Texas. In general, this grass is planted in bottomland areas which may be subject to overflow during certain periods of the year. Producer success with and acceptability of tall fescue have been erratic. When grown in a pure stand, forage quality and subsequent animal performance from fescue are less than desirable. However, when a legume such as white clover is included in the pasture mixture, both nutritive value and animal performance are greatly improved. Tall fescue-white clover pastures can provide actively growing forage during the time when conserved forage normally is being fed. A system which furnishes almost year-long grazing may be attained with the inclusion of this type of winter pasture.

TAM Wintergreen hardinggrass is a highly nutritious winter perennial grass which has had poor survival in the Pineywoods region. Primarily due to lack of summer dormancy, this species is poorly adapted to this humid part of Texas. In addition to poor summer survival, fertilizer rates necessary for plant establishment encourage the growth of common bermudagrass which competes for both above- and below-ground space. During the past few years, hardinggrass pastures have been most successful in the Blackland area of Texas (See Chapter 10, Forage and Animal Production Programs for Central Texas). At present, TAM Wintergreen hardinggrass is not recommended for use in the East Texas area.

COOL-SEASON ANNUAL FORAGES

Both legumes and ryegrass have been important to beef cattle production in East Texas for many years. Their productivity has generally been limited by inadequate fertilizer use and by the low levels of utilization necessary to permit reseeding. The need for increased production of high quality winter forage for growing replacement females and feeder cattle has stimulated research on production and utilization of small grains in addition to legumes and ryegrass.

The greatest potential for the cool-season annual forages lies in their production on existing warm-season perennial grasses. Little of East Texas is suitable for clean tillage because of erosion hazards. Also much of the open usable land is already in a bermudagrass or other warm-season perennials. Overseeding these perennials with cool-season annuals can increase total forage production per unit area and can extend grazing by 150 to 180 days per year.

Legume-Ryegrass

Ryegrass is usually included in plantings with legumes primarily because of possible occurrence of bloat from use of pure stands of legumes. Both of these types of forages have been used in this area as reseeding annuals. With the exception of some white clover varieties, none of the legumes or ryegrasses act as perennials in East Texas. In earlier years, the legumes were kept in the pastures with the addition of little or no nitrogen and only small amounts of P_2O_5 and K_2O. Once, however, the use of nitrogen fertilizer on warm-season grasses was incorporated into the forage system, the sod-forming grasses (bermudagrasses) became more dense, both in terms of above-ground and below-ground plant parts. With increased rates of nitrogen, intensified forage production, and increased stocking rates, the micro-environment of the sod was altered. As a consequence, stands of legumes which once were a regular, dependable part of the forage program began to diminish and disappear from the pasture. Today, legumes are most difficult to retain for more than a few years in a highly fertilized

bermudagrass sod. The competitive nature of bermudagrass plays a significant role in the unreliability of legumes under these conditions in East Texas. This competition can be reduced to some extent by appropriate fall management.

Dry Matter Production

Legumes - Small plot studies in the early fifties showed that the seasonal production of the reseeding crimson clovers amounted to slightly more than two tons of air-dry forage (Table 9-17). As pointed out by Holt et al. (1958), the crimson clovers are

Table 9-17. Forage production of legume varieties. Kirbyville.[1]

	Lb. air-dry forage/acre			
VARIETY	1951	1952	1956	Average
Crimson clover				
Auburn	3,360	4,580	4,650	4,200
Autauga	2,740	4,560	5,020	4,110
Dixie	3,360	4,750	4,250	4,120
Chief	3,300	4,750	4,930	4,325
Talladega	3,390	5,470	4,840	4,570
Common	2,780	4,940	4,720	4,150
White clover				
Ladino	880	3,400	1,760	2,015
Louisiana S-1	1,300	3,640	2,220	2,390
Louisiana	1,460	2,540	2,190	2,065
New Zealand	350	1,150	1,640	1,050
Subterranean clover				
Tallarook	2,440	4,530	4,280	3,750
Bacchus Marsh	2,350	3,630	4,080	3,355
Mount Barker	2,140	3,220	3,640	3,000
Nangeela	2,400	3,450	3,960	3,270

[1]Holt et al. 1958

ideally suited for pastures in this region of the State because of the high percentage of "hard seed" among certain selections. Hard seeds are able to over-summer in the soil without germination because the seed coats are impervious to water for a considerable time. Moisture, together with temperature, causes crimson clovers to germinate and "volunteer" following a year in which the legume has been allowed to set seed.

Selected legumes were overseeded alone or in combination with ryegrass on a Coastal bermudagrass sod at Overton (Table 9-18). Tibbee crimson and Meechi arrowleaf clovers produced nearly as much forage as ryegrass alone. Except for these two high producing legumes, the addition of ryegrass proved to be beneficial to seasonal production. For certain legumes, there was better distribution of forage production with addition of ryegrass to the sward. The arrowleaf clovers are two to six weeks later maturing than the crimson clovers. This extended growing period allows the arrowleaf clovers an opportunity to make a significant contribution to the forage program of East Texas.

Table 9-18. Dry matter production from legumes overseeded alone and with ryegrass on a Coastal bermudagrass sod. Overton. 1973.

	Dry forage/acre, lb.	
Legume	Legume alone	Legume plus ryegrass
Crimson clovers		
Dixie	3,710	4,595
Tibbee	4,730	4,575
Arrowleaf clovers		
Yuchi	3,530	3,690
Meechi	4,565	4,230
White clovers		
Louisiana S-1	2,575	3,210
Abon	3,115	3,375
Subterranean clovers		
Mount Barker	2,755	3,225
Nangeela	2,595	3,450
Woogenellup	2,875	3,375
Ryegrass alone		4,860

For successful establishment either by seeding or volunteering, the pasture should be either grazed short or harvested for hay in September. This allows the new seed to come in contact with the soil or provides a better environment for germination of the preceding year's seed crop. It is most important that the seed do not germinate in a heavy thatch. Seeds which germinate in this layer of dead grass have a high mortality rate in the event of extreme dry or cold conditions.

Successful stands of legume or legume-ryegrass mixture are obtained with very light disking of the sod at the time of seeding (usually late-September to mid-October). In addition, the use of a pasture drag, such as the Australian or English harrow, is an excellent method of covering the seed. The entire operation of disking, planting, and dragging may be accomplished in a "once-over" operation. A fertilizer low or void in nitrogen used at planting will discourage bermudagrass production. Nitrogen applied sometime during mid- to late-November will provide sufficient forage for grazing by mid-December to mid-January. Without applied nitrogen, these winter crops may not be available for grazing until March. Legumes can use nitrogen fertilizer although, if properly inoculated, they are able to utilize atmospheric nitrogen.

Ryegrass - Ryegrasses are the nucleus of any winter pasture program in East Texas. In terms of forage regrowth ability, ryegrass is one of the most vigorous cool season forages available. High yields with early production are possible with adapted varieties (Table 9-19). Ryegrasses which can produce enough forage for grazing by mid-December are extremely valuable as a pasture crop in East Texas. This early forage production can eliminate the need of small grain for fall grazing for some livestock programs.

Nutrient Production

The legume-ryegrass mixture provides one of the most nutritious diets available to the grazing ruminant (Figure 9-12). The quality contribution alone of the legume makes it worthy of consideration in a pasture program. The contribution of nitrogen to the soil by the legume is not the major criterion in evaluating its contribution. The growing season of the legume-ryegrass mixture overlaps that of the bermudagrass (Figure 9-12). Once the winter crop disappears from the pasture, the nutritive value of available forage rapidly declines. The rapidity of quality decline in June-July is partly a function of drouth which results in little new growth. By knowing the relative quality deterioration that will occur at this time of the year, one can make certain management decisions, such as calving dates and rebreeding periods or weaning dates, to match the animal's nutritive requirement with nutrient availability (See

Chapter 2, The Nutritional Value of Forages).

Table 9-19. Ryegrass variety evaluation. Overton.[1]

Variety	Lb. dry forage/acre 1966-67	1967-68	1968-1969 Dec. 10	Apr. 9	Total
C. S. 171-1		6,930	920	5,214	6,134
Gulf	4,342	7,490	1,126	5,317	6,443
Florida RR	4,538		907	5,949	6,856
C. S. 137-5	4,135	6,190	741	6,131	6,872
C. S. 14-16	3,494	6,600	552	5,597	6,149
Magnolia	3,120	6,830	1,342	5,778	7,120
Michigan	3,376	4,840	839	3,834	4,673
Astor		4,360	623	3,603	4,226
Michigan 4N	2,665	2,700	751	3,698	4,449
N6-125			1,293	5,802	7,095
N7-147			1,125	5,810	6,935
Tetrablend 333-69			1,200	5,572	6,772
N6-126			972	5,558	6,530
N6-127			1,490	4,919	6,409
Tetrablend 333			1,141	4,870	6,011
Commercial Domestic			1,037	4,238	5,275

[1]Lancaster and Holt. 1966-1969.

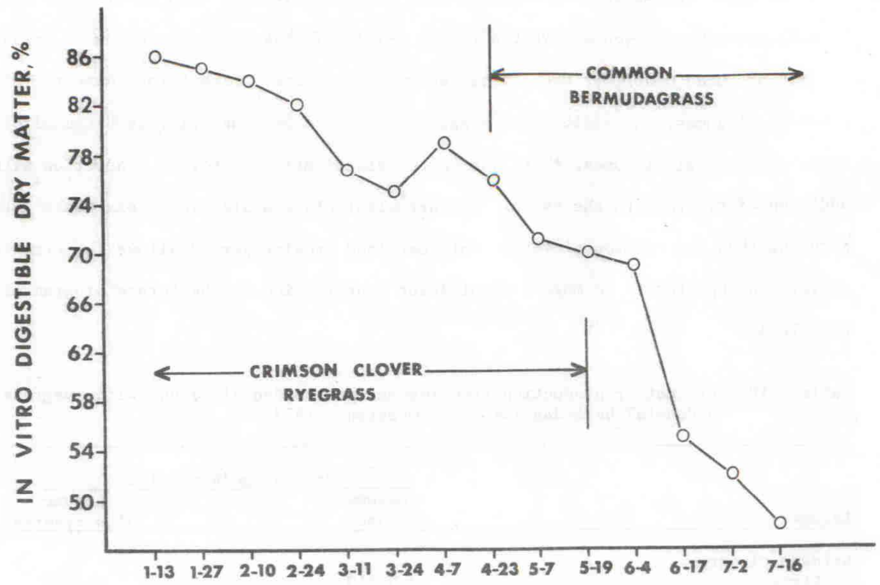

Figure 9-12. Transition of forage quality as affected by species and season. Overton.

Animal Performance

As a direct result of the nutritive value of legume-ryegrass pastures, individual animal performance (measured in terms of suckling calf gains) is at a maximum from this forage combination (Table 9-20). Carrying capacities from these pastures, however, are not as great as those of the pure stands of warm-season perennial pastures (Table 9-12, 13). This system requires fall-born calves weaned in late June to early July. This period of lactation and calf growth makes full utilization of maximum quality forages that can be produced for the year. Therefore, if the objective of the pasture program is that of maximum individual calf performance (weaning weight), then the legume-ryegrass fits part of the needs of this forage-animal program.

Legume-ryegrass pastures that are allowed to set seed for the subsequent year's volunteer crop must be very lightly stocked or completely non-grazed beginning April 1 to April 15 (depending upon climatic conditions). And, the pasture cannot be grazed

Table 9-20. Animal performance from crimson clover-ryegrass overseeded on a common bermudagrass sod. Overton. 1971-1972.

	Stocking rate (AU/acre)[1]	Period of grazing	Calf ADG[2] (lb.)	Gain/ animal (lb.)	Gain/ acre (lb.)
	0.38	Jan 20	2.49	401	152
1971	0.63	to	2.52	406	256
	0.87	June 30	2.60	419	364
	0.47	Dec 17	2.37	372	173
1972	0.77	to	2.46	386	298
	1.07	June 29	2.23	350	375

[1]Animal units (cow + calf)

[2]Average daily gain

until after the seed mature and the standing crop is removed, which usually occurs from May 15 to June 15. Thus, under this management scheme, approximately six to eight weeks of grazing time is lost from these pastures. However, it is during this period when the fall-born calf has the highest average daily gains (ADG). Calf performance for this 60- to 75-day period has been consistently 2.75 to 3.00 pounds per day which approaches 100 pounds per month or 200 pounds for the period. This added weight may be worth $50 to $100 for this size calf (600-700 pounds). Hence, it becomes most important that some of this forage be grazed rather than allowed to set seed. The legume-ryegrass may be established each year for a cost far below the returns obtained by grazing. This does not imply that every acre of legume-ryegrass on a particular farm be "grazed-out." But, with the excellent growing conditions of the spring, cattle may be confined to smaller areas, thus allowing a portion for both grazing and reseeding. This method of forage utilization would provide high quality grazing, high quality hay, seed for a volunteer crop, and the need to re-establish only part of the pasture system each year.

Cereals and Ryegrass

The cereals have been used for many years as forage crops; however, they have been planted primarily as grain producing crops and their forage production considered a by-product. Only recently has research been focused in the United States on the use of cereals solely as a forage crop.

The reasons for producing winter pastures depend on the individual farmer's need for forage during the period when warm season perennial grasses are dormant.

The characteristics of a desirable winter pasture are as follows:

1) It should provide forage during the period when warm-season grasses are dormant. In East Texas this period includes the months of November through May.
2) Forage production should be relatively uniform throughout the season.
3) Forage production should be sufficiently reliable to plan a livestock-forage system which will be successful at least three out of every four years.
4) It should be sufficiently aggressive to compete with warm-season perennial grasses into which it may be seeded in the fall.
5) Cost per pound of nutrients produced should be competitive with alternative nutrient sources during that period.
6) Quality must be sufficient to meet the nutrient requirements of the class of animals for which it is intended.
7) It must be able to do all the above under a grazing system.

Some of the presently available species or mixtures of species meet only part of these requirements. Morrison and Gill (1969) report that yearling steers grazing a combination of wheat-ryegrass produced 37 pounds more liveweight gain than steers grazing ryegrass only. Recent trials by Anthony et al. (1972) have demonstrated the value of a rye-ryegrass-yuchi clover mixture as a forage crop for production of slaughter steers. Steers receiving only this pasture forage gained 380 pounds each during a 209-day grazing period and produced carcasses which graded USDA good or better.

Available soil moisture is a factor which affects the success of fall-sown winter pastures. Wheeler and Campbell (1969) have indicated that a precipitation/evaporation ratio ($P/E^{.75}$) of 1.2 may be necessary for one month following germination of seedlings to become established in an actively growing sod. They also indicate that considerably lower ratios may be adequate if the sod is dormant. The $P/E^{.75}$ may be below 1.2 during the months in which cereals are seeded in East Texas in at least 50 percent of the years (Table 9-21). During the years covered in Table 9-21, September rainfall was above average, resulting in improbably high $P/E^{.75}$ values. If the precipitation/evaporation value suggested by Wheeler and Campbell (1969) is accepted, then the farmer must try to reduce transpirational losses by the existing sod. This may be done by herbicidal treatment of the sod to reduce growth.

Table 9-21. Precipitation/evaporation ($P/E^{.75}$) ratios for fall months at Overton during the past six years.

Year	September Rainfall (inch)	September $P/E^{.75}$	October Rainfall (inch)	October $P/E^{.75}$	November Rainfall (inch)	November $P/E^{.75}$
1967	3.70	.85	1.27	.34	2.40	.93
1968	8.01	1.85	2.06	.56	6.74	2.62
1969	4.07	.94	4.92	1.33	4.95	1.92
1970	5.64	1.30	10.85	2.94	1.15	.45
1971	5.09	1.17	1.40	.38	2.81	1.09
1972	4.99	1.15	5.75	1.56	4.40	1.71

The information which follows on cereal-ryegrass pastures is based on studies at the Texas A&M University Agricultural Research and Extension Center at Overton.

On approximately September 20 in each of three years, a mixture of small grain and annual ryegrass was planted in either a common bermudagrass sod or on a well-prepared seedbed. Pastures were fertilized at planting with 100 pounds each of N, P_2O_5, and K_2O per acre. Additional N was applied in three split applications to supply a total of 200 to 240 pounds of supplemental N per acre during the winter pasture season.

Grazing of these pastures started in early to mid-November for prepared seedbed plantings and from November to late January for sodseeded plantings, depending on date of planting and soil moisture conditions. In addition to the animals on pasture, a similar group was confined to drylot and given a diet of Coastal bermudagrass hay and 4 pounds of concentrate supplement per animal per day.

Table 9-22 outlines the treatments and numbers of animals involved in each year's study. Estimates of production and consumption were made from samples of forage obtained periodically. Samples also were analyzed for quality characteristics and mineral content.

Table 9-22. Summary of three wintering treatments comparing a cereal-ryegrass pasture established by sodseeding versus seeding on a well prepared seedbed. Pasture treatments were compared to the drylot group.

Treatment	Cereal-ryegrass sodseeded	Cereal-ryegrass prepared seedbed	Drylot
No. of animals/treatment			
1969-70	25	24	12
1970-71	22	26	15
1972-73	18	18	17
Experimental period, days			
1969-70	104	181	181
1970-71	200	200	200
1972-73	108	199	199
Stocking rate (animals/acre)			
1969-70	1.01	1.42	-
1970-71	1.35	1.14	-
1972-73	1.50	1.20	-

Factors Affecting Forage Production

Soil Fertility

The factor most limiting forage production in East Texas is lack of soil fertility. Cereals and ryegrass are particularly dependent upon applied plant food since they are not deep-rooted plants. Details of fertilizer studies with small grain-ryegrass pastures in East Texas are presented in Chapter 4, Fertilization of Forages.

Seedbed Preparation

If production of early grazing is an important objective, seedbed preparation becomes important to forage production programs. The average grazing period for the three years reported in Table 22 was 137 days for sodseeded pastures and 193 days for pastures produced on a well-prepared seedbed. Practically any treatment which reduces competition for plant nutrients, light, and moisture will increase initial production of forage. Disking a bermudagrass sod significantly increased ($P < .01$) early forage production of wheat-oats-ryegrass seeded on a common bermudagrass sod (Table 9-23).

Table 9-23. Chemical desiccation treatments.

Tillage treatment	Liquid 100-0-0 + paraquat applied separately	Liquid 100-0-0	Liquid 100-0-0 + paraquat applied together	Tillage mean
	Lb. dry forage - 105 days after planting			
Disk	436	452	653	513
No disk	368	337	394	366
Chemical means	402	395	523	

The simultaneous application of one-half pound of paraquat and liquid 100-0-0 (300 pounds of liquid 32-0-0) fertilizer solution per acre also significantly increased ($P < .05$) early forage production. Planting on a well-prepared seedbed 15 days earlier provided grazeable forage on November 6 contrasted with January 19 for pastures.

Temperature

Cold weather as generally encountered in mid-winter months is the principal limiting factor to plant growth, and high rates of nitrogen have little effect on forage production during this period (Figure 9-13). On the other hand an unusual delay in the onset of cold weather can prolong the competition from bermudagrass when small grains are sodseeded and result in a shortened winter grazing season and reduced forage yield. On small grain essentially no growth occurs below 40° F (Holt, Norris, and Lancaster, 1969. At temperatures above 40°, growth is directly related to temperature.

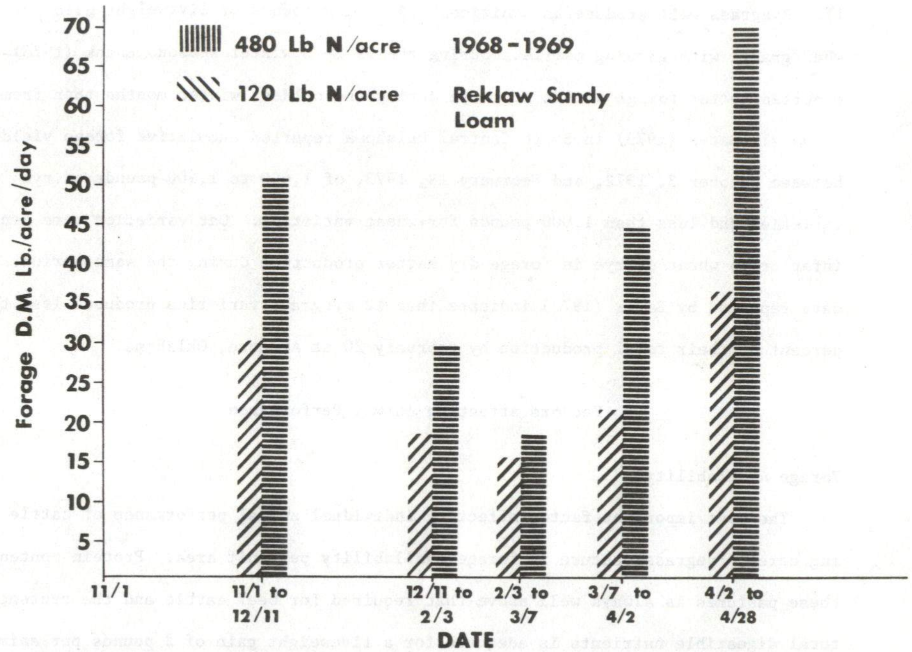

Figure 9-13. Seasonal production of wheat-ryegrass pasture as influenced by soil fertility.

Soil Moisture

Although East Texas receives more than 45 inches of rainfall per year (Table 9-1), it is rather poorly distributed and shortages of soil moisture may occur at any time. During the 1970-71 pasture season, cool-season forage production was severely reduced by dry weather in late April and May. Stocking rates were reduced and total liveweight gains reduced by 120 pounds per acre.

Species

Selection of species and varieties within species has a significant effect on forage production; however, soil type, climatic effects, planting date, and soil fertility differences make specific recommendations difficult. Generally speaking, a mixture of annual ryegrass with a small grain will extend the spring grazing season by

30 to 45 days. Small grains make little contribution to forage production after April 15. Ryegrass will produce an additional 75 to 100 pounds of liveweight gain per acre when grazed with growing cattle. During the 1972-73 winter season, Shank (1973) reported better forage yields from rye during the coldest winter months than from wheat or oats. Bates (1973) in South Central Oklahoma reported cumulative forage yields between October 3, 1972, and February 19, 1973, of 1,600 to 1,900 pounds of rye varieties and less than 1,000 pounds for wheat varieties. Oat varieties were generally inferior to wheat or rye in forage dry matter production during the same period. Other data reported by Bates (1973) indicate that 12 ryegrass varieties produced less than 5 percent of their total production by February 20 at Ardmore, Oklahoma.

Factors Affecting Animal Performance

Forage Availability

The most important factor affecting individual animal performance of cattle grazing cereal-ryegrass pasture is forage availability per unit area. Protein content of these pastures is always well above that required for beef cattle and the content of total digestible nutrients is adequate for a liveweight gain of 2 pounds per animal per day (Figure 9-14). Thus, animal performance (gain per animal) is positively

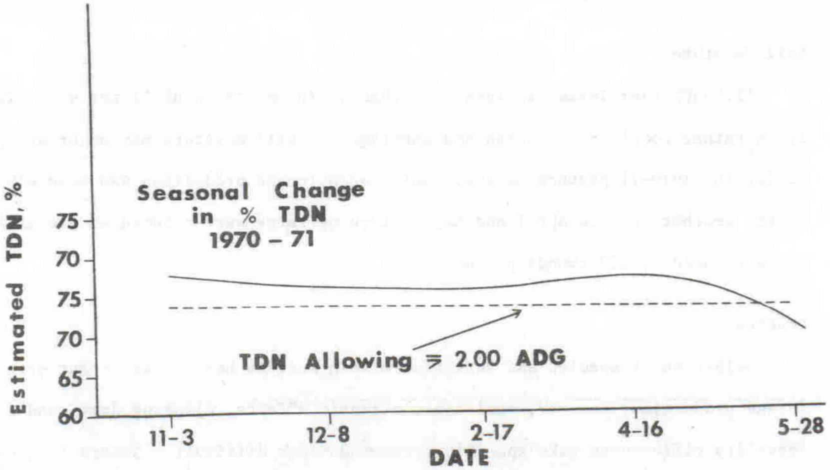

Figure 9-14. Estimated seasonal TDN content of wheat-ryegrass forage.

associated with forage available for grazing and is negatively related to stocking rate (Figure 9-15). This relationship appears to hold true for all forage species and classes of cattle which have been studied under variable stocking rates.

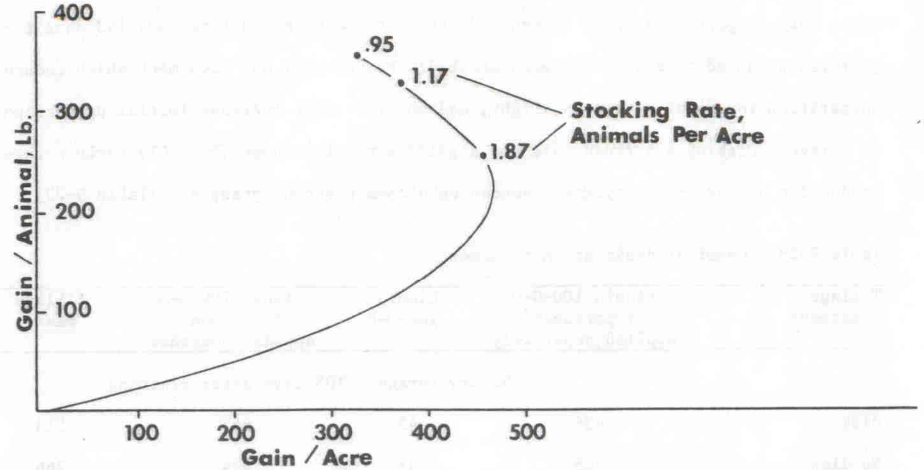

Figure 9-15. Effect of stocking rate on gain per animal and per acre.

The choice of stocking rate depends on the animal performance criteria and expected economic results established by the rancher. Generally the greatest return on invested dollars can be realized with stocker cattle when sufficient forage is available for near-maximum intake during most of the grazing season. If forage is limited during most of the grazing season, animal performance will be reduced and cost of gain increased.

At high stocking rates, practically all the available forage may be consumed after the initial period of approximately 60 days (Figure 9-16) whereas at low stocking rates forage availability is greater except for a short period in mid-winter (Figure 9-16). The choice of stocking rates or degree of forage utilization could be quite different for different classes of cattle. Mature cows can perform well when utilizing nearly all of the forage produced. However, calf performance may be reduced under limited forage intake. Substantial increases occur in the amount of forage dry matter required to maintain performance through the grazing season because of increased requirements

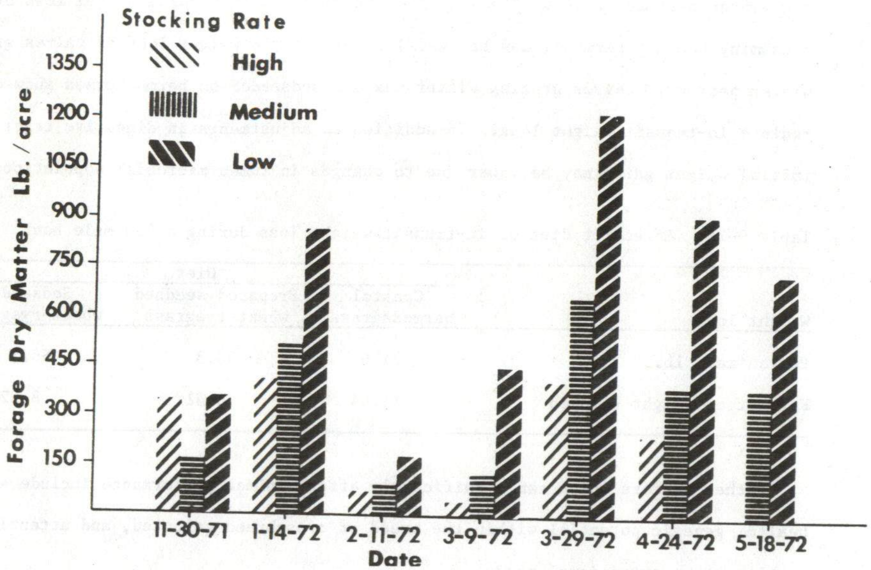

Figure 9-16. Effect of stocking rate on forage availability during the winter pasture season.

as the animal increases in size (Figure 9-17).

Animal Factors

Of the many animal factors which affect performance on a cereal-ryegrass pasture, most are confounded with other factors and cannot be isolated or evaluated under practical conditions.

Sex of stocker cattle will have about the same effect under pasture conditions as it does in drylot studies. Heifers generally have gained about 85 percent as much as steers under comparable pasture conditions. Breed or breed cross can influence animal gain, but frequently breed effect is confounded with age-weight relationships and previous treatment effects. For example, steer calves produced from Hereford x Brahman cows mated to Brown Swiss bulls are approximately 150 pounds heavier at weaning than purebred Hereford calves. Postweaning performance of purebred Hereford calves has

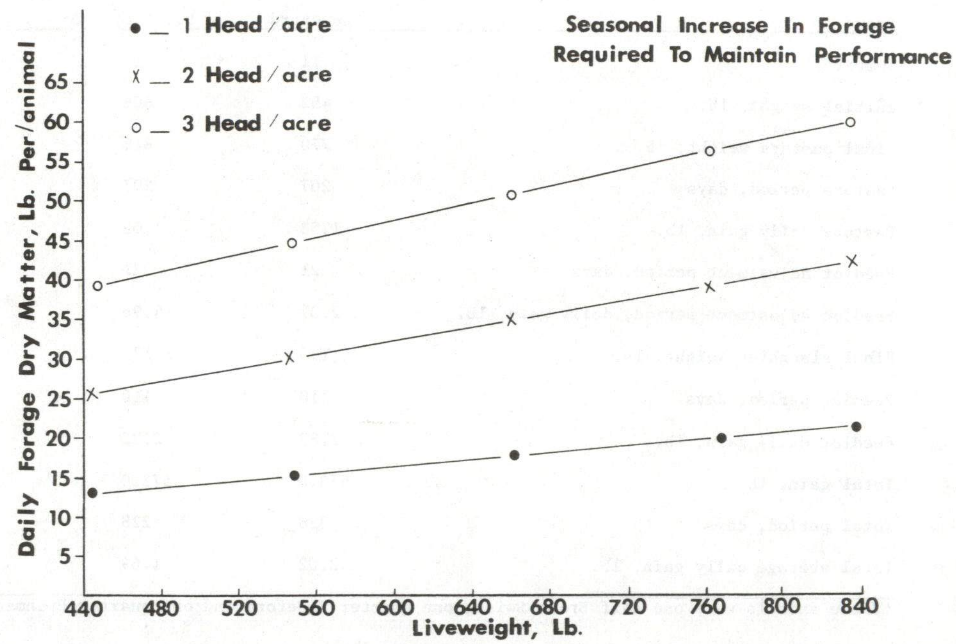

Figure 9-17. Effect of stocking rate and animal growth on forage dry matter required to maintain animal average daily gain of 2.00 lbs assuming initial liveweight of 440 lbs.

been superior when both the wintering and subsequent fattening period are considered (Table 9-24). The same trend in postweaning performance is found in a comparison of calves from Hereford, Hereford x Holstein, and Holstein cows in an Oklahoma study by Dean et al. (1973). Generally, crossbred calves with heavier weights at weaning gained more slowly and less efficiently during the postweaning feeding period than lighter purebred calves.

While the data in Table 9-24 may reflect breed differences, it is probable that they also reflect the influence of differences in previous growth rates that resulted in greatly different weight-age relationships at the beginning of the trial. When selecting calves for an extended winter pasture grazing program, the fact that these

Table 9-24. Influence of breed and initial experimental weight on postweaning performance of steer calves.

Breed	Hereford	2 BS, 1 H, 1 B[1]
Number	11	12
Initial weight, lb.	452	606
Final pasture weight, lb.	770	818
Pasture period, days	207	207
Pasture daily gain, lb.	1.53	1.03
Feedlot adjustment period, days	21	21
Feedlot adjustment period, daily gain, lb.	2.37	4.96
Final slaughter weight, lb.	1,135	1,177
Feeding period, days	110	110
Feedlot daily gain, lb.	2.87	2.32
Total gain, lb.	683.0	572.0
Total period, days	338	228
Total average daily gain, lb.	2.02	1.69

[1]These animals were one half Brown Swiss, one quarter Hereford and one quarter Brahman.

calves are to be sold as feeder steers must be taken into account. Heavy steers frequently have weighed in excess of 1,000 pounds at the end of the grazing season in studies at Overton. When they are fed a reasonable period in a commercial feedlot, they are too large to fit current market requirements for slaughter steers. On the basis of current (1975) differences in the price of carcass beef of various weights and grades, calves which weigh less than 500 pounds at weaning are the best prospects for a winter pasture grazing season of 180-200 days.

Digestive tract fill can have a significant effect on apparent animal performance, particularly in short-term grazing periods. Data from four winter pasture grazing seasons indicate that calves grazing wheat and ryegrass show a weight loss during the first 7 to 10 days on pasture. They may require three weeks to return to their initial liveweight. This initial weight loss generally has been ascribed to digestive tract

fill caused by differences in the rate of flow of bermudagrass vs. early season cereal-ryegrass pastures. Recently calves were shipped from Overton to Amarillo, Texas, after the winter pasture season. Table 9-25 shows that the in-transit weight loss of calves consuming Coastal bermudagrass hay was 160 percent the weight loss of calves grazing winter pasture. Calves grazing winter pasture sodseeded on bermudagrass showed intermediate in-transit weight loss. In addition to adjustments in digestive tract fill, initial weight gains may be lower due to changes in rumen microbial populations.

Table 9-25. Effect of diet on in-transit weight loss during a 450 mile haul.

	Diet		
Weight loss	Coastal bermudagrass	Prepared seedbed wheat-ryegrass	Sodseeded wheat-ryegrass
Per animal, lb.	81.6	50.3	56.5
Percent of weight shipped	11.04	6.41	8.22

Other factors which can significantly affect animal performance include animal health, genetic potential within the breed or crossbreed selected, and attention to supplementary nutritional needs.

Mineral Composition

Most mineral constituents of cereal-ryegrass forage are either adequate or more than adequate for practically all classes of cattle. Although potassium levels drop continuously through the season, they never fall below animal requirements (Table 9-26).

Table 9-26. Mineral contents of wheat-ryegrass forage (values as percent of dry matter).

	Sampling Date			
Element	12-8	2-17	4-6	5-28
K	3.87	2.68	2.03	1.48
P	.36	.29	.23	.18
Ca	.22	.23	.25	.28
Mg	.19	.21	.19	.17

Calcium values are slightly deficient for growing cattle; however, this need can easily be met through supplementation. Magnesium levels are adequate, assuming normal metabolism of the amount present. The high initial levels of potassium may interfere with magnesium metabolism and help precipitate grass tetany in cows. Growing animals are apparently not affected by the wide K:Mg ratio.

Forage Digestibility

Winter pasture forages are generally well above any warm season grasses in digestibility. Digestibility of cereal-ryegrass forage remains near 80 percent except for the midwinter period when it may drop to 70 percent. The best quality Coastal bermudagrass is produced in late April (Figure 1) and for much of the season is below 60 percent digestible.

Since cereal-ryegrass forage is high in digestibility and protein, it is best suited for animals with high nutrient requirements, particularly if it is grazed continuously. Replacement females and stocker calves can make rapid and efficient gains which are generally less expensive than gains from most alternative nutrient sources.

Winter Pastures for Cows

Although forages can be considered primarily as alternative sources of nutrients where utility will depend to a large extent on costs, cereal-ryegrass pastures have certain features which must be considered in addition to cost.

Lactating cows are subject to grass tetany or apparent hypomagnesemia when grazing cereal pastures. While several factors have been implicated as causative agents in grass tetany, none have been isolated as the cause. It is fairly clear, however, that feeding large amounts of magnesium is the best preventive measure against this mineral metabolism disorder. Workers at Virginia Polytechnic Institute and State University have implicated the very wide K:Mg ratio as being one of the major factors contributing to grass tetany. The generally high protein content must be considered when grazing cows on this forage.

Considering the average protein content to be 20 percent, then only 12 pounds of dry matter must be consumed to meet the protein needs of a heavily lactating beef cow.

That amount of cereal-ryegrass forage will meet only little more than one-half of the energy needs of a lactating cow. If a mature cow is allowed to meet her energy needs from this forage, then large amounts of protein are wasted. It is not possible to balance the needs for both protein and energy for the lactating cow using cereal-ryegrass pasture and Coastal bermudagrass hay. To balance the energy and protein needs using grain and winter pasture requires large amounts of grain in the diet. From a practical standpoint cereal-ryegrass pastures can be most economically used to supply all of the protein needs and about one-half of the energy needs of the cow. Good quality hay or hay and grain can be used to meet the balance of the energy needs.

One way of limiting the intake of winter pastures is to limit the time spent in grazing. Three-year-old Hereford cows grazing cereal-ryegrass pastures 4 hours daily remained in positive energy balance as evidenced by a slight gain in liveweight (Table 9-27). Calves nursing cows grazing continuously had higher daily gains. Also, cows grazing continuously gained much more than cows grazing 4 hours daily. During the 42 days following the winter pasture period, all cows and calves were placed in a common pasture of good quality bermudagrass. Cows on the continuous grazing treatment lost weight while the calves continued to gain 1.04 pounds per head per day. Cows which had grazed 4 hours daily gained a small amount, and the calves gained 1.14 pounds per head per day. At the end of the 142-day experimental period, the calves from cows grazing

Table 9-27. Effect of time on pasture on performance of Hereford cows and their calves.

Treatment	Winter pasture, continuous grazing	Winter pasture, 4 hours daily
Number of cows	17	13
Experimental period, days	82	100
Cow gain, lb.	96	30
Cow average daily gain, lb.	1.17	.30
Calf gain, lb.	153.0	148.00
Calf average daily gain, lb.	1.86	1.48

continuously exhibited a greater weight per day of age.

SUMMARY

Beef cattle, which comprise 94 percent of the total cattle numbers, provide the major source of agricultural income in East Texas. This beef cattle population is equivalent to that of each of several southern states. The primary factor limiting agricultural production in this region is the fertility status of the soil. Intensive forage-beef cattle systems depend on the availability of fertilizers to supply the deficient plant food nutrients.

The distribution of rainfall is uneven and will probably limit forage production during the months of July, August, and September when mean monthly rainfall is least and evaporative losses highest. While 62 percent of the annual rainfall occurs from October 1 through April 30, cold weather limits growth of cool season forages during a 45-day midwinter period.

The sod-forming warm-season perennial grasses constitute the nucleus of intensive beef production in East Texas. Presently, Coastal bermudagrass is the most productive grass in terms of forage for beef production. Bunch grasses such as lovegrass can be used profitably when managed to utilize the forage as it is produced. Pearl millet is the most productive warm-season annual forage crop for the sandy soils which predominate in East Texas. The warm-season annuals produce more rapid animal gains than perennial grasses, but the cost of establishment and problems associated with forage utilization reduce the utility of these crops for grazing purposes.

The only cool-season perennial grass which is well adapted to the area is tall fescue. When grown in conjunction with legumes, it provides a diet adequate for lactating cows and stocker calves. The principal disadvantages of fescue are its low quality in a pure stand and the fact that it is adapted to a very limited acreage in the area.

The cool-season annuals provide a very high quality diet for approximately 180 days under ideal conditions. The cereals provide the earliest grazing, being followed by ryegrass and legumes. Maximum liveweight gains may be obtained from cattle grazing

these pastures. Steers may gain 2 pounds per head per day. Lactating cows may gain over 1 pound per day, and their calves may gain up to 3 pounds per day, depending on breed and age. The disadvantages of the winter annuals are (1) high production costs and (2) a variable grazing season, depending on climate, insect, and disease damage.

Considering climatic conditions, forage production patterns, and cattle nutrient requirements, the following statements apply to the cow-calf operator who generally sells his calves at weaning: (1) Nutrient requirements of the cow should match nutrient production of the forage. Minimum digestibility of warm-season perennial grasses generally occurs during August and September. (2) Fall-born calves generally wean 100 to 200 pounds heavier than spring-born calves. However, at calving, nutrient requirements of the cow increase by 30 percent. Regardless of the calving season, a management system which concurrently allows for a maximum calf weaning weight and a properly rebred cow may be achieved with an all-forage diet or a combination of a forage-supplement diet. The cost of supplying these nutrients will determine the forage system to be incorporated.

The operator who utilizes carryover programs for weanling steers and heifers must provide diets high in available nutrients if economic gains are to be achieved. Some of the available options which provide the necessary growth rate for weanling calves are (1) Provision of supplemental energy to calves grazing warm-season perennials such as Coastal bermudagrass from weaning until cool-season annuals become productive (2) Establishment of summer annuals which can be grazed until October 1, followed by grazing on late season Coastal bermudagrass, until winter annuals become productive. (3) Confinement of calves and feeding of hay plus supplemental protein and energy until winter annuals are ready to graze. The choice of option depends upon costs associated with each option. Recent increases in production costs will force producers to examine interrelationships in the soil-forage-beef cattle complex and to maximize efficiency of the entire system.

Recent increases in the cost of feeding in confinement could well cause a major shift from extensive use of feed grains to extensive use of forage as the principal means of producing beef in the United States. Production of beef with forages alone

has serious limitations in terms of ability to supply packers with a uniform animal on a continual basis. However, systems which maximize liveweight gain from forage while utilizing the unique ability of feedlots to provide the packers with a continuous supply of a relatively uniform product will enable the beef cattle industry to continue to supply beef to the consumer at least possible cost.

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