PUBLICATIONS
1995

Ryegrass Symposium Proceedings

1995

CHAPTER 7

GRAZING MANAGEMENT AND UTILIZATION OF RYEGRASS

F. M. Rouquette, Jr., Forage Physiology
Texas A&M University Agricultural
Research and Extension Center - Overton

Introduction

The release of 'Gulf' ryegrass in 1958 by the Texas Agricultural Experiment Station (Weihing, 1963) signaled the beginning of modern-day intensive management and grazing of annual ryegrass in the U.S. The significant contribution of annual ryegrass in pastures is that the grazing period of warm-season perennial grass-based pastures may be significantly extended by 2 to 5 months. And, this additional grazing period occurs during that time of the year when lower quality hay or deferred forages usually provide the primary source of roughage. Thus, the extended grazing period, high nutritive value, compatibility and ease of establishment in warm-season perennial grass pastures, and resistance to defoliation regimens and stocking rates have created widespread use of ryegrass planted alone or in combination with other cool-season annual forages.

Early Grazing Experiments

One of the first grazing studies with Gulf ryegrass immediately after its release, was conducted in 1959-61 by Riewe *et al.* (1963). Steers grazed Gulf ryegrass or tall fescue at different stocking rates to develop grazing production curves to assist management decisions. In this study, stocking rates ranged from .9 to 1.84 steers/ac with the perennial tall fescue stocked at the highest level (Table 1). The relatively low average daily gains (ADG) of 1.48, 1.07, and .62 lb/day, respectively, from low, medium, and high stocked ryegrass pastures may have been due to animal genetics, environmental conditions, forage availability, soil fertility, or a combination of these and other factors.

This grazing experiment did, however, set the framework for evaluating gain per acre and gain per animal relationships using various stocking rates. In this study, the authors surmised that maximum gain per steer was highest from ryegrass pastures; gain per steer decreased more rapidly as stocking increased on ryegrass compared to tall fescue; at the point of maximum gain per acre, gain per steer and per acre was highest on ryegrass pastures; and at the point of maximum gain per acre, tall fescue pastures had the greatest carrying capacity. Also noteworthy was that the stocking rate that produced the maximum gain per acre did not result in maximum forage utilization. The maximum gain per acre occurred in those pastures where there was always adequate forage available to allow for selective grazing.

Table 1. Two-year comparison of steer performance on Gulf ryegrass and tall fescue pastures.[1]

	Stocking Rate		
Item	LOW	MED	HIGH
RYEGRASS			
Steers/ac	.90	1.24	1.53
Initial Wt/ac, lb	450	620	765
Gain/steer, lb	225	160	90
ADG, lb	1.48	1.07	.62
Gain/ac, lb	203	198	138
FESCUE			
Steers/ac	.90	1.38	1.84
Initial Wt/ac, lb	450	690	920
Gain/steer, lb	158	130	87
ADG, lb	1.47	1.30	.92
Gain/ac, lb	142	179	160

[1]Riewe *et al.*, Angleton, TX. 1963.

Not only does annual ryegrass grow compatibly with dormant warm-season perennial grasses, but it also makes an excellent mixture with clovers. Questions concerning the use of grass and nitrogen fertilizer *vs* grass plus a legume have provided the impetus for numerous plot and grazing experiments to ascertain management alternatives. Another early grazing study with Gulf ryegrass and either nitrogen fertilizer or clover was conducted at the TAES Angleton Station by Riewe (1976). A four-year grazing experiment was conducted in which ryegrass with 2 rates of nitrogen fertilization, 30 and 90 lb/ac, was compared with ryegrass plus 'Abon' persian clover (Table 2). At each of 3 stocking rates, 1.08, 1.64, and 2.14 steers/ac, the ryegrass-clover pastures produced higher ADG and more gain per steer and per acre compared to the ryegrass plus 30 lb/ac N. Although ryegrass pastures plus 90 lb/ac N did not produce steer ADG equivalent to the ryegrass + clover, the additional forage production resulted in higher stocking rates (1.53, 2.12, 2.69 steers/ac); thus, gain/ac was highest of the three treatments at 320 to 356 lb/ac.

From these types of data, economic optimum stocking strategies may be formulated to allow management the opportunity to make decisions based on known production costs and estimated marginal price. The grass-nitrogen *vs* grass-legume questions are not for debate but are soil and climate-specific as well as risk and management-specific. Numerous grazing experiments with ryegrass and/or clovers have shown that there are critical management decisions with either scenario and that pasture mixtures are chosen based on preference, bias, risk, knowledge base, or expected returns.

Table 2. Four-year average performance of steers grazing Gulf ryegrass with nitrogen or ryegrass with Abon persian clover pastures.[1]

	Stocking Rate		
Item	LOW	MED	HIGH
RYEGRASS + 30 N			
Steers/ac	1.08	1.64	2.14
Gain/steer, lb	183	151	117
ADG, lb	1.54	1.28	1.0
Gain/ac, lb	198	148	250
RYEGRASS + 90 N			
Steers/ac	1.53	2.12	2.69
Gain/steer, lb	209	168	131
ADG, lb	1.76	1.41	1.10
Gain/ac, lb	320	356	352
RYEGRASS + CLOVER			
Steers/ac	1.08	1.64	2.14
Gain/steer, lb	228	189	154
ADG, lb	1.91	1.58	1.30
Gain/ac, lb	246	310	330

[1]Riewe, Angleton, TX. 1976.

Distribution of Stocking Density

Although climatic conditions in the southeastern U.S. are generally ideally suited for winter annual forages, rainfall and/or temperature extremes cause widely fluctuating forage growth rates. Combining legumes in mixtures with ryegrass provides animals with a potentially higher nutritive value diet; however, most of the dry matter production from adapted legumes overlaps with that of ryegrass during late winter to late spring. The use of small grains such as oats, wheat, or rye in mixtures with ryegrass generally provides forage for grazing during the fall as well as during the winter months. Bagley *et al.* (1982) reported the results of a four-year grazing experiment in which pastures of Gulf ryegrass were compared to mixtures with 'Yuchi' arrowleaf clover, Yuchi arrowleaf-'Elbon' rye, and 'Regal' ladino clover-Elbon rye. Each year, all pastures received 84-69-90 lb/ac of N-P_2O_5-K_2O at planting, 66 lb/ac N in late January and again in April, and 50 lb/ac K_2O in April. The ryegrass-only pasture received an additional 30 lb/ac N during the spring.

A variable stocking rate was employed to utilize additional forage during favorable conditions, or to completely remove cattle during periods of diminished forage availability. The 4-year average stocking rate of each pasture treatment by month is shown in Table 3. In general, stocking rate of all pastures declined from December to February, with February being the month at this location in which climatic conditions restricted forage growth, and hence, stocking rate. From February to March and April, however, a 2- to 4-fold increase in forage production and stocking rate occurred as temperatures increased and day length became longer.

Table 3. Four-year comparison of differently stocked pastures of Gulf ryegrass alone or in combination with other forages.[1]

	Forage Mixture[2]			
Item	Rygr	RyAr	RRAr	RRLd
STEERS/ac				
Dec	.99	.79	1.21	1.24
Jan	.89	.71	.91	.99
Feb	.72	.54	.78	.81
Mar	1.73	2.01	1.57	1.98
Apr	1.97	2.43	1.66	1.63
Grazing Days	149	149	157	157
Initial Wt, lb	503	501	496	495
Final Wt, lb	843	871	874	869
Gain/steer, lb	340	370	378	374
ADG, lb	2.05	2.21	2.14	2.11
Gain/ac, lb	466	520	499	534

[1]Bagley *et al.*, Rosepine, LA. 1982.
[2]Forage mixtures = Rygr (Gulf ryegrass); RyAr (Gulf ryegrass and Yuchi arrowleaf clover); RRAr (Elbon rye, Gulf ryegrass, and arrowleaf clover); RRLd (Elbon rye, Gulf ryegrass and Regal ladino clover).

With respect to animal performance, ryegrass-arrowleaf clover pastures resulted in more

ADG than ryegrass alone; however, the two Elbon rye-containing treatments had ADG similar to the ryegrass-arrowleaf and to the ryegrass only pastures. Steer gains per acre were also similar across all treatments and averaged about 500 lb/ac.

Another Rosepine, LA grazing study (Feazel, 1986) showed monthly stocking density on two ryegrass varieties planted alone or with Elbon rye (Table 4). Both Marshall and Gulf ryegrass were planted at 40 lb seed/ac and the rye-ryegrass was planted at 60 and 25 lb/ac, respectively. All cool-season annual grasses were sod-seeded into a common bermudagrass sod. Stocking densities varied with climatic conditions and forage production in this variable stocking rate experiment. In most years, cattle were initially stocked from early to late November, and were briefly removed from pastures in mid-winter (January or February) due to inadequate forage availability. After a 2- to 4-week deferment, cattle resumed grazing test pastures. The average season-long stocking rates were similar at 1.34 to 1.42 head/acre for the 3 forages. Steers gained more than heifers as expected (2.06 *vs* 1.83 lb/day), and as a result, gain per acre of the different sexes of cattle ranged from 515 lb/ac for heifers grazing Gulf ryegrass to 614 lb/ac for steers grazing Marshall ryegrass.

Table 4. Three-year average monthly stocking rate and performance of steers and heifers grazing cool-season annual grasses.[1]

Month	Ryegrass Marshall		Ryegrass Gulf		Elbon rye + Gulf ryegrass	
Nov	.64		.62		.62	
Dec	1.18		1.12		1.19	
Jan	.42		.41		.45	
Feb	.19		.15		.20	
Mar	1.59		1.80		1.81	
Apr	2.10		1.99		1.90	
May	2.44		2.32		2.12	
Jun	.46		.29		.42	
Season Avg.	1.42		1.34		1.36	
Item	**Str**	**Hfr**	**Str**	**Hfr**	**Str**	**Hfr**
No. Years	2	3	2	3	2	3
No. Days/yr	160	151	160	154	160	157
ADG, lb	2.13	1.83	1.85	1.77	2.21	1.88
Gain/animal, lb	341	276	296	273	354	295
Gain/ac, lb	614	514	529	515	568	546

[1]J. I. Feazel, Rosepine, LA. 1986.

Monthly distribution of stocking density was more vividly expressed in a 5-year Overton, TX experiment in which Marshall ryegrass and Elbon rye were used as comparisons to combinations with 'Dixie' crimson clover in an N *vs* no N experiment (Rouquette *et al.*, 1989). Table 5 presents the minimum, maximum, and 5-year monthly average stocking density in terms of total animal body weight (BW) per acre. An average of 292-52-64 lb/ac of $N\text{-}P_2O_5\text{-}K_2O$ was split-applied on the prepared seedbed pastures. For a 500-pound equivalent animal, the 5-year "average" would indicate potential stocking rates for the N-fertilized pastures to range from a low of 1.5 animals/ac in January to 3.9 hd/ac in May. However, in one year out of the five, forage conditions were such that during the month of January, all animals had to be removed. Moreover, during March, April, and May, forage production accelerated to the point that the minimum stocking density was at least 1300 lb BW/ac (2.36 550-lb equivalents) from the N-fertilized pastures. These East Texas-West Louisiana grazing studies are but examples of data which indicate a strong bimodal dry matter production of cool-season annual grasses and especially if a small-grain is a mixture component. Thus, grazing management strategies must include these forage growth fluctuations in response to climatic conditions and fertility level.

Table 5. Five-year monthly carrying capacity of Marshall ryegrass planted with Elbon rye and crimson clover.[1]

	Nitrogen Fertilized			No Nitrogen		
	Marshall ryegrass + Elbon rye			Marshall ryegrass + Elbon rye + crimson clover		
Month	Min	Max	Avg	Min	Max	Avg
Dec	1100	1565	1380	550	950	890
Jan	0	1450	835	0	725	550
Feb	500	1750	1125	250	890	530
Mar	1300	2000	1650	700	1460	1000
Apr	1375	2500	1865	1100	2000	1370
May	1470	2885	2150	1000	2285	1610

[1]Rouquette *et al.*, Overton, TX. 1989.

Several approaches may be used to efficiently utilize the skewed, high spring growth rate of ryegrass pastures. Some of the following grazing strategies have been recommended to producers: (1) Stock pastures initially so that the low winter growth rate does not necessitate animal removal. In this scenario, additional cattle must be incorporated into the grazing scheme and/or excess spring growth must be harvested as silage or hay (hay is usually not a good alternative in March and April due to inclement conditions for curing). The "additional" cattle may be part of the resident cows and calves and/or may involve winter-spring purchased cattle. (2) Graze during the fall, vacate pastures during the winter and supplement with hay and/or protein, and resume grazing in the spring. (3) Stock pastures initially at the "optimum" spring stocking rate (1650-2000 lb BW/ac) and exercise a limit-graze scenario during the fall-winter period until the rapid spring forage growth rate occurs (usually late February to early March). This management strategy involves supplemental hay and protein in addition to an adjacent "sacrificed" area for animals to reside. Normally, these limit-graze systems would entail a 2- to 3-hr grazing per day with a 20- to 22-hour deferment, or some alternate-day grazing plan. The primary objective is to have some optimum number of cattle on hand and available for grazing during the spring period. (4) Delay grazing winter pastures until late winter (February-March) or until the rapid spring forage growth rate occurs. A component of this grazing scenario is that cattle would be purchased at a time when prices are generally higher than during the previous fall season. However, there is limited hay and supplemental requirements for this approach.

Alison (1992) reported results of a 3-year study in which various grazing initiation strategies were evaluated to optimize utilization of sod-seeded Gulf ryegrass. Forage production from ryegrass pastures that were either: (1) grazed continuously from initiation of planting; (2) grazed until early January and then deferred until early March; (3) not grazed until early January; and (4) not grazed until early March (Table 6). The 3-year mean spring ryegrass

Table 6. Effect of grazing management after planting Gulf ryegrass on spring forage production.[1]

Grazing Management Following Planting	Spring Forage Production (lb/ac) Year 1	Year 2	Year 3	AVG
Continuous grazing initiated at planting	4324	2360	1571	2751
No grazing until early January	4885	2570	1802	3086
Graze until early January, then defer until early March	4058	2589	1601	2749
No grazing until early March	5924	3796	1939	3887
LSD (.10)	1246	979	NS	553

[1]M. W. Alison, Winnsboro, LA. 1992.

forage production following a fall-winter deferment period was higher than forage production from fall-winter grazed pastures. It was reported that the fall-winter management did not necessarily affect early spring forage production; however, late season ryegrass production was affected. Significant experimental results and commercial producer profits are linked to interactions between year and management scenario.

The most important consideration to remember for management is that forage growth rate varies significantly over the course of the season and from month to month. Therefore, methods of forage utilization such as rotational grazing or a flexible-variable stocking density are usually more efficient than those approaches that incorporate continuous, non-adjustable or inflexible stocking densities. Climatic events, especially extreme-case conditions, must be reasonably predicted or expected so that management alternatives may be employed to approach desired levels of biological and economic efficiencies of ryegrass utilization.

Comparison of Ryegrass Varieties under Grazing

Small plot studies are used to assess differences between varieties or plant breeding materials because of the need to rapidly evaluate numerous cultivars or lines at moderate expenses. Eventually, grazing experiments are required to ascertain the impact of plot yields and nutritive value on animal performance on a per animal and per acre basis.

Much like 'Coastal' bermudagrass as a comparison for new bermudagrass hybrids, Gulf ryegrass has been the standard by which improved ryegrasses are measured. Both 'Jackson' and 'Surrey' ryegrass were compared with Gulf ryegrass during a 2-year period under both a bermudagrass sod-seeding and prepared seedbed establishment (Morrison, 1994). Although previous ryegrass comparisons at Rosepine, LA (Feazel, 1986) had shown slight improvements in animal performance from Marshall compared to Gulf ryegrass, this 2-year study showed no differences between Gulf, Jackson, or Surrey ryegrass (Table 7). Both Jackson and Surrey, as well as Marshall, were released as alternatives to Gulf because of winter hardiness traits. Thus, one may not expect dramatic animal performance differences from these various ryegrass varieties during mild winter conditions. Only an extended, and expensive, grazing comparison over multiple years may detect differences in animal performance between selected ryegrass varieties. There was, however, a difference in ADG between method of establishment in that steers grazing sod-seeded pastures gained 2.53 lb/day; whereas, steers grazing prepared seedbed pastures gained 2.31 lb/day. However, the fact that the initiation of grazing began 36 days later on sod-seeded pastures due to forage availability, compensatory gains were likely during the actual grazing period. Total gain/steer from prepared seedbed plantings were 50 pounds more than from sod-seeded pastures (345 *vs* 397 lbs). Final weights of these steers were therefore in excess of 800 lbs.

Table 7. Two-year average steer gains from three ryegrass varieties.[1]

	Gulf		Jackson		Surrey	
Item	Bed[2]	Sod[3]	Bed	Sod	Bed	Sod
No. Steers	28	28	28	28	28	28
Initial Wt, lb	452	482	454	490	451	481
Final Wt, lb	844	834	845	833	860	820
Gain/animal, lb	392	352	391	343	409	339
ADG, lb	2.27	2.59	2.27	2.52	2.38	2.49

[1]D. G. Morrison, Rosepine, LA. 1994.
[2]Prepared seedbed.
[3]Sod-seeded.

An estimate of economic returns from grazing ryegrass planted on prepared seedbed or sod-seeded is shown in Table 8. At this experimental site, steers grazing prepared seedbed had pasture and feed costs calculated at $.206/lb gain; whereas, steers grazing sod-seeded pastures had costs of $.236/lb gain.

Table 8. Method of planting ryegrass on performance and economic returns.[1]

Item	Prepared seedbed	Sod-seeded
Days on Pasture	172	136
Feed Cost/hd, $	25	42
Pasture Cost/hd, $	57	46
Initial Wt, lb	452	456
Final Wt, lb	850	829
Gain/animal, lb	398	373
Pasture & Feed Cost/lb Gain, $	.206	.236
Estimated Return[2]/hd, $	80	52

[1]D. G. Morrison, Rosepine, LA. 1994.
[2]Includes costs for feed, pasture, interest, labor, and medicine.

A variety comparison grazing experiment from the Overton Research Center which contributed to the eventual release of TAM 90 ryegrass (Nelson, 1991) showed that Brahman heifers grazing TAM 90 gained nearly 800 lb/ac; whereas, Brahman heifers grazing Gulf ryegrass gained 655 lb/ac (Table 9). Individual animal performance was similar and lower than anticipated because of breed of animal and stocking rates used to harvest forage. In general, the gain/ac advantage which occurred during the winter period was a primary component of the characteristics used to screen plants and select plant breeding materials for the release of TAM 90 ryegrass.

Table 9. Heifer gains from TAM 90 and Gulf ryegrass.[1]

	Ryegrass	
Item	TAM 90	Gulf
Grazing Days	122	112
Gain/heifer, lb	183	175
Stocking Rate[2]	4.36	3.74
ADG[3], lb	1.50	1.56
Gain/ac, lb	796	655

[1]Rouquette & Nelson, Overton, TX. 1991.
[2]Stocking rate calculations based on 500-lb = 1 Brahman heifer.
[3]Average daily gain.

Utilization by Cow-Calf Pairs

Ryegrass and/or clovers have long been used by cow-calf producers in East Texas and the southeastern U.S. to extend the grazing season of warm-season perennial pastures and enhance animal performance. Cows and calves have been used to evaluate annual winter forages, especially mixtures of ryegrass and clovers since 1969 at the Overton Center. In an effort to monitor the implications of nutrient recycling on grazed pastures, experiments were initiated using fall-calving cows to graze either ryegrass or clovers (Rouquette *et al.*, 1992a, 1992b). Results of the first 5 years of this long-term study in which Marshall ryegrass plus N was compared with Yuchi arrowleaf clover plus K_2O are shown in Table 10. Although the objectives of this experiment included a summer grazing component for both Coastal and common bermudagrass, only the winter grazing period data are presented. One of the most noteworthy observations was that when the Simmental-sired steers and heifers and their F-1 (Brahman x Hereford) dams grazed at a low stocking rate that allowed for sufficient forage available for selective intake, calf gain, was 3 lb/day (without supplementation). The stocking rate used in this variable stocking rate study to achieve this level of individual calf performance ranged from .8 to 1.0 cow-calf units (1500 lbs) per acre from either clover or ryegrass overseeded on bermudagrass.

Table 10. Five-year average of suckling calf gains at each of three stocking rates of Marshall ryegrass or clover overseeded on either Coastal or common bermudagrass.[1]

	Ryegrass + N			Clover + K_2O		
Bermudagrass	Stocking rate[2]	ADG[3]	Calf Gain/ac	Stocking rate	ADG	Calf Gain/ac
	AU/ac	lb/d		AU/ac	lb/d	
Coastal	2.42	2.21	642	2.25	2.09	451
	1.59	2.74	523	1.50	2.69	484
	0.96	3.05	351	0.87	3.05	255
Common	2.10	1.71	431	1.93	0.96	178
	1.48	2.65	471	1.42	2.75	375
	0.92	3.07	339	0.80	2.99	230

[1]Rouquette *et al.*, Overton, TX. 1992.
[2]Stocking rate based on 1500 lbs = 1 animal unit (AU).
[3]ADG = Average daily gain from February to mid-June.

Both gain per animal and gain per acre were affected by stocking rate which is the generally accepted, traditional animal response. However, because these were suckling calves rather than stockers, gain per animal was considerably higher for calves on the high stocking rate pastures due to the buffering effect of milk production from the cow. Except for the gain per acre responses monitored for Coastal bermudagrass overseeded with ryegrass, the medium stocked pastures (1.5 AU/ac) resulted in the highest calf gains/acre. And, although ADG of calves grazing either ryegrass or clover were relatively similar at all stocking rates except the high stocked common bermudagrass and clover pastures, calf gain per acre strongly favored the ryegrass pastures. The principal factor involved in the gain/acre difference was that during this five-year period, ryegrass pastures provided 24 more days grazing than the clover pastures. Thus, the importance of the winter-hardy Marshall ryegrass was evident.

Clearly, the most significant responses to the use of cool-season annual forages with warm-season perennial grass-based pastures are not only calf gain per acre, but also weaning weight of fall-born calves. Improved, environmentally adapted animal genotypes have resulted in weaning weights of 600 to 850 pounds which are dependent upon stocking rate (Gaertner *et al.*, 1992; Rouquette *et al.*, 1983; Rouquette, 1984). Under this calving season, animal genetics, and forage management system, the stocker phase is essentially eliminated wherein calves are excellent candidates to enter the feedlot immediately upon weaning (Hutcheson and Rouquette, 1992; Rouquette *et al.*, 1994). As in most cases where efficiency of operation and animal response (gain) are optimized, or even maximized, cow-calf producers must strongly consider the option of retained ownership to the carcass stage in order to receive economic compensation for their management expertise. This is not to say that stocker operations that utilize lightweight cattle and ryegrass will be diminished since the opportunity to capitalize on producer mistakes and/or misfortunes appears to be a "normal event" in the southeastern U.S. cattle operations.

Utilization by Horses

The development of yearling horses is often costly as well as labor intensive. Diet selection is critically important for meeting the nutritional requirements for maintenance and growth of yearling horses. Forage-based diets have traditionally been utilized to supply a portion of the daily nutritional needs of yearlings; however, an exclusive forage diet for this class of horse has not been examined in great depth. The combination of winter and summer forages in the southeastern regions of the U.S. can potentially provide high-quality, year-long pastures suitable for the development of yearling horses. Since horses are able to graze pastures more closely than cattle, forage must not only supply adequate nutrients but it must also be able to withstand frequent and severe defoliation regimens.

Yearling horses were grazed in each of two years on bermudagrass pastures overseeded with Elbon rye and Marshall ryegrass (Hansen *et al.*, 1988). Horses, with initial weights of about 650 pounds, were stocked on rye-ryegrass pastures and received either pasture only or pasture plus a daily energy supplemental feed (Table 11). There were no differences due to sex in either year; thus, daily gains of both colts and fillies are combined. A stocking rate of 1.5 horses per acre was used during the rye-ryegrass period and 3.5 yearlings per acre were used during the bermudagrass phase. Horses averaged 1.32 lb/day on rye-ryegrass pasture and 1.97 lb/day with pasture plus a supplement. In a controlled feeding study (Thompson *et al.*, 1988), 400-lb weanlings fed grain-based diets with *ad libitum* access to cool-season grass-legume pasture and hay gained from 1.22 to 1.53 lb/day during a 180-day period. Although yearling horses gained more weight and had higher visual body condition scores (fat) on pastures plus supplemental feed, all yearlings grew in height at the same rate regardless of treatment in the Overton study.

Development costs of yearlings (Table 12) favor use of pasture only rather than the inclusion of supplemental energy. There are some management objectives for horses, however,

Table 11. Two-year performance of yearling horses on Elbon rye-Marshall ryegrass-bermudagrass pasture or pasture plus supplemental feed.

	Year 1		Year 2		
Item	PAS	.5 FED[2]	PAS	.25 FED[2]	.5 FED[2]
Initial wt, lb	665	637	642	655	650
Final wt, lb	891	930	873	882	934
Weight gain, lb	226a	293b	230a	227a	284b*
ADG (lb/d)					
Rye-ryegrass period	.97a	1.87b	1.67a	1.98b	2.07b
Bermudagrass period	1.22	1.21	1.03a	.88a	1.28b
Total for trial	1.12a	1.46b	1.23a	1.21a	1.52b

*Treatment means in the same row of a specific trial and not sharing the same superscript differ (P<.05).

[1]PAS = Pasture only, no supplemental feed.

[2]Pasture + supplemental feed fed daily at 25% or 50% of NRC energy requirements.

Table 12. Estimated pasture and supplemental feed costs for yearling horses during a 270-day development period.

Item	Pasture + Supplement	Pasture Only
Commercial 14% Ration		
50% NRC, lb[1]	8	0
Total for period, lb	2160	0
Unit cost, $/T	$220.00	0
Cost for period[2], $/T	$237.60	0
Pasture Costs[3]		
Per acre	$125.00	$125.00
Stocking rate[4], no./ac	3	3
Per horse	$ 41.67	$ 41.67
ADG[5], lb/d	1.49	1.18
Total cost/horse	$279.27	$ 41.67
Cost/day	$ 1.03	$ 0.15
Cost/lb gain	$ .69	$ 0.13

[1]270-day period represents active grazing period from Jan.-Feb. to Sept.-Oct.

[2]Cost based on $11/cwt.

[3]Pasture costs based on fertilizer, seed, etc. of rye-ryegrass-bermudagrass.

[4]Stocking rate of 1-1/2 yearlings/ac for 70 days (winter/spring) and 3-1/2 yearlings/ac for 200 days (spring/summer) for an average of three horses/ac for the 270-day period.

[5]Based on data from a 2-year trial.

which may not be met through an exclusive pasture program. For example, horses which are being prepared for halter showing, sales, etc. may not attain the desired level of condition and visual appearance that has become expected for these events. It is also noteworthy that grazing behavior and pasture utilization by horses may require additional management practices to be employed such as rotational grazing, mechanical defoliation after grazing, etc. (Hansen *et al.*, 1987a, 1987b).

Utilization by Lambs

Sheep have been noted as leading all domestic livestock in their ability to produce marketable products from an exclusive forage diet. And, sheep are more efficient than cattle in utilizing rations that have high forage content (Terrill and Price, 1985). Previous research and observations with grazing weaned lambs on improved, perennial forages would suggest that these pastures should support 20 to 25 lambs per acre. In both semi-arid, rangeland and humid pastures, several investigators have reported that co-mingling or co-grazing sheep with cattle resulted in increased livestock gains per unit land area (Snell, 1935; Merrill and Miller, 1961; Merrill *et al.*, 1966).

More recently, Sladden and Bransby (1992), examined the influence of four stocking rates on performance of lambs and steers grazing Marshall ryegrass. Lambs (45 lbs each) were stocked at 15, 20, 25, and 30 head per acre; whereas, 550-pound steers were stocked at 1.5, 2.0, 2.5, and 3.0 in a fixed stocking rate study. Average daily gains of this 3-year study were negatively related to stocking rate with lamb gains at .23 to .33 lb/day and steers at 1.91 to 2.46 lb/day, respectively from high to low stocking (Table 13). Regression analyses predicted that maximum gain per acre for lambs occurred at 26 lambs per acre in two of the three years, and was beyond the limits of the stocking rates used in the other year. On the other hand, maximum gain per acre for steers was assumed to occur beyond the highest stocking rate of 3.0 steers per acre. An average of the 3-year's data, however, would suggest that maximum gain per acre for steers ranged from 2.5 to 3.0 animals/acre. The authors also cautioned producers to acknowledge the danger of employing a simple weight-by-weight comparison of livestock for stocking rate estimates. For example, in one year of the study, total body weight of steers was 2112 pounds at 3.0 steers per acre and 1875 pounds at 30 lambs per acre. However, forage available for grazing as estimated by ryegrass height was about 4.5 inches in the steer pastures and 1.75 inches in the lamb pastures. Obviously, forage intake was greater for the lambs than for the steers at comparable body weight totals.

Table 13. Three-year comparison of lambs and steers performance from various stocked Marshall ryegrass pastures.[1]

Item	Stocking Rate LOW	MLO	MHI	HIGH
LAMBS				
Hd/ac	15	20	25	30
Initial Wt[2], lb/hd	45	45	45	45
Initial Wt/ac, lb	675	900	1125	1350
ADG, lb	.33	.28	.28	.23
Gain/lamb[3], lb	30	25	25	21
Gain/ac, lb	430	500	607	593
STEERS				
Hd/ac	1.5	2.0	2.5	3.0
Initial Wt[2], lb/hd	550	550	550	550
Initial Wt/ac, lb	825	1100	1375	1650
ADG, lb	2.14	2.13	2.46	1.91
Gain/steer[3], lb	193	192	221	172
Gain/ac, lb	285	384	547	518

[1]Sladden & Bransby, Auburn, AL. 1992.
[2]Initial wt of lambs was 40-50 lbs each and steers was 500-600 lbs during 3 years.
[3]Gain per animal estimated as 90-day average of 3-year study.

The effect of stocking rate of annual ryegrass on performance of ewes and lambs was ascertained in a four-year study in South Africa (de Villiers *et al.*, 1993). Stocking rates of 8.1, 9.8, 11.3, 13, and 14.6 ewes with lambs per acre were used to graze Italian (annual) ryegrass for an 84-day period. An 8-paddock rotation system with a 3.5 day residence time per paddock was used with 3 complete rotation cycles of the area. Individual ewe and suckling lamb performances were best at the lowest stocking rate of 8.1 pair per acre. Stocking rate also had a negative influence on body weight and milk yield of ewes. Thus, stocking rate accounted for 22.5% of the variation in lamb growth. Weaning weight of all lambs, with about 50% being twins, ranged from 50.4, 47.7, 43.8, 42.7, and 37.8 lbs, respectively, for the lowest to highest stocking rate. The average daily gains for all lambs on these respective five stocking rates were .43, .39, .35, .33, and .28 lb/day. One of the most dramatic effects occurring in this trial was the decline in ADG on all stocking rate pastures from the first to the last (third) grazing cycle of the 8-paddock system. The authors questioned the merit of a fixed 3.5-day rotational grazing system over the entire season, and whether or not supplemental forage or grain should be offered when forage availability falls below 2 to 3 inches in height. Stocking rate recommendations for either weaned lambs or ewe-lamb systems depend on several factors which include absolute price, margin, pasture conditions, continued ownership, etc.

The value of ryegrass pastures is that economically acceptable performance may be obtained with either lambs or steers. With the products of wool and meat, sheep production in the humid, improved pastures may offer feasible alternative livestock production systems. Management practices for sheep, however, are more intensive since predators such as domestic and wild dogs must be controlled as well as animal health disorders such as internal parasites (Scott, 1982).

Pastures for Deer Farming

Deer farming, production of deer species for venison and breeding stock on moderately to intensively managed forages, has been commercially practiced in New Zealand since the early 1970's. The population of farmed red deer in New Zealand was about 1.1 million in 1992 and is projected to be about 2.9 million by 1996 (Ataja, 1992). In order to meet marketing demands in the Northern Hemisphere, red deer venison produced in New Zealand should have carcass weights of more than 100 pounds, or more than 200 pounds liveweight at one year of age. The use of high quality ryegrass pastures are critically important in the economic feasibility of these ventures. Although numerous grazing experiments have been conducted with red deer, Ataja (1992) reported that sod-seeding 'Moata' annual ryegrass into an existing pasture of perennial ryegrass increased slightly the forage dry matter accumulation, animal carrying capacity, and the proportion of stags attaining the target slaughter weight (Table 14).

In 1994, 1.3 million pounds of venison were consumed in the U.S. with only .21 million pounds being produced nationally. Of this production quantity, 72% originated in Texas. With current economic incentives for venison, East Texas and the southeastern U.S. has ideal climatic conditions for producing high quality forages that may be intensively managed for high stocking densities. The influence of stocking rate on ryegrass pastures by weaned fallow bucks was ascertained at the Overton Center during the winter of 1994-95 (Doctorian *et al.*, 1995). The ADG from fallow deer grazed in East Texas was similar to that of red deer in the New Zealand study by Ataja (1992). Liveweight gains ranged from about .1 to .2 lb/day during the winter, but then accelerated to .26 to .43 lb/day during the spring across the four stocking rates used (Table 15). Preliminary results from this study indicated that only those fallow bucks stocked at 12 hd per acre (lowest) may reach the target weight of 100 pounds liveweight by the end of May. A

Table 14. Two-year average venison production from red deer grazing annual or perennial ryegrass.[1]

Item	Ryegrass: Annual + Perennial		Ryegrass: Perennial	
No. Stags/yr	15		15	
Initial Wt, lb	123		123	
ADG, lb				
Winter	.33		.32	
Spring	.49		.51	
Pasture Height	2 in.	4 in.	2 in.	4 in.
ADG, lb				
Winter	.17	.29	.16	.33
Spring	.46	.46	.32	.52
Stags Reaching 200 lb, %	21	50	0	42

[1]Ataja, *et al.* Palmerston North, NZ. 1992.

Table 15. Performance of fallow deer grazing TAM 90 ryegrass at various stocking rates.[1]

Item	Stocking Rate (hd/ac): 12	16	20	24
Initial Wt, lb/hd	53	53	53	53
Initial Wt/ac, lb	636	848	1060	1272
Gain/hd[2]	39	35	33	23
Gain/ac	468	563	656	547
ADG[3]				
Winter[4]	.18	.14	.13	.08
Spring[4]	.43	.39	.40	.26
Season	.26	.24	.22	.15

[1]Doctorian *et al.*, Overton, TX. 1995.
[2]Grazing initiated December 7 and terminated May 4.
[3]Average Daily Gain.
[4]Winter = Dec 7 to March 1; Spring = March 15 to May 4.

stocking rate of 20 fallow bucks per acre (1050 to 1100 pounds body weight/ac) maximized gain per acre at more than 650 lbs; however, additional supplemental feed and/or time may be required for these animals to reach 100 pounds each.

For both the red deer in New Zealand and fallow deer in East Texas, trends for lower ADG during winter and higher ADG during the spring months occurred on the ryegrass pastures.

These seasonal gain differences may be due to climatic conditions, forage availability, or secretion of melatonin from the pineal gland (Barry *et al.*, 1991; Domingue *et al.*, 1992). It has been reported by some that the cycles of both voluntary intake and growth in seasonal breeds of deer are most likely linked to photoperiod by secretion of melatonin. An attempt by Ataja *et al.* (1992) was made to immunize the red deer to melatonin. Although there was a 73% response with antibody titres, vaccination of red deer at 3 months of age against melatonin had no effect on liveweight gain, carcass traits, or plasma concentrations of luteinizing hormone or testosterone.

Ryegrass and mixtures with small grains and/or clovers will be the critical component of the future deer farming industry in the southeastern U.S. The nutritional availability during the fall-winter-spring period coincides with energy and protein requirements for both growth of yearlings and reproduction of does. The grazing management and utilization of ryegrass should adhere to stubble height guidelines mentioned by Ataja *et al.*(1992) (Table 14) in which pasture height had a profound influence on the gain and percent of deer reaching target liveweights for venison. It is also anticipated that energy-protein supplementation programs may be a valuable component in the last quarter of the ryegrass growing season. And, as indicated with sheep, a weight-for-weight stocking rate across animal species will need adjustments to counter the apparent differences in intake between deer, sheep, and cattle.

Summary

The incorporation of annual ryegrass into either seasonal or year-round pastures in the southeastern U.S. provides producers with numerous opportunities for systems of grazing management and profit potential. The reliability of establishment and consistency of production of annual ryegrass in warm-season perennial grass-based pasture-hay systems have resulted in ryegrass being used as a normal part of the forage-animal enterprise. Beef cattle gains of 400 to 800 lb/ac, ADG exceeding 2 to 2.5 lb/day, and stocking densities in excess of 2500 lb BW/ac during the 75 to 100-day spring growth rate period are forage characteristics that cause producer selection and acceptability of this annual grass. Biologically, the nutritive value provided from annual ryegrass during the winter-spring period is adequate for superior animal performance without supplementation. Economically, costs associated with forage production are climate and soil fertility-specific; however, proper utilization of forage becomes the major management concern with respect to minimizing costs per pound of gain or costs per pregnancy. There are sufficient comparative databases in existence throughout the southeastern U.S. to provide producers with reasonable expectations of stocking rates necessary to utilize forage produced.

With most cool-season annual forages, some graze-rest system of management encourages dry matter production, particularly during the mid-winter period. That is not to say that rigid, time-based rotational grazing systems hold any advantage over a less strict movement or even continuously grazed pastures. The primary objective of management is to be prepared to properly utilize forage that is produced. This utilization scheme may involve a flexible, variable stocking density with one or more classes of livestock and/or the addition of storing forage as silage or hay.

Achieving the economic optimum grazing management and utilization of annual ryegrass pastures is not an especially easy task. A knowledge base of forage growth expectations and the art of managing proper defoliation regimens will allow for the greatest opportunity for positive economic returns and an acceptable transition from cool-season to warm-season pastures. The timing of events such as fertilization, initiation and duration of grazing, stocking rate, use of electric fencing to control defoliation severity, and selection of class of livestock are major criteria that affect economic returns. Annual ryegrasses are extremely tolerant of frequent and severe defoliation regimens created via high stocking rates; however, a balance between utilization and sustaining the forage resource needs to be incorporated into the management plan.

Literature Cited

Alison, W. M. 1992. Grazing management of overseeded ryegrass. AFGC Proceedings. p. 55-59.

Ataja, A. M., P. R. Wilson, T. N. Barry, J. Hodgson, R. M. Hoskinson, W. J. Parker, and R. W. Purchas. 1992. Early venison production from red deer (*Cervus elaphus*) as affected by grazing perennial or annual ryegrass pastures, pasture surface height and immunization against melatonin. J. Agric. Sci. 118:353-369.

Bagley, C. P., J. I. Feazel, and J. C. Carpenter, Jr. 1982. Grazing steers on winter annuals. Louisiana Agri. Exp. Stn. Rep. 26:22-23.

Barry, T. N., J. M. Suttie, J. A. Milne, and R.N.B. Kay. 1991. Control of food intake in domesticated deer. p. 385-401. *In* T. Tsuda, Y. Sasaki, and R. Kawashima (ed.) Physiological Aspects of Digestion and Metabolism in Ruminants. Proc. VII International Symposium on Ruminant Physiology. San Diego, California. Academic Press.

de Villiers, J. F., W. A. Batha, and Marie F. Smith. 1993. The effect of stocking rate on the performance of ewes and lambs on Italian ryegrass. So. Agr. J. Anim. Sci. 23:45-50.

Doctorian, D. S., G. W. Evers, D.A. Neuendorff, and R. D. Randel. 1995. Growing weaned fallow bucks to slaughter on cool-season pasture in East Texas. Overton Res. Ctr. Tech.

Rept. 95-2 (in press).

Domingue, B.M.F., P. R. Wilson, D. W. Dellow, and T. N. Barry. 1992. Effects of subcutaneous melatonin implants during long daylength on voluntary feed intake, rumen capacity and heart rate of red deer fed a forage diet. British J. of Nutr. 68:

Feazel, J. I. 1986. Beef calf performance on overseeded winter annual pastures. Rosepine Res. Stn. Prog. Rep. p. 131-137.

Gaertner, S. J., F. M. Rouquette, Jr., C. R. Long, and J. W. Turner. 1992. Influence of calving season and stocking rate of birth weight and weaning weight of Simmental-sired calves from Brahman-Hereford F_1 dams. J. Anim. Sci. 70:2296-2303.

Hansen, D. K., F. M. Rouquette, Jr., M. J. Florence, G. W. Webb, G. D. Potter. 1988. *In* Forage Research in Texas. Growth and development of yearling horses using pasture and supplemental feed. PR 4593:12-16.

Hansen, D. K., F. M. Rouquette, Jr., M. J. Florence, J. Walker, and R. Heitschmidt. 1987a. *In* Forage Research in Texas. Grazing behavior of yearling horses. I. Time spent grazing different forages. PR 4537:17-19.

Hansen, D. K., F. M. Rouquette, Jr., M. J. Florence. 1987b. *In* Forage Research in Texas. Grazing behavior of yearling horses. II. Selective or spot grazing of bermudagrass. PR 4537:19-20.

Hutcheson, D. P. and F. M. Rouquette, Jr. 1992. Feedlot and carcass traits of stocker yearling *vs* weanling calves. Overton Res. Ctr. Tech. Rep. 92-1:97-98.

Merrill, L. B. and J. E. Miller. 1961. TAES MP-484.

Merrill, L. B., P. O. Reardon, and C. L. Lineweber. 1966. TAES Prog. Rep. 12:4, 13-14.

Morrison, D. G. 1994. Effect of ryegrass variety and planting method on stocker steer performance. Rosepine Res. Stn. Prog. Rep. p. 91-96.

Nelson, L. R. 1991. 'TAM 90' annual ryegrass. Texas Agric. Exp. Stn. L-2428.

Riewe, M. E., J. C. Smith, J. H. Jones, and E. C. Holt. 1963. Grazing production curves. I. Comparison of steer gains on Gulf ryegrass and tall fescue. Agron. J. 55:367-372.

Riewe, M. E. 1976. Principles of grazing management. p. 170-206. *In* E. C. Holt and R. D. Lewis (ed.) Grasses and legumes in Texas - Development, production, and utilization. Tex. Agric. Exp. Stn. Res. Mono. 6C.

Rouquette, F. M., Jr., R. R. Riley, and J. W. Savell. 1983. Electrical stimulation, stocking rate, and creep feed effects on carcass traits of calves slaughtered at weaning. J. Anim. Sci. 56:1012-1019.

Rouquette, F. M., Jr. 1984. Forage systems for producing slaughter calves at weaning. AFGC Proceedings. p. 1-9.

Rouquette, F. M., Jr., M. J. Florence, and G. R. Smith. 1989. *In* Forage Research in Texas. Animal performance from winter pastures using fertilizer or cowpeas and clover for the nitrogen source. PR 4731:7-10.

Rouquette, F. M., Jr., M. J. Florence, V. A. Haby, and G. R. Smith. 1992a. *In* Forage Research in Texas. Sustained production from common bermudagrass pastures using clover-potassium or ryegrass-nitrogen. PR 5039:71-76.

Rouquette, F. M., Jr., M. J. Florence, V. A. Haby, and G. R. Smith. 1992b. *In* Forage Research in Texas. Sustained production from Coastal bermudagrass pastures. PR 5040:77-82.

Rouquette, F. M., Jr., M. J. Florence, C. R. Long, and T. H. Montgomery. 1994. Performance and carcass characteristics of fall-born calves placed into a High Plains feedlot at weaning. Overton Res. Center Tech. Rep. 94-1:99-100.

Scott, G. E. 1982. The Sheepman's Production Handbook. Sheep Industry Development Program. Denver, Colorado. Abegg Printing.

Sladden, S. E. and D. I. Bransby. 1992. Stocking rate-gain relationships for sheep and cattle on ryegrass. AFGC Proceedings. p. 51-54.

Snell, M. G. 1935. *In* Proc. Amer. Soc. Anim. Prod. 142:48.

Terrill, C. E. and D. A. Price. 1985. Sheep, goats, and rabbits: Efficient users of forage. Chapter 61, p. 578-589. *In* M. E. Heath, R. F. Barnes, and D. S. Metcalfe (ed.) Forages. The Science of Grassland Agriculture.

Thompson, K. N., S. G. Jackson, and J. P. Baker. 1988. The influence of high planes of nutrition on skeletal growth and development of weanling horses. J. Anim. Sci. 66:2459-2467.

Weihing, R. M. 1963. Registration of 'Gulf' annual ryegrass. Crop Sci. 3:366.