(CRN) which contains an ionophore. The economy of gain from CRN appears to be favorable under most conceivable pricing situations; whereas, the use of supplemental FMR may only be economically feasible in specific cattle pricing situations or cost of gain circumstances.

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Growth and Development of Yearling Horses Using Pasture and Supplemental Feed

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Summary

A 2-year pasture experiment was conducted at Overton to determine the influence of pasture (PAS) and pasture plus supplemental feed on average daily gain (ADG), height (HTH), heart girth circumference (HGC), fat thickness (FAT), and visual condition score (VCS). Thirty yearling horses averaging 650 lbs were grazed from March to October on bermudagrass pastures which were sod-seeded with 'Elbon' rye and 'Marshall' ryegrass. In study 1, yearlings were assigned to either PAS, or pasture plus a daily grain supplement which supplied 50 percent of Nuclear Regulatory Commission (NRC) energy requirements (.5 FED). Study 2 included PAS, .5 FED, and .25 FED (daily supplement which supplied 25 percent of NRC) treatments. The HTH was not affected by treatment in either study; however, HGC, FAT, and VCS were increased ($P<.05$) in the .5 FED groups. In both studies, horses assigned to .5 FED gain about .3 lb/d more ($P<.05$) than horses assigned to PAS. Horses which received the .25 FED treatment gained and responded similarly to those yearlings on PAS. Results indicated that yearlings on improved rye-ryegrass-bermudagrass pastures can attain similar or greater ADG than projected by NRC, and that there was no detrimental effect of a pasture only diet on skeletal development.

KEYWORDS: Bermudagrass/ryegrass/rye/forage quality/nutritive value/nutritional requirements.

Introduction

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 yearlings. Forages have long held traditional roles in supplying 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 United States can provide high-quality, year long pastures which may be suitable for the development of yearling horses. The objectives of these trials were to determine the biological feasibility of developing yearling horses on an exclusive forage diet, and to compare these yearlings to contemporaries fed supplemental grain in addition to pasture.

Procedure

Two separate trials were conducted in which a total of 30 yearling stock horses averaging 650 lbs were randomly allotted by sex, weight, height, and visual condition score (Henneke et al. 1981) to various pasture × supplemental feed treatments. In Trial 1, three geldings (Rep 1) and three fillies (Rep 2) were assigned to either: 1) pasture only (PAS); or 2) pasture plus a daily supplemental grain providing 50 percent of NRC recommended level of energy (.5 FED). The supplement in Trial 1 was a 14 percent crude protein (CP) commercially available, pelletized ration which was fed at the daily rate of 8 lbs per yearling. During Trial 2, three geldings (Rep 1) and three fillies (Rep 2) were assigned to the following treatments: 1) PAS; 2) .5 FED; or 3) pasture plus a daily supplemental grain providing 25 percent NRC recommended level of energy (.25 FED). The supplement used in Trial 2 was a 17 percent CP ration which consisted of ground corn, cottonseed meal, and ground alfalfa which provided 60 percent of NRC recommended level of protein in the .5 FED ration. Yearlings assigned to .5 FED received a once daily ration of 5 lbs per horse, and yearlings assigned to .25 FED received 2.5 lbs per horse. Horses had ad libitum access to water and trace-mineralized salt blocks throughout the trials. Yearlings were de-wormed at the initiation of the trials and at 60-day intervals throughout the experiments.

Forage

Bermudagrass (Cynodon dactylon [L.] Pers.) pastures growing on a Darco soil (Grossarenic Paleudult; loamy, siliceous, thermic) were sod-seeded with 'Elbon' rye (Secale cereale L.) and 'Marshall' ryegrass (Lolium multiflorum [L.] Lam.) in mid-October of each year of the two

as well as an economic alternative for developing yearling horses. It is recognized that although a high percentage of yearling horses can utilize this type of pasture development program, there are certain management objectives which cannot be met through an exclusive pasturing program. For example, horses which are being prepared for athletic events, halter performances, sales, etc. will most likely not attain the preferred or desired level of condition and visual appearance from an exclusive pasture diet. It is noteworthy, however, that yearling horses can gain at the rate of more than 1 lb/day from an exclusive pasture diet and without any detrimental effect on skeletal growth.

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trials. Pastures received 60-60-60 lbs/A of N-P_2O_5-K_2O, respectively, at planting, and 50 lbs N/A at 6-week intervals throughout the grazing period. Full-time, continuous grazing of cool season annual forages was initiated in late March of each year. The length of grazing period averaged 190 days for both years and was not initiated during the fall months due to availability of test animals. Pastures consisted of rye-ryegrass from March until late May, and bermudagrass from late May to October. Grazing trial data were partitioned into two periods during each year which coincided with available rye-ryegrass forage and exclusive bermudagrass forage. Stocking rates were held uniform at approximately 3.0 horses (1 horse equivalent = 700 lbs) per acre. Forage available to ground level (0 in height) was measured at monthly intervals in each year to ensure relatively equal availability on all treatments. Pastures were sampled for nutritive value at monthly intervals by hand-picking plant parts in near proximity to the grazing animal and which visually represented forage being selected by the horses. Forage samples were dried, ground, and analyzed for crude protein (Tecator 1030 Autoanalyzer, AOAC, 1975) and in vitro dry matter digestibility (Barnes 1969).

Animal Measurements

Live weight was taken at approximately 30-day intervals throughout the trials. Wither height was measured at the beginning, mid-point, and termination of each trial. Visual condition score (VCS) (Henneke et al. 1981) was taken at the beginning and end of each trial, and rump fat thickness was measured ultrasonically (Technicare 310 DX Ultrasound) 1 inch lateral to the midline, and mid-distance between the tuber aoxae and tuber ischii at the termination of each trial. Data from both trials were analyzed by the General Linear Model procedure of SAS using the analysis of variance procedures appropriate for the randomized block design. Significant ($P<.05$) treatment means were separated using the least significant difference method.

Results and Discussion

Forage available (lbs dry matter [DM]/A) and forage allowance (lbs DM/100 lbs body weight [BW]) for each pasture-supplement treatment for both trials are shown in Tables 1 and 2, respectively. Available forage was relatively similar between treatments within year and was available in adequate supply at all times as to not restrict ad libitum intake. Forage allowance was usually above 100 throughout both trials which corresponds with a designated light stocking rate measured in trials with beef cattle in similar pastures (Rouquette et al. 1984).

Percent crude protein (CP) content ranged from 19 percent to 10 percent in Trial 1, and from 26 percent to 13.7 percent in Trial 2 (Table 3). The CP of bermudagrass was above average during Trial 2 as compared to Trial 1 due to mild temperatures and evenly distributed rainfall during the entire growing season. However, within each trial, CP content of forage was very similar among replicate and treatment pastures.

TABLE 1. PERIODIC FORAGE AVAILABILITY[1] AND FORAGE ALLOWANCE[2] OF PASTURES GRAZED BY YEARLING HORSES RECEIVING ONLY PASTURE (PAS) OR PASTURE PLUS SUPPLEMENTAL FEED (.5 FED) IN TRIAL 1

	Treatment			
	PAS		.5 FED	
Trial 1 Date	lb DM/A[1]	lb DM/100 lbs[2] BW	lb DM/A	lb DM/100 lbs BW
Mar. 15	2,550	192	2,300	181
Apr. 27	3,996	275	5,854	396
May 29	2,719	184	2,868	185
July 3	1,142	58	742	40
Aug. 28	5,227	270	6,224	309
Oct. 2	3,110	154	4,675	222

[1]Lbs dry matter forage/A.
[2]Lbs dry matter forage/100 lbs body weight.

TABLE 2. PERIODIC FORAGE AVAILABILITY[1] AND FORAGE ALLOWANCE[2] OF PASTURES GRAZED BY YEARLING HORSES ASSIGNED TO PASTURE OR PASTURE PLUS SUPPLEMENTAL FEED IN TRIAL 2

	Treatment					
	PAS		.25 FED		.5 FED	
Trial 1 Date	lb DM/A[1]	lb DM/100 lb[2] BW	lb DM/A	lb DM/100 lbs BW	lb DM/A	lb DM/100 lbs BW
Mar. 28	1,912	111	2,966	169	3,271	188
Apr. 2	2,215	126	3,019	164	3,011	165
Apr. 28	2,848	156	3,217	172	2,720	146
May 12	3,125	159	3,115	152	2,634	129
June 2	2,859	144	2,965	143	2,969	141
June 21	3,266	164	2,448	117	2,368	110
July 21	4,629	219	2,723	124	3,726	163
Aug. 21	3,970	180	2,797	123	4,126	172
Sept. 23	6,004	257	3,426	145	5,558	222

[1]Lbs dry matter forage/A.
[2]Lbs dry matter forage/100 lbs body weight.

TABLE 5. PERFORMANCE OF YEARLING HORSES ON PASTURE OR PASTURE PLUS SUPPLEMENTAL FEED DURING BOTH TRIALS

Item	Trial 1		Trial 2		
	PAS	.5 FED	PAS	.25 FED	.5 FED
Initial wt, lb	665	637	642	655	650
Final wt, lb	891	930	873	882	934
Weight gain, lb	226a	293b	230a	227a	284b*
Average Daily Gain (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).

TABLE 6. 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, lbs[1]	8	0
Total for period, lbs	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./A	3	3
Per horse	$ 41.67	$ 41.67
Average daily gain,[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-rye-grass-bermudagrass.
[4] Stocking rate of 1½ yearlings/A for 70 days (winter/spring) and 3½ yearlings/A for 200 days (spring/summer) for an average of three horses/A for the 270-day period.
[5] Based on data from a 2-year trial.

to the projected gains for yearlings of this size (NRC 1978); whereas, the ADG for yearlings which received .5 FED in both trials was higher than that projected by NRC (1978). The gains for horses assigned to both PAS and .25 FED also performed similarly to yearlings which were limit-fed a concentrate-hay diet (Ott and Asquith 1986). The ADG of the .5 FED yearlings was similar to gains attained by ad libitum feeding of yearlings at a similar beginning age and weight (Ott and Asquith 1986).

Conclusions

Results of these trials indicated that high quality, improved pastures which are high in protein and energy can support yearling horses with weight gains consistent with NRC (1978) projections. Additionally, these overseeded bermudagrass pastures are capable of accommodating stocking rates in excess of three 700-lb horse equivalents/A during the yearling development stage. Yearling horses fed a grain supplement, which provided 50 percent of NRC (1978) daily energy requirement (.5 FED), gained more weight and had a greater VCS and rump fat thickness than PAS or .25 FED animals which indicated a portion of increased weight was due to fat gain. There appeared to be no advantage of feeding a grain supplement providing 25 percent of NRC (1978) (.25 FED) recommended level of energy to yearlings over non-supplemented horses on pasture as evidenced by weight, height, VCS, and rump fat thickness.

During the first year, supplemental feed provided an additional .34 lbs/day of weight gain and horses were visually scored to have more condition or fat when compared to yearlings on the pasture only treatment. There was no difference between horses assigned to PAS or .5 FED with respect to height gain. In the second trial, yearlings which received 5 lbs/day gained an extra .29 lbs/hd/day, had more rump fat, and were visually scored to be in better condition. There was no influence of supplemental feed on increases in either height or heart girth circumference. Although absolute performance appeared to be different between years as anticipated, the only impact of supplementing yearling horses with approximately 50 percent of their nutrient requirements was an additional weight gain of approximately .3 lbs/day. The conversion of the supplemental feed to extra gain was 24:1 in Trial 1 and 17:1 in Trial 2. Perhaps, the most significant part of these trials was that the supplemental feed used was probably substituting for forage rather than having an additive effect on weight gain.

Table 6 shows the cost relationships between pasture only and supplemental feeding on pasture. In general, anticipated feed costs would average from $1.25 to $1.50/hd/day under conditions where pasture was either not available or not used as a source of nutrients. By using the animal performance data from the 2-year trial, estimated costs may be projected which allows for a comparison of pasture only and pasture plus a supplemental feed. During a 270-day grazing period, total costs per yearling on the pasture only treatment was $41.67; whereas, total yearling costs on pasture plus supplemental grain was $279.27. These costs indicate a daily pasture-feed cost of $1.03 per yearling on the supplemental regimen and $0.15 per yearling on pasture only. Although it is not generally customary to examine costs per pound of gain for horses, the yearlings which received supplement on pasture gained at a cost of nearly 70 cents per pound of gain; whereas, the yearlings which received pasture only gained at a cost of 15 cents per pound of gain.

Results from these experimental grazing trials indicated that bermudagrass pastures overseeded with winter annuals such as rye and ryegrass can provide a biological

TABLE 3. PERCENT CRUDE PROTEIN (CP) AND IN VITRO DRY MATTER DIGESTIBILITY (IVDMD) OF PASTURES GRAZED BY YEARLING HORSES

	Trial 1 Treatment Pastures			
	PAS		.5 FED	
Date	CP	IVDMD	CP	IVDMD
	Percent			
Apr. 4	19.0	76.2	18.8	75.2
May 10	17.5	73.0	20.0	76.7
May 24	9.9	61.7	11.7	65.8
June 11	10.6	55.7	10.9	53.0
June 29	10.2	49.5	11.4	55.0
July 18	16.4	61.3	16.7	59.0
Aug. 1	16.3	58.6	15.1	60.0
Aug. 15	13.8	58.4	14.2	58.4
Sept. 6	11.1	48.0	11.3	50.4
Oct. 2	10.8	49.5	11.0	50.2

	Trial 2 Treatment Pastures		
Date	PAS	.25 FED	.5 FED
	Percent CP		
Mar. 26	26.8	25.0	25.5
Apr. 2	22.3	23.0	22.8
Apr. 28	24.8	22.5	23.2
May 12	22.3	21.0	22.6
June 2	19.3	20.1	21.4
June 21	16.9	17.6	18.2
July 21	14.2	13.7	14.7
Aug. 21	16.8	16.6	18.9
Sept. 24	19.5	19.1	19.2

Initial measurements of height at the withers and VCS (Table 4) were similar across treatments. Final wither height was not affected by treatment within each trial. Total height gain averaged 1.8 inches in Trial 1 and 2.9 inches in Trial 2. The height similarities between treatments in both trials indicated that adequate skeletal growth of yearling horses was possible from improved pastures without the use of supplemental feed. The values for final height were similar to yearlings that were either limit fed or fed an ad libitum hay-grain diet for 140 days (Ott and Asquith 1986). This verifies that yearlings on these pasture treatments were growing at a similar rate to contemporary yearlings in other experiments. The VCS was similar initially between treatments, but was greater ($P<.05$) for the supplemented yearlings in Trial 1 compared to horses assigned to PAS. In trial 2, a similar trend was seen as final VCS was greater ($P<.05$) for yearlings which received .5 FED than yearlings assigned to either .25 FED or PAS. The VCS were verified by rump fat thickness which was greater ($P<.05$) for horses assigned to .5 FED than to those assigned to PAS in Trial 1. In Trial 2, rump fat thickness was greater ($P<.05$) in horses which received .5 FED than for horses which received either PAS or .25 FED.

Initial weight (Table 5) was similar across treatments and averaged 651 lbs in Trial 1 and 649 lbs in Trial 2. The .5 FED animals had greater total weight in both trials

TABLE 4. GROWTH AND DEVELOPMENT MEASUREMENTS OF YEARLING HORSES ON PASTURE OR PASTURE PLUS SUPPLEMENTAL FEED IN BOTH TRIALS

	Trial 1		Trial 2		
ITEM	PAS	.5 FED	PAS	.25 FED	.5 FED
Withers Height (in.)					
initial	54.1	52.8	52.8	52.8	52.4
final	56.0	54.5	56.2	55.6	55.8
gain	1.9	1.7	3.4	2.8	3.4
Heart Girth (in.)					
initial	—	—	59.3	59.2	59.3
final	—	—	65.6	65.2	66.7
gain	—	—	6.3b	6.0b	7.4a*
Condition Score**					
initial	4.0	4.0	4.5	4.6	4.6
final	4.2a	5.9b	5.3a	5.2a	6.3b
Rump Fat Thickness (in.)					
initial	—	—	.14	.17	.18
final	.30b	.35a	.21b	.24b	.35a
gain	—	—	.07b	.08b	.18a

*Treatment means in the same row of a specific trial and not sharing the same superscript differ ($P<.05$).
**Condition score described by Henneke et al. (1981).

($P<.05$) than PAS yearlings and also greater gain than .25 FED yearlings in Trial 2. In Trial 1, ADG for the rye-ryegrass grazing period was greater for .5 FED yearlings than PAS yearlings. Similar trends between fed and non-fed animals grazing winter pasture have been observed with cattle during the first 60 to 75 days of the grazing period (Rouqette et al. 1982). In Trial 2, both the .25 FED and .5 FED groups had greater ADG than PAS yearlings during the winter pasture period. It is not clear whether the gain advantage in the winter annual forage grazing period of the yearlings receiving supplemental feed was a result of supplemental energy, dry matter content of supplement, or a combination of these or other digestive factors. In the bermudagrass grazing period of Trial 1, there was no difference in ADG between treatments which averaged 1.21 lbs/day. However, in Trial 2, horse ADG from the bermudagrass period was greater ($P<.05$) for .5 FED yearlings at 1.28 lbs than for both PAS yearlings (1.03 lbs) and .25 FED yearlings (.88 lb). Supplemental-fed yearling gains during the bermudagrass phase in both trials tended to decline somewhat compared to the rate of gain during the rye-ryegrass period. This was probably due to forage quality differences and the fact that animals became more mature during the summer months; thus, growth was slowed which agrees with NRC (1978) gain projections.

Average daily gain over the entire experiment in Trial 1 was greater ($P<.05$) for yearlings in the .5 FED group (1.46 lbs) than for yearlings in the PAS treatment (1.12 lbs). In Trial 2, the same trend was apparent as the .5 FED yearlings had greater ($P<.05$) weight gain (1.52 lbs) than either .25 FED yearlings (1.21 lbs) or PAS yearlings (1.23 lbs). The ADG values for yearlings assigned to PAS in Trial 1 and 2, and for .25 FED yearlings in Trial 2 were similar