Growth Performance of Stocker Calves Backgrounded on Sod-seeded Winter Annuals or Hay and Grain

K. P. Coffey[1], W. K. Coblentz[1], T. G. Montgomery[2], J. D. Shockey[3], K. J. Bryant[2], P. B. Francis[2], C. F. Rosenkrans, Jr.[1], and S. A. Gunter[4]

Story in Brief

Sod-seeded winter annual forages may produce less forage than those same forages planted by conventional tillage practices but have potential to provide an economically-viable option for retaining ownership of fall-weaned calves. A study was conducted during the winters of 1998, 1999, and 2000 using 180 crossbred calves (576 ± 6.2 lb initial BW; n = 60 each year) to compare sod-seeded winter annual forages with conventional hay and supplement backgrounding programs in southeast Arkansas. Calves were provided bermudagrass hay (ad libitum) and a grain sorghum-based supplement (6 lb/d) on 2.5-acre dormant bermudagrass pastures (HS) or were grazed on 5-acre pastures of bermudagrass/dallisgrass overseeded with 1) annual ryegrass (RG), 2) wheat plus RG, or 3) rye plus RG at a stocking rate of 1 calf/acre. Calves grazed from mid-December until mid-April, but were fed bermudagrass hay during times of low forage mass. Mean forage CP and in vitro dry matter digestibility (IVDMD) concentrations were 19.0 and 71.1%, respectively across sampling dates and winter annual forages. During the first two years, calves fed HS gained less ($P < 0.05$) BW than calves grazing winter annual forages, and gains did not differ ($P \geq 0.23$) among winter annual treatments. During the third year, undesirable environmental conditions limited growth of the winter annual forages, and total gain did not differ ($P = 0.66$) among the four treatments. Winter annual forages offer potential to provide high quality forage for calves retained until spring, but consistent forage production and quality are a concern when sod-seeding techniques are used.

Introduction

Considerable research has been conducted evaluating winter annuals as a forage source for stocker calves, but much of the research has been conducted using conventional tillage practices. Winter annual forages are generally high in quality (McCormick et al., 1998; Lippke et al., 2000) and capable of producing high rates of calf gain. Winter annuals seeded into warm-season forage sods may have lower and more variable forage production (Moyer and Coffey, 2000) and lower animal gains/acre (Moyer et al., 1995) than those seeded into prepared seedbeds. However, sod-seeded winter annuals offer the potential to improve land use efficiency (Moyer et al., 1995) and animal gains relative to those expected from calves wintered on other dormant forages (Wilkinson and Stuedemann, 1983). It is therefore necessary to evaluate different winter annual forage programs for their production potential and use in retained-ownership programs for stocker calves. The objectives of this study were to 1) compare BW gain of calves grazing sod-seeded ryegrass, wheat and ryegrass, or rye and ryegrass with gain of calves fed bermudagrass hay and supplemental grain during winter, and 2) compare forage quality and availability from the different combinations of winter annual forages throughout the grazing season.

Experimental Procedures

Nine 5-acre pastures containing 'common' bermudagrass (*Cynodon dactylon* (L.) *Pers.*) and dallisgrass (*Paspalum dilatatum Poir.*) were allocated randomly to one of three winter annual forage treatments in a 3-yr grazing study during the winter months of 1998, 1999, and 2000. In a fourth backgrounding treatment, calves were placed on three dormant bermudagrass pastures (2.5 acres) and provided ad libitum access to bermudagrass hay and fed a grain sorghum – based supplement (15.3% CP) at 6 lb/d along with 0.65 lb of cottonseed meal (HS, Table 1). Forage treatments consisted of overseeding the pastures with either 30 lb/acre of 'Marshall' annual ryegrass (RG), 30 lb/acre of 'Marshall' annual ryegrass plus 100 lb/acre of 'Bonel' rye (RRG), or 30 lb/acre of 'Marshall' annual ryegrass plus 120 lb/acre of 'Madison' soft wheat (WRG). Pastures were disked lightly and overseeded by broadcasting the respective forages in late-September of each year. Pastures were then harrowed lightly to help incorporate seed. Pastures were fertilized by broadcasting with 50 lb/acre each of N, P_2O_5, and K_2O (as KCl) in late-November and with an additional 50 lb/acre of N in early February. Once original randomization was determined, pastures received the same forage treatment throughout the entire 3-yr study. During the summer months, pastures were used to evaluate the impact of different supplementation programs on performance by stocker cattle grazing bermudagrass pastures. Those studies were terminated in sufficient time to allow grazing of each pasture at excessive stocking rates to remove excess bermudagrass forage prior to seeding winter annual forages.

Forage mass was measured monthly by clipping three random areas per pasture to a height of approximately 1 in and drying these samples to a constant weight. Random hay samples were collected each week as the bales were being fed and composited across dates. Since the same cutting of hay was fed in years 1 and 2, those samples were composited across years as well. Samples were analyzed for in vitro dry matter digestibility (IVDMD) and for crude protein (CP).

One hundred eighty crossbred calves (576 ± 6.2 lb; n = 60 per year) from the University of Arkansas Southeast Research and Extension Center cowherd were used over the 3-yr period. The cowherd consisted of either Brahman x Hereford or Brahman x Charolais cows bred to either Angus (yr 1 and 2) or Beefmaster (yr 3) sires. Calves were weighed on two consecutive days in mid-

[1] Department of Animal Science, Fayetteville
[2] University of Arkansas, Monticello
[3] Former Research Specialist, University of Arkansas, Monticello
[4] Southwest Research and Extension Center, Hope

December of each year, stratified by weight and sex, and allocated randomly to one of twelve groups of five head each. Grazing began December 19, 1997, December 18, 1998, and December 17, 1999 and continued for 112, 112, and 119 d in yr 1, 2, and 3, respectively. In yr 1, one replicate of heifers and two replicates of steers were allocated to each treatment. In yr 2, one replicate of steers, one replicate of heifers, and one replicate of mixed steers and heifers were allocated to each treatment. In yr 3, two heifers and three steers were distributed within each replicate of calves. All calves had been weaned and vaccinated in October before beginning the grazing period. Steer and heifer calves were implanted with zeranol (36 mg; Ralgro; Schering-Plough Animal Health, Inc., Omaha, NE) and dewormed with oxfendazole (Synanthic; Ft. Dodge Animal Health, Overland Park, KS) immediately before allocation to experimental pastures or dormant bermudagrass lots during yr 1 and 2, but only steers were implanted in yr 3.

Once original pasture allocations were made, calves remained on their assigned pasture throughout the duration of the study. The exception to this was during yr 3 when low available forage dictated removal of calves from all winter annual forage pastures for 41 d. Adverse weather conditions led to low forage production on most pastures. These conditions were characterized by an extremely dry fall and early winter and a rapid decline in temperature in mid-December that caused considerable damage to the winter annual forages. Since available moisture was limiting and forage production during the ensuing period was anticipated as minimal, the decision was made to remove calves from the experimental pastures on d 28. Calves were offered hay as a group rather than leaving them on their respective pastures. This was done to allow the forage time to grow when growing conditions improved. Calves were returned to their original pastures on d 69 when available forage was adequate. During yr 1 and 2, bermudagrass hay was offered when available forage was deemed inadequate by visual appraisal (< 1.25-in forage height), but calves were allowed to remain on their respective pastures.

Calves grazing the winter annual pastures were fed 2 lb/animal daily of a grain sorghum-based supplement (11.4% CP) containing trace mineral salt, necessary minerals, and 200 mg monensin per calf (Elanco Animal Health, Indianapolis, IN; Table 1). Calves fed bermudagrass hay (12.0% CP, 54.0% IVDMD) were also fed 5.9 lb/d of a ground grain sorghum-based supplement (1% of initial BW in yr 1) and 0.65 lb/d of cottonseed meal. The supplement contained trace mineral salt, limestone, and monensin (200 mg/hd) to provide similar quantities of each of these components as was offered to calves on pasture. Square bales of bermudagrass hay were offered daily in feed bunks to provide ad libitum consumption.

Calves were weighed without prior removal from feed and water on two consecutive days in early April to determine ending weights and grazing was terminated on April 10, 1998, April 9, 1999, and April 19, 2000, in yr 1, 2, and 3, respectively.

Statistical analyses for IVDMD, CP, and forage mass were conducted using SAS (SAS Inst., Inc., Cary, NC) GLM procedures for a split-split plot design. Animal BW and gain data were analyzed using a repeated measures analysis of variance.

Results and Discussion

A 3-way interaction between year, treatment, and sampling date was detected ($P < 0.01$) for forage CP and IVDMD concentrations. Therefore, data were analyzed and reported within year. In yr 1, CP concentrations were lower ($P < 0.05$) from RG pastures than from WRG pastures on d 0 and 28 and from RRG pastures on d 28, but higher ($P < 0.05$) from RG than from RRG pastures on d 84. Forage CP concentrations did not differ ($P \geq 0.71$) among winter annual treatments on d 56 or 112. The change in trends for forage CP concentration among treatments is likely due to differential growth patterns between the cereal grains and ryegrass (Huneycutt, 1991; 1994; Aiken, 1998). Although not compared statistically, forage CP concentrations on d 112 were lower than those from day 28 through 84 and are a reflection of advancing forage maturity. Forage CP concentrations did not differ among treatments in yr 2 ($P = 0.59$) or yr 3 ($P = 0.71$), but did vary across sampling dates ($P < 0.01$).

The IVDMD did not differ among forages in yr 1 ($P = 0.57$) or yr 3 ($P = 0.23$), but did vary across sampling dates ($P < 0.01$) within both years. In vitro DM disappearance averaged 70% during yr 1 and 3 and ranged from 53.6 to 82.1%. In yr 2, mean IVDMD concentrations of RRG were higher ($P < 0.05$) than RG (76.5 vs. 70.6%). The IVDMD of WRG averaged 73.9% and did not differ from that of RRG ($P = 0.14$) and tended to be higher than that of RG ($P = 0.08$).

A 3-way interaction between year, treatment, and sampling date was detected ($P < 0.01$) for forage mass. Forage mass ranged from 403 to 4,276 kg/ha during the 3-yr study (Table 3). Sampling date effects were observed ($P < 0.01$) but neither forage effects nor sampling date x forage treatment effects were detected ($P \geq 0.17$).

A 2-way interaction between year and treatment was detected ($P < 0.01$) for total BW gain. Therefore, BW and gain data were analyzed within year. Total weight gains (d 0 to 112) during yr 1 and 2 were greater ($P < 0.05$) from calves grazing annual forages than those fed hay and grain (Table 4). During yr 1 and 2, weight gains averaged approximately 2.2 lb/d on the winter annual programs. Total weight gains did not differ ($P \geq 0.23$) among the annual forage treatments during yr 1 and 2. In yr 3, total weight gains did not differ ($P = 0.95$) among the four treatments. Overall gain by calves grazing winter annual forages during yr 3 (218 lb avg.) was numerically lower than that from yr 1 (257 lb) and yr 2 (246 lb), whereas gain by calves fed hay plus supplement was numerically higher during yr 3 than in yr 1 or 2. The probable reason for lower gain from winter annual forage treatments during yr 3 is that forage production was limited and the calves were removed from winter annual forages and fed bermudagrass hay along with the same level of supplement as fed daily on pasture. Hay quality during yr 3 was higher than in previous years (12.7 vs. 11.7% CP; 56.1 vs,53.0% IVDMD), possibly resulting in the higher gain by HS than from previous years.

Diets for calves fed HS were formulated based on feeding 1% of BW as ground grain sorghum using initial BW in yr 1, and were estimated to produce ADG of 1.5 lb/d. Average hay consumption for HS across the 3-yr study was 8.7 lb/d or approximately 1.3% of average BW. The low levels of forage intake are likely because of a negative associative effect on forage digestion that reduced forage intake and grain conversion efficiency (Goetsch et al., 1991; Elizalde et al., 1998). Actual gains by calves fed hay plus supplement in each year were greater than would be predicted from NRC (1996) equations based on the level of forage consumption. Therefore, it is probable that forage intake was actually greater than accounted for from measured hay consumption, and likely included consumption of dormant bermudagrass, annual grasses, and broadleaf weeds from the 2.5-acre lots.

Although interactions with year were detected for growth performance, the bottom line for producers wanting to use this type of information is animal performance averaged over multiple years. When averaged across years, animal BW gain averaged 61 lb greater ($P < 0.05$) and ADG averaged 0.54 lb/d faster ($P < 0.05$) from calves grazing the winter annual forages than from those fed HS. Daily hay consumption averaged 6.3 lb/d more ($P < 0.05$) from HS than from calves grazing the winter annual forage treatments. Animal gain and hay consumption did not differ ($P > 0.05$) among the winter annual treatments. Based on this information, producers can make economic decisions using their own costs to determine if retaining ownership of their calves will work for them.

Implications

Disking bermudagrass pastures and sod-seeding annual ryegrass alone or in combination with rye or wheat may provide winter grazing for fall-weaned calves. This could reduce hay and grain consumption, provide greater weight gains from calves, and allow cattlemen to market their calves on a more favorable spring market. Trends varied throughout the 3-yr study, but there was no apparent advantage of adding rye or wheat to ryegrass.

Literature Cited

Aiken, G. E. 1998. J. Prod. Agric. 11:185-190.
Elizalde, J. C., et al. 1998. J. Anim. Sci. 76:1691-1701.
Goetsch, A. L., et al. 1991. J. Anim. Sci. 69:2634-2645.
Huneycutt, H. 1994. Arkansas Agric. Exp. Stn. Res. Series 435.
Lippke, H., et al. 2000. J. Anim. Sci. 78:1625-1635.
McCormick, M. E., et al. 1998. J. Prod. Agric. 11:293-300.
Moyer, J. L., and K. P. Coffey. 2000. Agron. J. 92:748-753.
Moyer, J. L., et al. 1995. Prof. Anim. Sci. 11:67-73.
NRC. 1996. Nutrient Requirements of Beef Cattle. 7th ed. National Academy Press, Washington, DC.
Wilkinson, S. R., and J. A. Stuedemann. 1983. In: J. A. Smith and V. W. Hays (ed.) Proc XIV International Grassl. Cong., Lexington, KY, June 15-24, 1981, pp. 568-571. Westview Press, Boulder, CO.

Table 1. Daily feeding levels and formulations of supplements offered to calves grazing sod-seeded winter annual forages or provided ad libitum access to bermudagrass hay

Item	Winter annual	Hay + supplement
Total daily supplement, lb	2.0	6.6
	-- % of daily supplement[a] --	
Ground grain sorghum	90.04	87.28
Cottonseed meal		9.70
Ground corn	0.61	0.18
TM salt[b]	4.24	1.28
Ground limestone	5.00	1.51
Rumensin 80 premix[c]	0.12	0.04

[a]As-fed basis.
[b]Contained 96 – 98.5% salt, and not less than 0.35% Zn, 0.2% Mn, 0.2% Fe, 0.03% Cu, 0.007% I, and 0.005% Co.
[c]Contained 80,000 mg monensin/lb (Elanco Animal Health, Indianapolis, IN).

Table 2. Crude protein and IVDMD of forages clipped on different dates during the grazing season from bermudagrass pastures overseeded with winter annual forages

		Forage treatment			
Study year	Sampling date	Ryegrass	Rye + ryegrass	Wheat + ryegrass	SE
Crude protein, % of DM					
1997-98[de]	12/19	16.8[h]	22.2[gh]	24.1[g]	1.87[b]
	1/16	17.1[h]	23.3[g]	23.5[g]	
	2/13	21.0[g]	21.8[g]	21.2[g]	
	3/13	26.8[g]	20.5[h]	23.9[gh]	
	4/10	14.5[g]	13.6[g]	14.1[g]	
1998-99[d]	12/19	23.6	26.8	21.8	0.70[c]
	1/15	15.6	20.7	17.1	
	3/11	23.2	20.2	19.9	
	4/8	27.9	25.2	29.9	
1999-00[d]	12/17	15.5	16.1	16.3	0.78[c]
	1/14	13.4	13.5	15.0	
	2/24	17.7	20.1	19.6	
	3/22	16.4	12.7	14.1	
	4/14	11.4	8.5	10.3	
IVDMD, % of DM					
1997-98[d]	12/19	48.8	68.8	73.1	2.14[c]
	1/16	72.6	75.8	79.2	
	2/13	63.4	68.9	64.3	
	3/13	82.1	76.4	78.9	
	4/10	77.7	78.1	74.9	
1998-99[df]	12/19	78.9	80.3	81.3	1.10[c]
	1/15	50.7	66.5	58.8	
	3/11	77.3	80.6	74.5	
	4/8	75.5	78.8	80.9	
1999-00[d]	12/17	61.1	62.8	63.1	1.86[c]
	1/14	53.6	55.4	59.9	
	2/24	62.6	63.9	69.6	
	3/22	75.6	81.7	77.8	
	4/14	69.8	74.3	77.8	

[b] Standard error of the mean for comparison of forage means within a sampling date.
[c] Standard error of the mean for comparison of main effect forage means across all sampling dates.
[d] Sampling date main effects were detected ($P < 0.01$).
[e] Date x forage interaction was detected ($P < 0.05$).
[f] Forage treatment main effects were detected ($P < 0.05$).
[g,h] Forage means within a sampling date without a common superscript letter differ ($P < 0.05$).

Table 3. Forage mass (lb/acre) on different dates during the grazing season from bermudagrass pastures overseeded with winter annual forages

		Forage treatment			
Study year	Sampling date	Ryegrass	Rye + ryegrass	Wheat + ryegrass	SE[b]
1997-98[c]	12/19	1,399	1,409	1,594	84.5
	1/16	583	635	648	
	2/13	721	590	1,203	
	3/13	759	442	638	
	4/10	1,616	1,213	1,498	
1998-99[c]	12/19	1,118	1,352	1,254	98.6
	1/15	693	858	572	
	3/11	428	541	360	
	4/8	1,616	1,213	1,498	
1999-00[c]	12/17	1,217	1,138	1,155	280.7
	1/14	1,406	604	735	
	2/24	2,211	1,975	1,546	
	3/22	1,987	2,089	1,750	
	4/14	3,818	3,798	2,591	

[b] Standard error of the mean for comparison of main effect forage means across all sampling dates.
[c] Sampling date main effects were detected ($P < 0.01$).

Table 4. Growth performance and apparent hay consumption by calves grazing different winter annual forages or provided ad libitum access to hay along with a grain sorghum-based supplement

			Forage treatment		
Item	Hay + supplement	Ryegrass	Rye + ryegrass	Wheat + ryegrass	SE
		------------------- 1997-98 --------------------			
Weight, lb					
12/19	590	588	590	589	6.1
4/10	756	860	834	843	27.2
Total gain, lb d 0 to 112	166[e]	272[d]	243d	254[d]	22.7
Hay consumption, lb/d[a]	9[d]	0[e]	1[e]	0[e]	0.6
		------------------- 1998-99 --------------------			
Weight, lb					
12/19	568	566	568	573	18.6
4/8	724	829	816	800	33.3
Total gain, lb	157[e]	263[d]	247[d]	227[d]	19.7
Hay consumption, lb/d	10[d]	1[e]	0[e]	1[e]	0.4
		------------------- 1999-00 --------------------			
Weight, lb					
12/17	569	571	569	569	1.0
4/14	782	789	783	792	11.9
Total gain, lb[b]	213	218	214	223	12.1
Apparent hay consumption, lb/d[c]	7[f]	6[g]	6[g]	6[g]	0.4
		------------------- 3-year average --------------------			
Total gain, lb	179[e]	251[d]	234[d]	234[d]	13.8
Daily gain, lb	1.56[e]	2.20[d]	2.06[d]	2.05[d]	0.121
Hay consumption, lb/d	8.7[d]	2.1[e]	2.9[e]	2.1[e]	0.28

[a] Apparent hay consumption is expressed on an as-is basis.
[b] Represents total weight gain from d 0 through d 112 including the period when calves assigned to winter annual forages were removed from pasture.
[c] Hay consumption was allocated equally across winter annual treatments because all replication were combined from d 29 to 69 of the study.
[de] Means within a row without a common superscript letter differ ($P < 0.05$).
[fg] Means within a row without a common superscript letter differ ($P < 0.10$).