WINTER-CALVING PERFORMANCE OF COWS FED WHOLE COTTONSEED AND OTHER SUPPLEMENTS WITH HAY

G. M. Hill[1], K.C. Halbig[1], Carole Hicks[2], and B. G. Mullinix, Jr[3].
Animal and Dairy Science Department, The University of Georgia, Tifton Campus[1] and Statesboro[2]; and Experimental Statistics, Tifton Campus[3]

Introduction

Cow herds in the Southeastern USA, and other regions depend upon hay as a winter feed source. Amount of hay required depends upon geographical location of herds, weather conditions in particular years, and availability of stockpiled or winter annual forages. Increased fertilizer, labor, and equipment costs in recent years have increased production costs for cow-calf producers. A key study was planned to determine the first documented replicated comparison of the new CPM Super-P cotton by-product blocks (CPM**;** A. G. Daniel Co., 5120 5th Avenue, Eastman, GA 31023) with other supplements (SUP) and hay fed to beef cows during winter. The CPM blocks potentially could supply a total replacement for hay and supplements for beef cows, and it contained considerable portions of cotton gin trash, a by-product of the cotton ginning industry. Incorporation of low-cost cotton gin trash as a feed ingredient could alleviate part of the environmental problems associated with gin trash disposal, while providing locally available feed for beef cows across the SE USA. A large, replicated cow study was proposed to compare CPM blocks and other supplements with hay as feedstuffs for winter-calving cows. Unfortunately, the large CPM blocks were not being manufactured at the time the cow study began December 17, 2009, and supplementation with whole cottonseed (WCS) compared with other supplements continued through March 15, 2010, while treatment effects were monitored until calf weaning in September, 2010.

Materials and Methods

Pregnant, mature (> 3 yr of age) beef cows (n= 110; Brangus and Angus X P. Hereford) were assigned to 10 groups on December 17, 2009, with regard to body weight (BW), age, breeding, and estimated fetal age. Groups were then randomly assigned to 10 paddocks of dormant bermudagrass and bahiagrass mixtures. Cows were fed these dietary treatments for 92 d (**Table 1**): **1)** Hay only (**H**), **2)** Hay plus free-choice commercial protein blocks (Super Mol 32% Molasses Block, Florida Mineral, Salt & Agricultural Products, Inc., 4014—40th Street North, Tampa, FL; 32% CP; **HPMP**), or **3)** Hay plus whole cottonseed at 0.5% of cow body weight daily (**HWCS**), **4)** Hay plus distillers dried grain with solubles (**HDG;** 4.5 lb DDG/cow daily); **5)** Hay plus corn/distillers grain (**HCDDG**; 50/50 corn and DDG mixture fed at 6 lb/cow daily). The **HCDDG** treatment was included as a substitute treatment replacing the planned CPM block treatment, and it provided additional information relative to comparisons of WCS with dried distillers grains with solubles (DDG) fed to beef cows during winter.

Mixed bermudagrass hay was fed free-choice in hay rings to all cows. The cows were

weighed on two consecutive days, body condition scored visually (Scale 1 to 9; 1=emaciated, 5=normal flesh, 9=obese), and had rib fat and rump fat measured by ultrasound on December 17, 2009, before assignment to treatment pastures 2 weeks prior to the initiation of calving season. Hay disappearance and supplement dry matter intake (DMI), cow weight change and cow body condition score (BCS) changes were determined during the supplementation period. Periodic samples of cottonseed, hay, and supplements were analyzed for nutrient content and DM. A commercial mineral containing at least 8% P and salt was available free-choice to all cows. Following the supplementation period, groups were reassigned and exposed to either Angus or Brangus bulls that had passed BSE examinations, for 75 days. Pregnancy rates were determined by rectal palpation of cows and ultrasound 45 days after the breeding season ended. Cow and calf weights (2 consecutive daily unshrunk BW, averaged), cow visual BCS, and ultrasound cow rib and rump fat depth were determined at the end of the supplemental period, March 19, and cow and calf BW and BCS were recorded on June 29, 2010. Calf weight change from birth to the end of supplementation period, March 19 to end of breeding interval, and from birth to end of breeding season and weaning were determined. Cows and calves were reassigned to summer grazing treatments with regard to the original supplementation treatments, from June to weaning in September. Hay disappearance, cottonseed intake, and supplement intake were carefully measured during the supplemental period. Statistical analyses of the cow data included treatment, rep, rep X treatment in the model, and cow breed, age of dam and initial cow weight were covariates used to adjust least squares means.

Results and Discussion

In Table 1, the chemical analyses of the hay and supplements fed to the cows during the 92-d SUP period (December 17–March 19) are displayed. Hay nutrient content was somewhat higher than most farmers might feed to beef cattle, according to the average of thousands of bermudagrass hay samples submitted to state laboratories for analyses. The typical bermudagrass and bahiagrass hay samples submitted average about 7-8 % crude protein (CP), but may range from 5% to > 15% CP. Bermudagrass hays typically have higher ADF and NDF concentrations than other kinds of hay. Depending on variety, higher NDF may not affect digestibility of the hay. The S content of the hay was higher than expected in the 7 hay samples (Table 1). The total digestible nutrients (TDN) content of the hay was in expected ranges, and it should be noted that Dairy One Labs, Ithaca, NY, typically report lower TDN values for forages and concentrates than those reported in NRC and other publications. The WCS and dried DDG used in the study (Table 1) had CP and TDN values, respectively, of 26.33 and 26.59 % CP, and 73 and 88% TDN. The 2007 Feedstuffs Reference Issue (Vol. 78; pg 21) reported average values for WCS and DDG, respectively, of: 23 and 29 % CP; and 96 and 98% TDN. According to the analyses (Table 1), CP of WCS and DDG fed to cows in this experiment had similar CP, but different amounts of each SUP were fed on the different treatments.

Cow performance (Table 2) was typical for larger beef cows that were pregnant at the

initiation of the experiment, and that calved during the supplemental period. Cow initial BW for all treatments averaged 1333.6 ±119.56 lb. Initial BW was higher for Brangus cows (n= 78, 1359 lb) than Angus X P. Hereford cows (n=32, 1272 lb). Because of this breed difference ($P < 0.01$; SE 17.5 lb), cow breed was used as an adjustment in Least Squares Means for cow performance. Cows on all treatments lost body weight and body condition during this supplementation interval, which was normal for cows during the time they are calving. Cows fed the HWCS and the HCDDG treatments lost less weight than cows fed HDG; however, cows fed Hay Only and HPMP had the greatest weight losses during the 92-d SUP interval. Body condition score and US ribfat and rump fat changes during the December-March SUP interval followed the same general trends as body weight losses for the treatments (Table 3). The additional energy in WCS, and in the corn and DDG mixture in HCDDG, and the amounts of these SUP fed, increased cow body weight retention. Since DDG became available in our region in recent years, it must be fed in limited amounts because of the high fat content, and possible high sulfur content. Cows on the HDG treatment had intermediate performance, lower than WCS, but higher than HPMP and Hay Only treatments during the SUP interval. Depending upon price and availability, WCS and DDG may be the most effective supplements for wintering beef cows with hay.

Cow gain performance during the 102-d interval from the end of SUP feeding (March 19) until June 29 (Table 2), which included the transition to summer perennial forages, mostly bahiagrass, and the breeding interval, was positive for all treatments. Cows on H and HWCS SUP treatments tended to have higher ADG than cows that were previously fed the other three SUP treatments. The ADG during this interval was similar for the cows previously fed HPMP, HDG, and HCDDG SUP treatments. The Dec-Sep 278-d ADG, and a comparison of LS Mean Initial BW with September 21 BW, in Table 2, indicates that cows on all treatments regained their bodyweight by the time calves were weaned in September. It is important to remember that the goal of these low-level winter supplementation programs was to have cows perform well, re-breed, and regain their weight before their next calf is born. These SUP with hay accomplished these goals. Pregnancy rates were above 95% for all SUP treatment groups, including the cows fed Hay Only (Table 2). In previous similar studies, SUP treatments including WCS and other protein-based SUP, had high (> 90%) pregnancy rates, but hay-only had significantly lower pregnancy rates. In those studies, CP of hay was around 9%, compared to hay in this study which averaged above 10% CP, with 53% TDN (Table 1).

Hay as-fed intake was reduced for HWCS, HDG, and HCDDG compared with H and HPMP treatments (Table 2). Supplement intake was controlled for HWCS, HDG, and HCDDG, but hay intake on all treatments and consumption of protein blocks for HPMP were not controlled. Total feed intake was similar for all treatments. Results indicate that the traditional feeding of WCS at 0.5% of cow weight is competitive with other supplementation treatments, and continues to support higher performance than the protein blocks used in the present study.

Cow performance (Table 1) indicated that cows on HWCS and HCDDG treatments had

the quickest recovery of BW, exceeding the December 17 BW by June 29. Cows on these two treatments had slightly higher BCS scores by June 29 than their initial Dec 19 BCS Scores. All cows made very acceptable gains during the spring grazing and breeding interval from March 19 to June 29. Cows continued grazing through summer on perennial pastures of Coastal bermudagrass, common bermudagrass and Tifton 9 bahiagrass. Cows lost some weight during summer as grazing pressure increased, pasture quality declined, and cow milk production waned with increasing calf age and weight. For the interval from pre-calving weight, December 17, to weaning, September 21, cows originally supplemented with WCS had the smallest weight loss. Pregnancy rates were extremely good for cows on all treatments. Calf ADG (Table 4) averaged 2.0 lb for all treatments during summer. Calf weaning weights were outstanding, ranging from 640 to 670 lb, with no differences associated with pre-weaning treatments. The cost of feeding the HCDDG SUP was higher than feeding WCS on the HWCS treatment during the winter feeding interval. Results indicate that the traditional feeding of WCS at 0.5% of cow weight is competitive with other supplementation treatments, and continues to support higher performance than the protein blocks used in the present study.

Acknowledgements

Project sponsored, in part, by Cotton, Inc., Cary, NC; and by Florida Mineral, Salt & Agricultural Products, Inc., 4014 40th Street North, Tampa, FL.

Table 1. Chemical analyses of hay and supplements fed to cows during the winter calving interval from December to March

Item[a]	Hay	32 CP Block[b]	WCS	DDG	Corn/DDG
No Samples	7	6	3	3	3
DM basis, %					
DM	89.44	82.20	90.30	88.53	88.52
Ash	7.12	44.95	4.13	4.60	2.80
Crude Protein	10.73	29.98	26.33	26.59	17.00
Acid detergent Fiber	40.64	7.08	45.03	11.26	5.15
Neutral detergent fiber	72.99	13.55	59.03	32.98	17.95
Crude Fat (EE)	1.70	4.42	16.60	14.43	7.15
Sulfur	0.21	0.56 (1)	------	0.48 (1)	
TDN	53.71	42.67 73.00		88.00 (1)	
Mcal/lb DM					
NEm	0.44	0.34	0.84	1.07 (1)	
NEg	0.19	0.10	0.55	0.75(1)	

[a]Abbreviations: CP = crude protein; WCS = whole cottonseed; DDG = Dried distillers grain with solubles; Corn/DDG = a 50/50 mixture of ground corn with DDG; TDN = Total digestible nutrients; NEm = Net energy for maintenance; NEg = Net energy for gain (TDN, Net energy, S were determined by Dairy One Labs, Ithaca, NY); Hay was fed in round bales with hay rings, disappearance accounted for during hay/SUP period. Parenthetical designations indicate no. of samples analyzed for mineral or energy.

[b] The Molasses protein blocks were advertised as “32% CP Blocks”; Samples from blocks that were analyzed indicated that blocks contained 29.98% CP on a DM basis, and 36.47% CP on an as-fed basis. The blocks contained 4.42% crude fat on a DM basis; and 5,38% crude fat on an as-fed basis. Both CP and fat content were near advertised concentrations.

Table 2. Performance of beef cows fed WCS and supplements with hay in winter during the calving interval and subsequent performance until weaning (LS Adjusted Means).

Item[a]	Hay only H	32% CP Block HPMP	0.5% BW WCS HWCS	DDG 4.5 lb/d HDG	Corn/ddg 6 lb/d HCDDG	SE
No. Cows[b]	22	22	22	22	22	
Dec 17 BW (actual)	1329	1340	1332	1337	1328	
LS mn Dec 17 BW**	1303	1321	1318	1323	1312	27.8
Mar 19 BW	1193	1213	1251	1225	1254	18.9
Jun 29 BW**	1321	1315	1371	1321	1365	21.2
Sep 21 BW	1292	1306	1331	1293	1294	28.3
Reproductive performance						
Cows Pregnant	22/22	22/22	21/22	21/22	21/22	
Pregnancy, %	100	100	95.4	95.4	95.4	
Days Preg atPalpation	79.43	88.84	86.99	82.52	90.05	4.43
Cow gain, lb						
Dec-Mar 92d ADG	-1.53	-1.31	-0.89	-1.18	-0.87	0.205
Mar-Jun102dADG**	1.26	1.01	1.17	0.94	1.09	0.140
Dec-Jun 194d ADG**	-0.06	-0.09	0.19	-0.07	0.17	0.109
Jun-Sep 84d ADG**	-0.40	-0.12	-0.48	-0.48	-0.86	0.336
Dec-Sep278d ADG	-0.15	-0.09	-0.01	-0.14	-0.14	0.103
SUP & Hay intake, 92 d, as-fed						
Hay, lb/d	39.0	39.3	35.8	36.6	35.1	
SUP, lb/d	0.0	0.76	6.82	4.54	6.0	
Total, lb/d	39.0	40.1	42.6	41.1	41.1	

** Cow breed effect ($P < 0.01$); LS means adjusted for Cow Breed .
[a]All weights and ADG reported in pounds. Abbreviations: SUP= Supplement; WCS = Whole cottonseed; DDG = dried distillers grain with solubles; ADG = avg daily gain; BW = body weight.
[b]Two pens of 11 cow-calf pairs/treatment; Cows on Corn/DDG treatment combined into one group because of pasture soil saturation with rain, moved from original 2 pens.

Table 3. Body condition scores and ultrasound measurements of ribfat and rump fat in cows fed different supplements with hay while calving during winter (LS Means).

Item[a]	Hay only H	32% CP Block HPMP	0.5% BW WCS HWCS	DDG 4.5 lb/d HDG	Corn/ddg 6 lb/d HCDDG	SE
BCS Score(Scale 1-9)						
Dec 17**	5.57	5.03	4.86	4.93	5.12	0.122
Mar 19 End SUP	4.80	4.92	5.05	5.08	5.16	0.107
BCS Chg Dec-Mar	-0.29	-0.20	-0.07	-0.04	0.04	0.109
Jun 29 After breeding	5.36	5.52	5.68	5.53	5.78	0.107
BCS Chg 102 d	0.55	0.60	0.63	0.44	0.62	0.102
Sep 9 Just before wn	5.36	5.44	5.57	5.39	5.52	0.101
BCS Chg Dec-Sep	-0.24	0.33	0.46	0.28	0.40	0.101
US Ribfat, cm						
Dec 17*	0.405	0.597	0.412	0.451	0.397	0.050
Mar 19EndSUP time	0.300	0.368	0.294	0.415	0.359	0.045
US ribChg Dec-Mar*	-0.125	-0.180	-0.136	-0.045	-0.062	0.034
Jun 29 After breeding	0.618	0.746	0.766	0.647	0.709	0.066
US ribChg Mar-Jun*[d]	0.316	0.379	0.475	0.252	0.354	0.049
US rib– Chg Dec-Jun[d]	0.191	0.340	0.196	0.206	0.293	0.059
US Rump fat, cm						
Dec 17	0.629	0.808	0.547	0.625	0.580	0.079
Mar 19End SUP time[c]	0.391	0.557	0.419	0.564	0.552	0.063
USrumpChg DecMar*	-0.248	-0.184	-0.174	-0.065	-0.060	0.046
Jun 29 After breeding	0.814	1.072	0.966	0.964	1.098	0.094
USrump ChgMar-Jun[d]	0.418	.0508	0.557	0.410	0.553	0.067
USrump ChgDec-Jun[d]	0.175	0.334	0.388	0.349	0.499	0.080

** Treatments differ ($P < 0.01$); * Treatments differ ($P < 0.05$).

[a]Abbreviations: SUP= Supplement; WCS = Whole cottonseed; DDG = dried distillers grain with solubles; ADG = average daily gain; BW = body weight; Chg= change; US=Ultrasound measured in cm; BCS=Body Condition Score (1=emaciated; 5 = average flesh; 9 =obese).

[b]Two pens of 11 cow-calf pairs/treatment; Cows on Corn/DDG treatment combined into one group because of pasture soil saturation with rain, moved from original 2 pens.

[c]Rump fat affected by cow breed ($P < 0.05$). LS Means adjusted for cow breed.

[d] Change in ribfat and/or rump fat affected by cow breed ($P < 0.01$); LS Means adjusted.

Table 4. Calf Performance after their dams were fed the SUP treatments for 92 d during the winter calving interval

Item[a]	Hay only H	32% CP Block HPMP	0.5% BW WCS HWCS	DDG 4.5 lb/d HDG	Corn/ddg 6 lb/d HCDDG	SE
No calves	22	22	22	20	22	
Calf data, lb						
Birth weight	88.4	91.4	89.5	93.2	89.5	2.80
Calf age Mar 18, d	53.1	51.9	53.4	55.5	55.0	3.63
BW Mar 18	206.4	208.8	222.7	226.6	221.8	9.75
BW Jun 29	484.2	488.3	489.8	494.0	496.6	11.99
102-d ADG Mar-Jun[b]	2.71	2.70	2.59	2.60	2.67	0.05
Wean wt Sep 21[c]	648.1	662.5	657.1	672.6	644.1	14.33
205-d BIF adj. Wn wt[c]	583.9	594.6	586.1	591.7	572.6	13.31
84-d ADG Jun-Sep	2.06	1.98	2.00	2.05	1.98	
186-d ADG Mar-Sep[c]	2.39	2.45	2.35	2.38	2.29	0.08
ADG Birth to Wean[c]	2.36	2.42	2.42	2.41	2.33	0.07

[a]Abbreviations: SUP= Supplement; WCS = Whole cottonseed; DDG = dried distillers grain with solubles; ADG = average daily gain; BW = body weight; BIF = Beef Improvement Federation (Guidelines for Adj. Wt.). LS means adjusted for covariant effects of: Calf sex, calf breed, cow age, initial cow wt, calf birth weight.

[b] Calf breed effect ($P < 0.01$); Brangus calves greater than AN X PH (ADG :2.83 vs. 2.52 lb).

[c] Calf breed effect ($P < 0.05$); Brangus calves heavier weights or higher ADG for each variable.