REPRODUCTIVE PERFORMANCE OF BEEF COWS FED WHOLE SOYBEANS BEFORE THE BREEDING INTERVAL

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ABSTRACT

Effects of feeding soybeans before breeding were determined using primiparous and multiparous Angus (n=17 and 36 respectively) and Polled Hereford (n=12 and 11 respectively) cows randomly assigned to control (no supplementation), or cracked whole soybean (2.12 kg DM/cow daily) treatments from February 11 to April 11. The breeding interval began April 14, using AI (d 1 to d 44), and natural service (d 45 to d 71). Calf ADG during the pre-breeding period, and during the interval from d 1 to weaning at d 210, was unaffected by treatment ($P > 0.10$). Calf breed affected ($P < 0.01$) calf pre-breeding ADG, 210-d ADG, and 205-d weaning BW, which respectively, were: Angus 1.18, 0.92, 230.6 kg; Polled Hereford 1.01, 0.83, 211.8 kg. Pregnancy rates were unaffected ($P > 0.10$) by treatment, cow breed, or parity. On d 60, serum triglyceride was greater for cows fed soybeans than control cows ($P < 0.01$; 31.2 vs. 27.0 mg/dl), and serum cholesterol was affected by a treatment x parity interaction ($P < 0.05$), with respective values for control primiparous and multiparous and soybean treatment primiparous and multiparous: 134.6, 176.2, 195.8, 201.5 mg/dl. Serum leptin on d 60 for these respective treatments, were: 5.4, 9.0, 8.4, 8.6 ng/ml, with the lowest ($P < 0.05$) concentration in control primiparous cows. Feeding soybeans to primiparous cows increased serum leptin ($P < 0.05$), and primiparous cows fed soybeans had similar serum triglyceride, cholesterol, and leptin compared with multiparous for these variables.
Key words: cow, reproduction, soybean, leptin, cholesterol

INTRODUCTION

Supplying energy and protein to cows after calving to meet nutritional requirements has a great influence on reproductive performance of the cow herd (Wiltbank et al., 1964). Fat supplementation after calving increased pregnancy rates (De Fries et al., 1998). The use of safflower seed fed during the postpartum period improved subsequent conception rates in primiparous cows (Lammoglia et al., 1997), and soybean oil improved ovarian follicular growth compared with either tallow or fish oil (Thomas et al.,1997). Fall-calving cow and calf gain performance were improved when cows were fed soybeans with hay, but pregnancy rates were not improved by supplementation (Steele et al., 2007). Whole raw soybeans were fed to beef heifers (Howlett et al., 2003), resulting in no differences in AI conception rates compared with heifers fed diets with other protein and energy supplements. Banta et al. (2008) fed whole soybeans or soybean meal/hull diets to beef cows, and they reported reduced BW gain during late-gestation, and inconsistent effects of diets on reproductive performance. The present research was designed to investigate the effects of feeding whole raw soybeans to grazing beef cows before spring breeding on cow reproductive and cow and calf gain performance.

MATERIALS AND METHODS

***Animals and Experimental Procedures*.**

Reproductive and gain performance resulting from feeding raw soybeans to cows on pasture were determined using primiparous (508.8 ± 35.8 kg BW) and multiparous (581.4 ± 66.6 kg BW) beef cows in a single year. The cows were purebred Angus (n=17 and n=36 respectively) and Polled Hereford (n=12 and n=11 respectively). These cows calved from December 30 to February 24. On d 1 (February 11) all cows that had already calved were stratified by parity, breed, cow and calf initial BW, and calf age, before cow-calf pairs were randomly assigned to either control or soybean supplement treatments, with one treatment group for each of four pastures. On d 10 (February 24) additional cows (multiparous = 12; primiparous = 7) that had calved between d 1 and d 10 were ranked in the same manner as the original cows, and randomly assigned to the treatment groups. The control cows (primiparous =14, multiparous =25) were assigned to pastures with no supplemental feeding, except hay. The soybean supplemented cows (primiparous =14, multiparous =24) were assigned to pastures, and they were fed cracked whole soybeans (containing 23.1 % crude fat, Table 1), were fed at 2.12 kg DM/cow daily for 70 d, immediately before, and at the start of breeding season. Both groups were assigned to dormant Coastal bermudagrass (cv. Coastal, *Cynodon dactylon*) pastures that were sod-seeded with annual ryegrass (cv. Passerel, *Lolium multiflorum* Lam.; 26.7 kg/ha; Pennington Seed Co., Madison, GA). Cows and calves on pastures were rotated twice to minimize any pasture effects. Bermudagrass hay (Table 1) was provided free-choice, and hay disappearance was calculated. All cattle were managed under procedures approved by the University of Georgia Animal Care and Use Committee Guidelines.

On d -68 (Dec. 4), d 1 (Feb. 11), d 28 (Mar. 11) and d 60 (Apr. 11) cows were weighed, cow ultrasound fat depth was measured at the 12th rib, and a BCS (scale 1-9, 1=emaciated, 9=obese) was assigned to each cow. On d 1, d 28, and d 60 calf BW were recorded, and a blood sample was taken from each cow by tail veinipuncture. The same procedures were followed for the cow-calf pairs that calved later than the original group of cows when they entered the experiment on d 10. Cow BW was recorded, BCS were assigned to cows, and ultrasound fat depth measurements were recorded for cows on June 16. Additional cow and calf BW were recorded at 28-d intervals from June 16 to Sept. 19, when the last cow BW were recorded, and calves were weaned on Sept. 8 (d 210).

The breeding interval began on d 63 (Apr.14), consisting of a 44-d AI interval followed by a 27-d natural service interval using mature fertile beef bulls. All cows regardless of pre-breeding treatment or parity were combined into one group on d 77, and remained in this group throughout the AI interval. Cows were monitored for estrual activity by visual observation for 30 min twice daily at 12-h intervals. A Heatwatch® System (DDX Inc, Denver, CO) was used to detect estrus, and cows were bred 12 h after the onset of estrus. If cows were visually detected in estrus, and there was Heatwatch observations, these cows were bred 12 h after initial visual observation. At the end of the AI interval, cows were separated by breed and exposed to a fertile mature bull of the opposite breed from May 28 to June 24. On Sept. 17 pregnancy examinations via rectal palpation were completed for each cow, and the approximate date of conception was determined by aging of the fetus by an experienced technician.

Chemical Analyses of Diets and Blood Components.

Samples of all major dietary components were chemically analyzed for DM and CP (AOAC, 1990). The ADF and NDF were determined (Van Soest 1991). The TDN and NE_m were determined using equations in NRC (1996). Three randomly selected round bales of hay were sampled in three different locations of each bale using a core sampling tube, grounded, composited, and chemically analyzed (Table 1). Soybeans were sampled from several sites in the load and analyzed (Table 1). Ryegrass forage was sampled by cutting at ground level on d 18 and d 48 of the supplementation period at three different locations within each pasture, dried, ground, and chemically analyzed (Table 1).

All blood samples were refrigerated after collection, and cooled overnight before being centrifuged to separate serum. Serum was collected, frozen, and stored for later analysis. A Boehringer Mannhiem/Hitachi 912 analyzer was used to analyze serum for cholesterol, high-density lipoprotein, and triglycerides (Roche Diagnostics, Indianapolis, IN). The low-density lipoprotein was calculated using the formula: Total cholesterol – (high-density lipoprotein [triglycerides/5]). Serum leptin was determined using an RIA that had been validated for bovine serum (Delavaud et al., 2000).

Statistical Analyses.

The cow data in the experiment were statistically analyzed using Proc MIXED (SAS, 2002). All analyses began with full models including treatment, parity, cow breed, treatment X parity, and the appropriate linear covariate, except for BW, BCS and ultrasound fat depth on d -68 (December 4), which used interaction and cow breed only. The analyses were examined, and terms with an *F*-value less than 1.0 were removed from the analysis, and a final analysis was then conducted for each variable. The BW, ADG, BCS, and ultrasound fat depth measurements and reproductive data for the cows (Table 2) were analyzed as a 2 x 2 factorial with cow as the individual experimental unit as the source of error (Lents et al., 2005; Long et al., 2007). Cow breed was removed as a class effect covariable, and treatment x parity was left in the model when determined to be important. Calf birth weight, ADG, and weaning weights were analyzed as a 2 x 2 factorial (treatment and breed as factors) using Proc MIXED (SAS, 2002). Least squares means for calf birthweight, calf sex (bulls=24, heifers=28; steers =24), calf age at weaning and age of dam were used as covariables when appropriate.

Additional analyses were conducted for the serum components as a 2 x 2 x 3 factorial (breed, treatment, and date as factors) using Proc MIXED (SAS, 2002), with cow being the experimental unit, and cow within treatment and parity as the source of error. Repeated measures effects of date of sampling were examined for each serum component variable. All analyses began with full models including all four interactions (treatment x cow breed, treatment x sampling date, cow breed x sampling date, and treatment x cow breed x sampling date), using cow age as a covariable. Any effect that had an *F*-value less than 1.0 was removed from the model, and new analyses were conducted with reduced models.

RESULTS AND DISCUSSION

***Nutrient Intake Effects on Cow and Calf Performance*.**

The effects of feeding raw soybeans to cows before the breeding interval on cow BW gain, BCS and pregnancy rates are shown in Table 2. During the supplementation interval, cows were fed bermudagrass hay, while grazing sod-seeded ryegrass with high levels of CP and TDN (Table 1). On d 1, initial BW was higher ($P < 0.05$; Table 2) for the cows that were assigned to the soybean treatment compared with the cows assigned to the control treatment, and multiparous cows were heavier than primiparous cows. Cow average daily gains during the supplementation period did not differ ($P > 0.10$) for treatments and parity. Cow breed affected breeding interval average daily gains, with Angus cows losing BW, and Polled Hereford cows gaining BW [Angus vs. Polled Hereford, ADG (kg): -0.38 vs. 0.14, $P < 0.01$]. During the 73-d breeding interval following the supplementation period, cows on the soybean treatment had lower ($P < 0.05$) BW losses than control cows. Calves were weaned on September 8 (d 210), and 210-d ADG of cows was unaffected ($P > 0.10$) by pre-breeding supplementation or parity. The initial cow BCS (Table 2) did not differ for the supplementation treatments, but higher ($P < 0.01$) BCS was observed for multiparous than primiparous, and a similar pattern of observations continued through d 128. Visual BCS declined for primiparous cows by d 1 of the supplementation period because many cows had already calved and were nursing calves. On d 1, and on subsequent scoring dates, soybean supplementation did not affect BCS scores. Cow ultrasound fat depth increased for all cows from d 1 to d 60 (Table 2). The ultrasound data supports visual BCS, with similar ultrasound fat depth for control and soybean treatments on d 1, d 60, and d 128. At d 128 multiparous tended ($P < 0.12$) to have greater fat depth than primiparous.

Pregnancy data for the cows indicated that cows on the soybean treatment tended ($P = 0.19$) to have lower pregnancy rates than control cows (Table 2). Cow breed and parity did not affect pregnancy rate. Pregnancy rates for all herds at the same research farm bred under similar conditions and breeding interval were lower than normal (approximately 70% pregnancy rate for 180 cows), and cows on this experiment fit the overall pattern observed for cows in the breeding herd that year. The relatively low numbers of cows in the experiment, and numbers of primiparous and multiparous cows on each treatment contributed to inconsistencies in cow pregnancy rates, which added to the difficulty in drawing conclusions regarding pregnancy effects of these treatments.

The estimated fetal age determined after weaning (Table 2) indicated that pre-breeding treatments did not affect time of conception after the initiation of the breeding interval, but primiparous cows conceived about 11 d later ($P < 0.10$) than multiparous cows. A treatment x parity interaction ($P < 0.10$) for fetal age indicated that primiparous and multiparous cows fed soybeans during the pre-breeding interval conceived at about the same time, but for control cows, multiparous cows conceived about 22 days earlier than primiparous cows, and 12 days earlier than either group of soybean supplemented cows. Bottger et al. (2002) reported no improvement in days to conception rates of primiparous beef heifers fed safflower seeds from d 3 to d 90 postpartum. Reproductive performance was not greatly improved when soybeans were fed to cows in the present study, and these results were supported by research in which no differences in pregnancy rates were observed in cows fed raw soybeans (Whitney et al., 2000), soybean oil (Howlett et al., 2003), rolled soybeans, or fed whole (Steele et al., 2007), and whole corn germ (35% ether extract, Martin et al., 2005). Banta et al. (2008) reported reduced BW gain of beef cows fed whole soybeans compared with soybean meal/hull supplemented diets, but effects on reproduction were inconsistent.

Calf performance data are presented for pre-breeding treatment and calf breed (Table 3). Calf BW on d 1 was similar for control and soybean treatments, and calf breed did not affect d 1 calf BW. Pre-breeding treatment did not affect weaning weights, but Angus calves were heavier ($P < 0.01$) than Polled Hereford calves. Calf average daily gains were unaffected ($P > 0.10$) by treatment during the pre-breeding interval (d 1 to d 60), during the breeding interval (d 60 to d 133), or from d 1 to weaning. Calf breed affected pre-breeding average daily gains and total average daily gains from d 1 to d 210 ($P < 0.01$), with Angus calves having higher average daily gains than Polled Hereford calves. During the breeding interval, calf gains were similar ($P > 0.10$) for pre-breeding control and soybean treatments, and for calf breeds. Feeding soybeans to the cows during the pre-breeding interval apparently did not stimulate additional milk production for calves, or cause a positive average daily gains carry-over effect during the breeding interval, or extending until weaning. This was probably the result of the higher quality pasture being grazed and hay being fed (Table 1) to cows during the pre-breeding interval, which minimized effects of the supplemental soybeans. Martin et al. (2005) observed no differences in actual or adjusted weaning weights of calves whose dams were fed whole corn germ for 45 d after calving. Studies in which soybeans were fed as supplements to cows for 100 d during winter to fall-calving cows reported improved calf weaning weights and increased early lactation milk production in these cows compared with calf and cow performance of non-supplemented cows (Steele et al.,2007),. Banta et al. (2008) observed no differences in calf weaning weights when cows were fed whole soybean or soybean/hull supplemented for 80 d during gestation.

Soybean Supplementation Effects on Serum Components of Cows.

In order to determine effects of pre-breeding treatments on serum lipid components (Table 4), blood samples were collected on d 1, d 28 and d 60. Serum cholesterol was similar for control and soybean supplemented cows on d 1, but at d 28 and d 60 cholesterol concentrations were greater ($P < 0.01$) for cows fed soybeans than control cows. Cholesterol at d 60 was lower for primiparous than multiparous cows ($P < 0.05$; 188.8 vs. 166.2 mg/dl). A treatment x parity interaction ($P < 0.05$) occurred for cholesterol at d 60, with soybean supplemented primiparous cows having cholesterol concentrations similar to multiparous cows, but control primiparous cows had substantially reduced cholesterol compared with control multiparous cows.

Serum triglycerides were similar for control and soybean supplemented cows on d 1 and d 28, but at d 60 triglyceride concentrations were greater for soybean supplemented cows than control cows ($P < 0.05$; Table 4), and soybean supplemented cows had greater ($P < 0.01$) overall triglyceride concentrations. Triglyceride concentrations were greater ($P < 0.01$) for primiparous cows than multiparous cows at d 1, and at d 28 and d 60($P <$ 0.05). Cow breed affected triglyceride concentrations, with Angus cows having more (P < 0.01) triglycerides than Polled Hereford cows ($P < 0.06$; Table 6). The high-density lipoprotein concentrations were greater ($P < 0.05$) at d 28 and d 60 for soybean supplemented cows than control cows. At d 60 primiparous cows fed soybeans had elevated high-density lipoproteins compared with either primiparous or multiparous cows on the control treatment (treatment x parity, $P < 0.10$, Table 4). Concentrations of low-density lipoproteins were greater in soybean supplemented cows than controls at d 28 and d 60 ($P < 0.01$; Table 4), and the overall mean low-density lipoprotein concentrations tended to increase ($P < 0.10$) over time for all cows. As with cholesterol and high-density lipoproteins, at d 60 low-density lipoproteins had a treatment x parity interaction ($P < 0.01$), with soybean supplemented primiparous cows having substantially greater low-density lipoproteins than either control primiparous or multiparous cows.

Serum leptin was affected by a treatment x parity x date interaction ($P < 0.01$; Table 5). Serum leptin increased ($P < 0.05$) over time for primiparous and multiparous cows fed soybeans, and for control multiparous cows, but it declined for control primiparous cows (Table 5). Serum leptin was higher for primiparous than multiparous on d 1 for control and soybean treatments ($P < 0.05$). On d 60, leptin was higher for multiparous than primiparous cows on the control treatment ($P < 0.05$; 9.0 vs. 5.4 ng/ml), but within the soybean treatment, primiparous and multiparous cows had similar leptin concentrations ($P > 0.10$; 8.4 vs. 8.6 ng/ml). Additionally, at d 60, leptin was higher for soybean supplemented primiparous cows than for control primiparous cows ($P < 0.05$; 8.4 vs. 5.4 ng/ml). Cow breed affected serum leptin concentrations (Table 6), with greater leptin concentrations ($P < 0.01$) in Angus than Polled Hereford cows. Therefore, feeding soybeans to cows during the pre-breeding interval increased leptin during the 60-d supplementation period, and primiparous cows had increased leptin, bringing concentrations in serum of these cows to the levels observed in multiparous cows. Using mature beef cows, Lents et al. (2005) concluded that amount of nutrient intake had a greater effect than body energy reserves on insulin and leptin concentrations in plasma of gestating beef cows. Long et al. (2007) fed a supplement containing rumen-protected fat and corn gluten feed to heifers on pasture before the breeding interval, which improved reproductive performance and increased serum lipids, including leptin.

The serum lipids in cows were affected by feeding soybeans during the pre-breeding interval. Cholesterol, triglycerides, low- and high-density lipoproteins, were all elevated by d 60 for the soybean treatment (Table 4). These results are supported by Whitney et al. (2000) who reported an increase in cholesterol concentrations in cows when feeding soybean oil at 3% and 6 % of a supplement that was fed at 2.87% of BW. Thomas et al. (1997) reported an increase in total cholesterol, high-density lipoproteins, and triglycerides when soybean oil was fed at 4% of DMI as part of a complete diet**.** A new observation in our study indicated that cows of different parity responded differently to soybean supplementation with different serum lipid concentrations. The multiparous cows had greater concentrations of cholesterol and high-density lipoproteins compared with primiparous cows in the same treatment groups. The opposite was true for triglycerides, with primiparous cows having greater concentrations than multiparous cows. Parity had no affect on low-density lipoproteins.

IMPLICATIONS

The feeding of soybeans as a postpartum supplement is a relatively new idea, and there are few published results supporting or dismissing the practice as a feasible option for improving postpartum reproduction. Feeding soybeans increased the concentrations of serum cholesterol, triglycerides, high-density and low-density lipoproteins. The increased serum component concentrations occurred without affecting cow BW, BCS, or ultrasound fat measurements. However, pregnancy rates were not consistently improved in cows on the soybean treatment, with pregnancy rate being the most important economic factor to cow-calf producers. Feeding whole soybeans as a short-term postpartum supplement effectively delivered high levels of fat and CP to the cows, but additional research is needed to determine if the practice can reliably improve reproductive performance in beef cows.

LITERATURE CITED

AOAC. 1990. Official Methods of Analysis. 15th ed. Assoc. of Offic. Anal. Chem., Arlington, VA.

Banta, J. P., D. L. Lalman, C. R. Krehbiel, and R. P. Wettemann. 2008. Whole soybean supplementation and cow age class: Effects on intake, digestion, performance, and reproduction of beef cows. J. Anim. Sci. 86:1868-1878. [Published Online First on April 25, 2008 as doi:10.2527/jas.2007-0383]

Bottger, J. D., B. W. Hess. B. M. Alexander, D. L. Hixon, L.F. Wodard, R. N. Funston, D. M. Hallford, and G. E. Moss. 2002. Effects of supplementation with high linoleic or oleic cracked safflower seeds on postpartum reproductive and calf performance of primiparous beef heifers. J. Anim. Sci. 80:2023-2030.

De Fries, C. A., D. A. Neuendorff, and R. D. Randel. 1998. Fat supplementation influences postpartum reproductive performance in Brahman cows. J. Anim. Sci. 76:864–870.

Delavaud, C., F. Bocquier, Y.C. Hilliard, D.H. Keisler, A. Gertler, and G. Kann. 2000. Plasma leptin determination in ruminants: effect of nutritional status and body fatness on plasma leptin concentration assessed by a specific RIA in sheep. J. Endocrinol. 165:519-526.

Howlett, C. M., E. S. Vanzant, L. H. Anderson, W. R. Burris, B. G. Fieser, and R. F. Bapst. 2003. Effects of supplemental nutrient source on heifer growth and reproductive performance, and on utilization of corn silage-based diets by beef steers. J. Anim. Sci. 81:2367-2378.

Lammoglia, M. A., S. T. Willard, D. M. Hallford, and R. D. Randel. 1997. Effects of dietary fat on follicular development and circulating concentrations of lipids, insulin, progesterone, estradial-17β, 13, 14-dihydro-15 keto-prostaglandin F2α and growth hormone in estrous cyclic Brahman cows. J. Anim. Sci. 75:1591-1600.

Lents, C. A., R. P. Wettemann, F. J. White, I. Rubio, N. M. Ciccioli, L. J. Spicer, and D. H. Keisler. 2005. Influence of nutrient intake and body fat on concentration of insulin-like growth factor - I, insulin, thyroxin, and leptin in plasma of gestating cows. J. Anim.

Sci. 83:586-596.

Long, N. M., G. M. Hill, J. F. Baker, W. M. Graves, M. A Froetschel, D. H. Keisler, and B. G. Mullinix, Jr. 2007. Reproductive performance of beef heifers supplemented with corn gluten feed and rumen protected fat before breeding. Prof. Anim. Sci. 23:316-324.

Martin, J. L., R. J. Rasby, D. R. Brink, R. U. Lindquist, D. H. Keisler, and S. D. Kachman. 2005. Effects of supplementation of whole corn germ on reproductive performance, calf performance, and leptin concentration in primiparous and mature beef cows.J. Anim. Sci. 83:2663-2670.

SAS. 2002. SAS/C OnlineDOC™, Ver. 8.2. SAS Institute, Inc., Cary, NC.

Steele, J. D., J. P. Banta, R. P. Wetteman, C. R. Krehbiel, and D. L. Lalman. 2007. Drought stressed soybean supplementation for beef cows. Prof. Anim. Sci. 23:358-365.

Thomas, M. G., B. Bao, and G. L. Williams. 1997. Dietary fat varying in their fatty acid Composition differentially influence follicular growth in cows fed isoenergetic diets. J. Anim. Sci. 75:2512-2519.

Van Soest, P. J., J. B. Robertson, and B. A. Lewis. 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. J. Dairy Sci. 74:3583-3597.

Whitney, M. B., B. W. Hess, L. A. Burgwald-Balstad, J. L. Sayer, C. M. Tsopito, C. T. Talbott, and D. M. Hallford. 2000. Effects of supplemental soybean oil on in vitro digestion and performance of prepubertal beef heifers. J. Anim. Sci. 78:504-514.

Wiltbank, J. N., W. W. Rowden, J. E. Ingalls, and D. R. Zimmerman. 1964. Influence of post-partum energy level on reproductive performance of Hereford cows restricted in energy intake prior to calving. J. Anim. Sci. 23:1049-1053.

Table 1. Nutritional analyses of hay, pastures, and soybeans fed to cows during the pre-breeding soybean supplementation period.

Item	DM	C P	ADF	NDF	TDN	NE_m
	----------	----------	----------	% DM	----------	----------
Bermudagrass hay	88.6	14.2	39.5	70.9	56	0.48
Soybeans	93.6	41.9	8.95	17.9	103	1.32
Pasture 1 d 18	92.1	32.3	27.4	55.0	64	0.62
Pasture 2 d 18	91.7	33.0	27.2	52.2	65	0.64
Pasture 3 d 18	92.9	35.2	22.2	47.5	66	0.66
Pasture 4 d 18	91.9	36.4	23.4	49.4	66	0.65
Pasture 1 d 48	92.1	16.3	26.3	45.6	69	0.72
Pasture 2 d 48	90.2	18.2	25.4	44.8	70	0.72
Pasture 3 d 48	94.5	12.2	30.5	50.6	68	0.70
Pasture 4 d 48	92.0	15.9	27.4	48.8	69	0.71

[a]Pastures consisted of Coastal bermudagrass sod-seed with ryegrass. Bermudagrass was dormant during experimental period.

Table 2. Least square means for cow gain and reproductive performance when soybeans were fed during the pre-breeding interval.

	Treatment		Parity			*P* <	
Item[a]	Control	Soybeans	PC	MC	SE	T	P
No. cows	40	38	29	49			
Cow gain	----------------------	kg		------------------------			
Initial BW[c]	537.4	567.9	510.1	593.2	9.50	*	**
Pre-breeding ADG[d]	0.32	0.18	0.32	0.18	0.15	ns	ns
Breeding interval ADG[ef]	-0.19	-0.04	-0.15	-0.09	0.04	**	ns
210-d ADG[g]	0.03	-0.03	0.02	-0.02	0.03	ns	ns
Cow BCS	----------------	Scale 1 to 9		---------------------			
d 1	5.22	5.18	4.95	5.46	0.11	ns	**
d 60	5.11	5.13	4.91	5.32	0.09	ns	**
d 106	5.24	5.35	5.16	5.42	0.08	ns	*
d 128	4.64	4.92	4.74	4,92	0.08	ns	*
Ultrasound rib fat[h]	---------------------	cm		-------------------------			
d 1	0.64	0.64	0.66	0.62	0.03	ns	ns
d 60	0.72	0.72	0.74	0.70	0.06	ns	ns
d 128	0.61	0.68	0.59	0.70	0.05	ns	ns
Pregnancy status	-------------------------	%		------------------------			
Pregnancy rate	75.8	60.4	64.6	71.7	0.08	ns	ns
Days pregnant, d	116.0	115.3	110.0	121.3	4.30	ns	†

** (P < 0.01); * (P < 0.05); † (P < 0.10).

[a]Abbreviations: T = treatment; P = Parity; PC = primiparous cows; MC = multiparous cows; BCS = body condition score (scale 1 to 9; 1 = emaciated; 9 = obese).

[c]Initial BW on d 1 of supplemental feeding period, 60 d before breeding interval began.

[d]Pre-breeding ADG for cows during 60 d supplemental feeding period.

[e]Cow ADG during 71-d breeding interval.

[f]Cow breed affected breeding interval ADG and BCS at d 128: [Angus vs. Polled Hereford, ADG (kg) was -0.38 vs. 0.14, *P* < 0.01; BCS was 4.54 vs. 5.22, *P* < 0.01].

[g]Cow ADG from d 1 until calf weaning in September.

Table 3. Least squares means of Angus and Polled Hereford calf performance for cows supplemented with soybeans during the pre-breeding interval.

	Treatment			Calf breed			*P* <	
Item	Control	Soybeans	SE	A	PH	SE	T	CB
No. calves	40	36		53	23			
Calf performance	-------------------------------			kg	-----------------------			
Initial BW	57.2	57.1	1.43	58.4	56.0	1.31	ns	ns

Weaning BW	237.6	241.0	5.57	249.3	229.4	5.10	ns	**
Calf ADG								
Pre-breeding [c]	1.08	1.11	0.03	1.18	1.01	0.03	ns	**
Breeding interval [d]	0.83	0.84	0.03	0.81	0.85	0.02	ns	ns
Total [e]	0.87	0.89	0.03	0.92	0.83	0.03	ns	**

** (P < 0.01).
[a]Abbreviations: A= Angus; PH = Polled Hereford; T= treatment; CB = calf breed.
[b]Calf performance data were analyzed with age of dam as a covariate. Calf birthweight, calf age and calf sex were covariables in the models.
[c]Pre-breeding interval (d 1 to d 60) while cows were fed Control or Soybean supplementation treatments
[d]Breeding interval (d 60 to d 128), cows subjected to AI or natural service breeding.
[e]Total ADG from d 1 to weaning on d 210 (February 11 to September 8).

Table 4. Serum lipids in cows supplemented with soybeans before the breeding interval.

	Treatment		Parity			*P* <	
Item[a]	Control	Soybeans	PC	MC	SE	T	P
No. cows	40	38	29	49			
Cholesterol	-------------------- mg/dl -----------------------						
d 1	105.7	110.5	112.0	104.2	4.06	ns	ns
d 28	126.6	161.0	147.3	140.2	6.17	**	ns
d 60[b]	155.4	198.6	165.2	188.8	4.52	**	*
Triglycerides							
d 1	19.7	19.4	21.3	17.4	0.86	ns	**
d 28	23.1	23.3	27.8	21.6	1.83	ns	*
d 60	27.1	31.0	30.9	27.2	1.10	*	*
HDL							
d 1	86.2	89.1	90.7	84.6	3.18	ns	ns
d 28	97.6	124.7	112.7	109.6	4.66	**	ns
d 60[c]	122.7	154.0	127.4	149.3	4.96	**	**
LDL							
d 1	15.6	17.6	17.1	16.1	0.97	ns	ns
d 28	24.3	31.7	29.7	26.3	3.17	**	ns
d 60[d]	27.3	38.4	31.6	34.1	3.06	**	ns

** (P < 0.01); * (P < 0.05); † (P < 0.10).
[a]Abbreviations: C = control; S = supplemental soybean; PC = primiparous cows; MC = multiparous cows; T= treatment; P= parity; CHO = Cholesterol; TRI = Triglyceride; HDL = High-density lipoprotein; LDL = Low-density lipoprotein.
[b]Cholesterol at d 60, treatment x parity interaction (P < 0.05; mg/dl): Control-PC 134.6; Control-MC 176.2; Soybeans-PC 195.8; Soybeans-MC 201.4.
[c]High-density lipoprotein at d 60, treatment x parity interaction (P < 0.10; mg/dl): Control-PC 105.8; Control-MC 139.7; Soybeans-PC 149.0; Soybeans-MC 159.0.

[d]Low-density lipoprotein at d 60, treatment x parity interaction (P < 0.01; mg/dl): Control-PC 23.0; Control-MC 31.5; Soybeans-PC 40.1; Soybeans-MC 36.8.

Table 5. Treatment, parity and date interaction (P < 0.01) for serum leptin in cows fed soybeans during the pre-breeding interval.

	Control		Soybeans	
	PC	MC	PC	MC
No. cows	15	25	14	24
Serum leptin	ng/ml			
d 1	6.8[a]	5.5[b]	6.7[bm]	4.1[bn]
d 28	5.5[a]	4.3[b]	6.8[b]	8.5[a]
d 60	5.4[any]	9.0[am]	8.4[ax]	8.6[ax]

[a,b] Means bearing different subscripts within a treatment x parity combination for dates (*P* < 0.05; SE 0.58 with 140 df).
[m,n,x,y] Means bearing different subscripts differ (*P* < 0.05; SE= 0.81,140 df)

Table 6. Effects of cow breed on serum triglyceride and leptin concentrations during the pre-breeding interval.

Item[a]	A	PH	SE
Triglyceride, mg/dl	25.1[y]	22.3[z]	0.84
Leptin, ng/ml	7.6[w]	5.6[x]	0.44

[a]Abbreviations: A = Angus; PH = Polled Hereford.
[wx]Means on same line with different superscript letters differ (*P* < 0.01).
[yz]Means on same line with different superscript letters differ (*P* < 0.06).