Influence of Biostimulation on Enhancement of Reproductive Performance in Beef Cattle

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Introduction

Cows calving early breed back earlier in the subsequent breeding season (Lesmeister et al., 1973; Spitzer et al., 1975). It is therefore essential that virgin heifers reach puberty and cows be cyclic prior to or early in a breeding season to achieve early pregnancy. However, wide variations occur in onset of puberty (Beverly and Spitzer, 1980) and average postpartum intervals to estrus range from 46 to 168 days in suckled beef cows (see review of Dunn and Kaltenbach, 1980). With such large variations in reproductive response, many virgin heifers and lactating cows may not be cyclic either at the start of or early in a breeding season.

Males play important roles in reproductive function in addition to mating. In many species, males seem to trigger neuroendocrine reflexes which alter reproduction (positively or negatively) in females (see review of Signoret, 1980). A "negative" example is the "Bruce Effect" where pregnant mice will abort if exposed to a male mouse of a different strain (or even if placed in a cage recently vacated by a male). A "positive" example is induced ovulation in cats where male copulation is an absolute prerequisite for ovulation to occur. These reflexes are very species specific.

Biostimulation is a term coined to describe the stimulatory (positive) effects of a male on estrus, ovulation, or pregnancy (Chenoweth, 1983). Presence of a male clearly hastens onset of puberty in ewe lambs (Dyrmundsson and Lees, 1972) and gilts (Brooks and Cole, 1970; Kirkwood et al., 1981), and certainly advances onset of estrus in mature ewes (Oldham et al., 1978; Pearce and Oldham, 1988), goats (Shelton, 1960) and lactating sows (Rowlinson and Bryant, 1974). Sheep, goat, and swine producers routinely utilize these effects in management procedures to enhance reproductive performance.

In cattle, biostimulatory effects were first inferred by producers with well-fed cows on year-round natural mating breeding programs who observed cows returning to estrus earlier than most data would indicate. Studies where natural mating has shown advantages over artificial insemination also imply a biostimulatory effect for males (Mattner et al., 1974; Langley, 1978).

Biostimulatory Effects On Puberty In Heifers

In heifers, acceleration of puberty by biostimulation has yielded inconsistent results. Neither short-scrotum bulls nor vasectomized bulls exposed to prepuberal heifers for periods of 18 to 30 days enhanced cyclicity (Berardinelli et al., 1978; Macmillan et al., 1979). Roberson et al. (1987) penned heifers with or without exposure to mature teaser bulls from 9.5 to 15 months of age (152 days duration), but saw no effects on proportion of heifers reaching puberty (Table 1).

Table 1. Cumulative Percentages of Heifers Reaching Puberty by Age in Months

Group	n	Cumulative % in Estrus				
		11 mo	12 mo	13 mo	14 mo	15 mo
Bull Exposure	48	13	48	65	77	83
isolated	50	14	50	66	84	88

Roberson et al., 1987

Conversely, in a later study conducted over a 4-year period (Roberson et al., 1991), heifers were exposed to or isolated from bulls from 11.5 to 14 months of age (76 days duration), with more exposed heifers being cyclic at initiation of breeding at 14 months of age (Table 2).

Table 2. Cumulative Percentages of Heifers Reaching Puberty by Age in Months				
Group	n	**Cumulative % in Estrus**		
		12 mo	13 mo	14 mo
Bull Exposure	136	25	52 a	60 a
isolated	131	10	23 b	30 b

ab - Figures followed by different letters, within age differ (P<.05). Roberson et al., 1991.

A follow-up experiment from the same study indicated a significant interaction between rate of gain postweaning (High = 1.75 lbs/day, Moderate = 1.30 lbs/day) and bull exposure from 9 to 15 months of age (175 days duration). Effects of bull exposure were greater for heifers in High gain group than for heifers in Moderate gain group. However, heifers fed to attain either high or moderate growth rate and exposed to bulls attained puberty at younger ages than heifers isolated from bulls.

Chenoweth and Lennon (1984) reported higher cyclicity rates and greater pregnancy rates when peripubertal heifers were exposed to testosterone-treated cows (Testosterone treated cows) between first and second prostaglandin injections (13 days duration) and then exposed to fertile bulls. Thus, biostimulatory effects on advancing puberty in heifers appear, in part, to be dependent on rate of gain, other environmental factors (location, season), length of exposure, and probably inherent differences (breed, biological type), as well as on factors we may not have identified to date.

Biostimulatory Effects On Reproduction In Postpartum Cows

To my knowledge, all controlled studies to date have shown biostimulatory effects on reducing postpartum interval to estrus in primiparous (Gifford et al., 1989; Custer et al., 1990; Fernandez et al., 1993) as well as multiparous (Zalesky et al., 1984; Alberio et al., 1987; Naasz and Miller, 1990; Burns and Spitzer, 1992) cows.

When multiparous cows were exposed to bulls within three days of parturition, onset of estrus was advanced by about 20 days (Table 3) compared to cows isolated from bulls until 53 days postpartum (Zalesky et al., 1984).

Table 3. Days from Calving to Resumption of Estrous Cycles		
Group	Year	
	1981	1982
Bull Exposure	43 a	39 a
isolated	63 b	61 b

ab - Figures followed by different letters, within age differ (P<.01). Zalesky et al., 1984.

This biostimulatory effect on return to postpartum estrus can also be elicited with testosterone-treated cows (Appendix 1 - Testosterone-treated Cow; Burns and Spitzer, 1992). In this study (Table 4), it was observed that cows exposed to either bulls or testosterone-treated cows had similar postpartum intervals to estrus (Exp. 1). However, in Exp. 2, cows exposed to bulls had an 8-day earlier return to estrus than did cows isolated from biostimulation, and in Exp. 3, cows exposed to testosterone-treated cows had a 12- day earlier return to estrus than did cows isolated from biostimulation. It would appear that bulls or androgenized females elicit similar biostimulatory effects in reducing postpartum interval to estrus.

Table 4. Effects (days) of Biostimulation on Postpartum Intervals to Estrus (ITE) and Pregnancy (ITP)			
Experiment	Treatment	ITE	ITP
Experiment 1	Bull Exposure	43	80
	Testosterone-treated Cow Exposure	43	85

Experiment 2	Bull Exposure	44a	81
	Isolated	52b	85
Experiment 3	Testosterone-treated Cow Exposure	41a	87
	Isolated	52b	91

ab - Figures followed by different letters within experiment differ (P<.05). Burns and Spitzer, 1992.

Note that interval to pregnancy was not different in this series of experiments. This was because biostimulation exerted its stimulatory effects early postpartum (Table 5). By 40 days postpartum, 29 and 31% more cows exposed to bulls or testosterone-treated cows, respectively, were observed to be in estrus compared with cows isolated from biostimulation (Exp. 2 and 3, respectively). By 60 days postpartum, 23% more cows exposed to testosterone-treated cows were observed to be in estrus compared with cows isolated from biostimulation (Exp. 3). After 60 days postpartum, biostimulation had no effect on percentage of cows in estrus. Zalesky et al., (1984) indicated the biostimulatory effect occurred prior to day 53 postpartum in their study.

With the fixed breeding season used in these experiments, a majority of cows were cyclic before the start of the breeding season, regardless of treatment. In the study of Burns and Spitzer, after the first 20 days of breeding, 97% of cows exposed to biostimulation and 94% of cows isolated from biostimulation were observed to be in estrus. Therefore, biostimulation had no effect on postpartum interval to pregnancy. However, biostimulation would seem to be beneficial in reducing postpartum interval to estrus in late-calving cows to ensure cyclicity at the start of a breeding season.

Table 5. Effects of Biostimulation on Cumulative Percentages in Estrus by Days Postpartum

Experiment	Treatment	Cumulative % in Estrus				
		20 days	40 days	60 days	80 days	100 days
Experiment 1	Bull Exposure	2	52	84	96	100
	Testosterone-treated Cow Exposure	4	55	85	94	97
Experiment 2	Bull Exposure	4	52 a	76	95	96
	Isolated	0	26 b	62	92	98
Experiment 3	Testosterone-treated Cow Exposure	3	62 a	87 a	95	95
	Isolated	5	31 b	64 b	90	100

ab - Within experiment, means followed by different letters within days differ (P<.05). Burns and Spitzer, 1992.

Mechanisms for Biostimulation

Mechanisms by which bulls or testosterone-treated cows reduce postpartum interval to estrus are unknown. Puberty occurred earlier in heifers when bull urine was placed directly in the vomeronasal organ than in heifers having water placed in the vomeronasal organ (Izard and Vandenbergh, 1982). Androgens in the urine may act as pheromones [compounds that are perceived by the vomeronasal organ to elicit endocrine and behavioral responses (Doty, 1976)] to reduce postpartum interval to estrus.

Olfactory and auditory signals have been implicated as possible mechanisms for effects of biostimulation, as have been direct genital contact and allelomimetic (i.e. "copy-cat") behavior. Nuzzling, nudging and licking of the perineal region of a female by a bull might initiate estrus behavior, and may be important in mediating these effects. Certainly, studies indicating biostimulatory effects with testosterone-treated cows (Chenoweth and Lennon, 1984; Burns and Spitzer, 1992) indicate the stimulatory factors are not exclusively linked to a bull. Further work is needed to determine exact mechanisms involved with biostimulatory effects on postpartum reproduction.

Discussion and Conclusions

Both delayed puberty in heifers and long postpartum intervals to estrus in cows are recognized as major causes of reduced reproductive performance in beef herds. While data concerning biostimulatory effects on earlier puberty are inconsistent, there is overwhelming evidence to support this application in inducing earlier return to postpartum estrus. That this effect may be elicited by testosterone-treated cows may make its application easier.

Biostimulation appears to have its effect prior to day 60 postpartum, after which no effects were observed. Therefore, biostimulation would be a useful management tool for increasing reproductive performance in late-calving cows by reducing postpartum interval to estrus and having these cows cyclic at either the start of or early in a breeding season to ensure early pregnancy. This would appear to work extremely well in situations where artificial insemination (AI) will be used. Select a sound, early calving individual from the bottom end of the cow herd. Begin testosterone treatments as soon as she calves and continue through the AI breeding season. This will provide potential benefits of biostimulation and an aid to estrous detection for AI breeding.

Appendix 1 - Testosterone-treated Cow

Our procedure for programming a testosterone-treated cow (Testosterone-treated cows) is based on Kiser et al., (1977) as modified by Heekin (1983).

> Day 1 - 1.5 gm(1500 mg) Testosterone Enanthate Subcutaneously plus 0.5 gm(500 mg) Testosterone Enanthate Intramuscularly
>
> Days 14 and 28 - 1 gm(1000 mg) Testosterone Enanthate Subcutaneously
>
> Days 42 and on - 1.0 gm(1000 mg) Testosterone Enanthate Subcutaneously every 14 to 21 days depending on behavior of individual Testosterone-treated cows
>
> Withdrawal - 6 months from last injection to sale or slaughter

Testosterone Enanthate is a controlled substance, prescription drug only available through your veterinarian. Consult with him concerning use and extended withdrawal times to slaughter required. A veterinarian's easiest source is to write a prescription to your local pharmacist. Testosterone Enanthate is supplied in 10ml vials (200 mg/ml) by Geneva Pharmaceutical, Inc., Broomfield Co.

In our experiences, 90% of cows thus treated will become adequate Testosterone-treated cows. Mature cows seem to work much better than first-calf cows, and virgin heifers seldom work at all.

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