Effect of Daylength on Reproductive Performance of Brahman Cattle

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EXTENDING THE DAYLENGTH BY ARTIFICIAL LIGHT FOR THE FALL-WINTER BREEDING OF BRAHMAN COWS

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SUMMARY

Three field trials were completed to assess the effect of extending the daylength to 14 hours of light, by artificial means, on reproductive performance of Brahman cows during the fall breeding season. No beneficial effect was found in the number of cows showing normal estrous cycles, normal estrus periods nor in pregnancy or conception rates. It was concluded that more basic research or other modifications of management are required to alleviate the suppression of fertility found during fall and winter breeding seasons in Brahman cattle.

RATIONALE

Brahman cattle (which appear to be long day breeders) show a marked variation in reproduction during the different seasons. The fall breeding season in Brahman cattle is usually less successful than a spring breeding season (using either natural service or A.I.). Since the success of a breeding season partially determines the net dollar return to the rancher it is obvious that the more successful the breeding season the greater the dollar return. Therefore, exposing Brahman cattle to additional light during the fall breeding season could potentially increase the reproductive performance of Brahman cattle. This would be done by providing the cow with the "illusion" that she is being maintained in a long day situation.

OBJECTIVES

The objectives of this trial were to investigate the effect of increasing the daylength to 14 hours during the fall-winter breeding season of Brahman cows. The measurements taken during this trial were: (1) number of animals exhibiting normal reproductive cycles, (2) pregnancy rates and (3) conception rates.

EXPERIMENT I

MATERIALS AND METHODS

A field trial was conducted at the McKellar Ranch, Mt. Pleasant, Texas during the fall of 1978. Fifty lactating Red Brahman cows and 87 dry Red Brahman cows were assigned to either a control or light-treated group. Twenty-six lactating cows and 52 dry cows were placed in the control group while 24 lactating cows and 35 dry cows were placed in the light-treated group. Cows in the control treatment were exposed to the natural daylength with covered shelters available at night. Cows in the light treatment were exposed to the natural light by day. At 5:00 P.M. the light-treated cows were "called up" and were housed in a barn with artificial lighting. The additional lighting increased the daylight length to 14 hours. Artificial lignting was provided by evenly spaced strings of 200 watt incandescent lights such that a newspaper could be easily read anywhere in the barn. (Note: It appears that any source of lighting, that is florescent, mercury vapor, etc., would be just as effective as the incandescent lights in this study). The lights were turned off and on by a heavy duty poultry house timer with multiple time stops. All cows were fed adequate diets in order to maintain good body condition.

The cows were kept in the treatment groups for two weeks before the 45 day artificial insemination season began and throughout the breeding season. All cows were palpated before the breeding season and midway through the breeding season in order to assess reproductive function. Forty-five days after the end of the breeding season all cows bred were palpated for pregnancy. When the experienced A.I. technician observed a cow standing for mount by an infertile heat check bull or another cow, the cow was considered in heat and bred using frozen semen 8 hours later.

RESULTS

The light treatment did not appear to affect the numbers of animals exhibiting normal reproductive function as determined by palpation of the reproductive tract (Table 1). Results showed that 79.7% of the light-treated animals and 82.0% of the control animals had normal reproductive structures indicative of normal estrous cycle activity. However, more animals in the control treatment (17.9%) had silent heat periods than those in the light treatment (5.1%, table 2). This was assessed by palpation of a corpus luteum

(the structure that develops on the ovary at the egg rupture site and maintains pregnancy) without observation of standing heat. The pregnancy rates (pregnancies/all cows) and conception rates (pregnancies/all cows bred at) are shown in table 3. Generally, pregnancy and conception rates were higher in both the dry and lactating cow groups exposed to additional light than those exposed only to natural light. Overall, the light treatment appeared to increase pregnancy rates by 6.2% and conception rates by 12.9 percent.

Table 1. The number of animals exhibiting and not exhibiting reproductive cyclicity in the control and light-treated groups (Experiment I).

Treatment	Production status	# Animals	Reproductive status # Cycling	(%)	# Not cycling	(%)
Light	Dry	35	28	(80.0)	7	(20.0)
	Lactating	24	19	(79.1)	5	(20.8)
Control	Dry	52	45	(86.5)	7	(13.4)
	Lactating	26	19	(73.0)	7	(26.9)
Light		59	47	(79.7)	12	(21.0)
Control		78	64	(82.0)	14	(17.9)

Table 2. The number of animals that ovulated[a] but did not exhibit estrus (Experiment I).

Treatment	Production status	# Animals	# Animals ovulating but not exhibiting estrus	(%)
Light	Dry	35	3	(8.6)
	Lactating	24	0	(0.0)
Control	Dry	52	9	(17.3)
	Lactating	26	5	(19.2)
Light		59	3	(5.1)
Control		78	14	(17.9)

[a] This was assessed by rectal palpation of a CL and no A.I. estrus date.

Table 3. The pregnancy[a] and conception[a] rates in the control and light-treated groups (Experiment I).

Treatment	Production status	# Animals	Reproductive Parameters # Pregnancies (%)	# Animals A.I.'d	Conception Rate %
Light	Dry	33	14 (42.4)	24	58.8
	Lactating	24	9 (37.5)	19	47.4
Control	Dry	52	18 (34.6)	45	40.0
	Lactating	26	8 (30.8)	19	42.1
Light		57	23 (40.4)	43	53.5
Control		78	26 (34.2)	64	40.6

[a]This was by palpation at 45 days following the end of the trial.

EXPERIMENT II

MATERIALS AND METHODS

A second field trial was conducted at the McKellar Ranch, Mt. Pleasant, Texas during the fall of 1979. Twenty-seven lactating Red Brahman cows and sixty-five dry Red Brahman cows were assigned to either a control or light-treated group. Thirteen lactating cows and thirty-six dry cows were placed in the control group while fourteen lactating cows and twenty-nine dry cows were placed in the light-treated group. Cows in the control treatment were exposed to the natural daylength with covered shelters available at night. Cows in the light treatment were exposed to the natural light by day. At 5:00 P.M. the light-treated cows were "called up" and were housed in a barn with artificial lighting. The additional lighting increased the daylength to fourteen hours. Artificial lighting was provided as in Experiment I. All cows were fed adequate diets in order to maintain good body condition.

The cows were placed in their treatment groups at the beginning of the 45 day artificial insemination season. All cows were palpated before the breeding season and midway through the breeding season in order to assess reproductive function. Forty-five days after the end of the breeding season all cows bred were palpated for pregnancy. When the experienced A.I. technician observed a cow standing for mount by an infertile heat check bull or another cow, the cow was considered in heat and bred using frozen semen 8 hours later.

RESULTS

The light treatment appeared to affect the numbers of animals exhibiting normal reproductive function in this experiment (table 4). Results showed that 81.4% of the light-treated animals and 71.4% of the control animals had normal reproductive structures indicative of normal estrous cycle activity. Contrary to results from Experiment I, more of the animals in the light treatment (9.3%) had silent heat periods than did animals in the control treatment (0.0%, table 5). This was assessed by palpation of a corpus luteum (the structure that develops on the ovary at the egg rupture site and maintains pregnancy) without observation of standing heat. The pregnancy rates (pregnancies/all cows) and conception rates (pregnancies/all cows bred at) are shown in table 6. The reverse of trends for light treated

cows to have higher pregnancy and conception rates was found with a slight advantage for the control treated cows.

Table 4. The number of animals exhibiting and not exhibiting reproductive cyclicity in the control and light-treated groups (Experiment II).

Treatment	Production status	# Animals	Reproductive Status # Cycling	(%)	# Not cycling	(%)
Light	Dry	29	26	(89.7)	3	(10.3)
	Lactating	14	9	(64.3)	5	(35.7)
Control	Dry	36	30	(83.3)	6	(16.7)
	Lactating	13	5	(38.5)	8	(61.5)
Light		43	35	(81.4)	8	(18.6)
Control		49	35	(71.4)	14	(28.6)

Table 5. The number of animals that ovulated[a] but did not exhibit estrus (Experiment II).

Treatment	Production status	# Animals	# Animals ovulating but not exhibiting estrus	(%)
Light	Dry	29	2	(6.9)
	Lactating	14	2	(14.3)
Control	Dry	36	0	(0.0)
	Lactating	13	0	(0.0)
Light		43	4	(9.3)
Control		49	0	(0.0)

[a]This was assessed by rectal palpation of a CL and no A.I. estrus date.

Table 6. The pregnancy[a] and conception[a] rates in the control and light-treated groups (Experiment II).

Treatment	Production status	# Animals	Reproductive Parameters # Pregnancies	(%)	# Animals A.I.'d	Conception Rate %
Light	Dry	29	14	(48.3)	24	45.2
	Lactating	14	4	(28.6)	7	66.7
Control	Dry	36	19	(52.8)	30	47.5
	Lactating	13	5	(38.5)	5	71.4
Light		43	18	(41.9)	31	48.6
Control		49	24	(49.0)	35	51.1

[a]This was by palpation at 45 days following the end of the trial.

EXPERIMENT III

MATERIALS AND METHODS

A field trial was conducted at the Wentz Ranch, Olmito, Texas during the winter of 1979. Twenty-seven lactating Brahman cows and twenty-eight dry Brahman cows were assigned to either a control or light-treated group. Fourteen lactating cows and fourteen dry cows were placed in the light-treated group while thirteen lactaing cows and fourteen dry cows were placed in the control group. Cows in the control group were exposed to the natural environment. Cows in the light treatment were "called up" and kept in a lot lighted with artificial lighting at 5:00 P.M. daily. The additional lighting increased the daylight length to 14 hours. Artificial lighting was provided by area flood lights, such that a newspaper could be read anywhere in the lot. The lights were turned off and on by a heavy duty poultry house timer with multiple time stops. All cows were fed adequate diets in order to maintain good body condition.

The cows were kept in the treatment groups throughout the natural breeding season. All cows were palpated before the breeding season and midway through the breeding season in order to assess reproductive function. Forty-five days after the end of the breeding season all cows were palpated for pregnancy. Each treatment group was bred by a different fertile Brahman bull, equipped with a chin ball marking devise to detect estrus.

RESULTS

A greater proportion of animals in this experiment exhibited normal reproductive function as determined by palpation of the reproductive tract compared with Experiments I and II (table 7). No differences were apparent between light treatment and controls in reproductive function. More animals were not detected in estrus in the light group (21.4%) compared to the control group (3.7%). This discrepancy is probably due to bull differences as no ovarian function differences were found. Pregnancy rates (pregnancies/all cows) and conception rates (pregnancies/all cows bred at) are shown in table 9. Generally, pregnancy and conception rates were higher in the control cow groups compared to the light-treated animals.

Table 7. The number of animals exhibiting and not exhibiting reproductive cyclicity in the control and light-treated groups (Experiment III).

Treatment	Production status	# Animals	Reproductive Status # Cycling	(%)	# Not cycling	(%)
Light	Dry	14	13	(92.9)	1	(7.1)
	Lactating	14	13	(92.9)	1	(7.1)
Control	Dry	14	12	(85.7)	2	(14.3)
	Lactating	13	12	(92.3)	1	(7.7)
Light		28	26	(92.9)	2	(7.1)
Control		27	24	(88.9)	3	(11.1)

Table 8. The number of animals that ovulated[a] but were not detected in estrus (Experiment III).

Treatment	Production status	# Animals	# Animals ovulating but not detected in estrus	(%)
Light	Dry	14	4	(28.6)
	Lactating	14	2	(14.3)
Control	Dry	14	0	(0.0)
	Lactating	13	1	(7.7)

[a]This was assessed by rectal palpation of a CL or by pregnancy with no breeding date.

Table 9. The pregnancy[a] and conception[a] rates in the control and light-treated groups (Experiment III).

Treatment	Production status	# Animals	Reproductive Parameters # Pregnancies	(%)	Conception Rate (%)
Light	Dry	14	9	(64.3)	60.0
	Lactating	14	9	(64.3)	64.3
Control	Dry	14	11	(78.6)	84.6
	Lactating	13	9	(69.2)	60.0
Light		28	18	(64.3)	62.1
Control		27	20	(74.1)	71.4

[a]This was by palpation at 45 days following the end of the trial.

DISCUSSION

When the data from all experiments is combined a slight (nonsignificant) advantage in reproductive function was found in the light-treated cows (table 10). Normal reproductive function was found in 83.1% of the light-treated cows compared to 79.9% of the control cows. The number of cows with silent estrus/undetected estrus was not different between treatments (table 11). Further, no differences were found in pregnancy rate (light = 45.4%, control = 45.4%) or conception rate (light = 57.5%; control = 58.2%) as shown in table 12.

The data from Experiment I appeared to show an advantage in pregnancy and conception rates. Experiments II and III show that this advantage does not exist. The conclusion from this data is that while season modifies the reproductive function of Brahman cattle, addition of supplemental artificial light (14 hours of total daylength) does not markedly alter the reproductive function in fall bred Brahman cows in Texas. It is possible that Brahman cows in locations further north might show economic benefits from supplemental lighting. Under current conditions other parameters must be examined before any worthwhile economic benefits may be obtained from artifically extending daylength for fall breeding seasons for Brahman cattle.

Table 10. The number of animals exhibiting and not exhibiting reproductive cyclicity in the control and light-treated groups (All Experiments).

Treatment	Production status	# Animals	Reproductive Status # Cycling	(%)	# Not cycling	(%)
Light	Dry	78	67	(85.9)	11	(14.1)
	Lactating	52	41	(78.8)	11	(21.2)
Control	Dry	102	87	(85.3)	15	(14.7)
	Lactating	52	36	(69.2)	16	(30.8)
Light		130	108	(83.1)	22	(16.9)
Control		154	123	(79.9)	31	(20.1)

Table 11. The number of animals that ovulated[a] but were not detected in estrus (All Experiments).

Treatment	Production status	# Animals	# Animals ovulating but not not detected in estrus	(%)
Light	Dry	78	9	(11.5)
	Lactating	52	4	(7.7)
Control	Dry	102	9	(8.8)
	Lactating	52	6	(11.5)
Light		130	13	(10.0)
Control		154	15	(9.7)

[a]This was assessed by rectal palpation of a CL or by pregnancy with no breeding date.

Table 12. The pregnancy[a] and conception[a] rates in the control and light-treated groups (All Experiments).

Treatment	Production status	# Animals	Reproductive Parameters # Pregnancies	(%)	Conception Rate (%)
Light	Dry	78	37	(47.4)	57.4
	Lactating	52	22	(42.3)	57.9
Control	Dry	102	48	(47.1)	55.2
	Lactating	52	22	(42.3)	65.7
Light		130	59	(45.4)	57.5
Control		154	70	(45.4)	58.2

[a]This was by palpation at 45 days following the end of the trial.