RESPONSE OF FALL-BORN CALVES TO PROGESTERONE-ESTRADIOL
BENZOATE IMPLANTS AND REIMPLANTS

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ABSTRACT

Two trials, involving 469 steer and heifer calves, were conducted to evaluate the practices of
implanting or reimplanting suckling fall-born calves with progesterone-estradiol benzoate (PE)
implants (100 mg of progesterone, 10 mg of estradiol benzoate). Calves having an average initial
weight of 67 kg were randomly allocated within sex and location to remain either nonimplanted or
to receive a PE implant in the late fall, in the spring just before green grass, or in both fall and
spring. All animals grazed good- to excellent-quality native Bluestem range. Nonimplanted calves in
Trial 1 gained .57 kg/d during the winter months and PE implants improved growth rate by 7% to
.61 kg/d (P<.05). Growth rate of calves on dry winter range in Trial 2 was only .20 kg/d, and was
not affected by PE implants. Average daily gain of nonimplanted calves during the spring and
summer months was .96 and .87 kg/d for trials 1 and 2, respectively. Performance of implanted
calves during that period was improved an average of 4.3 to 10% (P<.05) by PE implants in both
trials regardless of when the calves were implanted. Growth rate of calves over the entire 8-mo
trials was .66 kg/d for nonimplanted calves and was improved (P<.01) to .70, .70 and .71 kg/d for
calves on the two single-implant and reimplant schedules, respectively. Implanted calves gained an
average of 10.4 kg more than nonimplanted calves during the study.
(Key Words: Progesterone, Estrogens, Growth Promoters, Calves.)

Introduction

Prior studies have demonstrated that a
four-pellet, progesterone-estradiol benzoate (PE)
implant⁶ containing 100 mg of progesterone
and 10 mg of estradiol benzoate is both safe
and effective for improving growth rates of
suckling steer and heifer calves (Spires et al.,
1983; FDA, 1984). All efficacy trials supporting
those claims, however, were conducted using
spring calves in which cows and calves were
grazing pastures of sufficient quality to main-
tain minimum average daily gain (ADG) of
calves above .6 kg/d at all times during the
study (Spires et al., 1983; Gill et al., 1984).

Rearing of fall calves constitutes a different
situation than rearing of spring calves, because
poor pastures decrease available dietary energy
to the suckling calf at a time when cold en-
vironmental temperatures increase its main-
tenance energy requirement. Consequently,
gains of suckling calves on winter pastures
typically are lower than on spring pastures and
any benefits of implanting with PE implants
under those conditions have not been estab-
lished. Furthermore, effects of early-calfhood
implanting upon growth rate of the calf several
months later also is a subject on which little
information is available.

This study was conducted to monitor the
performance until weaning of fall calves which
were implanted with PE implants, either in the
fall, the spring, or in both the fall and spring.

Materials and Methods

Four hundred sixty-nine suckling calves,
having an average initial weight of 66.9 kg, were
selected for two trials. One hundred thirty-eight
steer and 155 heifer Hereford calves were used
for Trial 1 near Claremore, Oklahoma, while
82 steer and 94 heifer Hereford and Hereford x

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Angus calves were used in trial 2 at Mill Creek, Oklahoma. Calves were pastured with their dams on native bluestem range throughout the study. The forage was dormant from the start of the trials until the beginning of the growing season, about May 1. Growth rate was evaluated over two consecutive periods — a winter period and the subsequent spring-summer period. Calves were individually identified by eartags and were randomly assigned, within sex, to one of following four treatments: (1) control, no implants throughout the trial; (2) PE implant-control, implanted only on the first day of the study; (3) control-PE implant, not implanted at the start of the study but implanted just prior to green grass; and (4) PE implant-PE implant, implanted both at the beginning of the trial and reimplanted just prior to green grass. The start, reimplant and end dates were November 30, April 17 and July 25, respectively, in Trial 1, while the same dates for Trial 2 were December 8, April 5 and August 15.

Implants were placed subcutaneously in the top, central one-third of the ear. All calves were weighed and vaccinated for blackleg on the first day of the study and all bull calves were castrated at that time. All calves were reweighed at the reimplant dates and again at termination of the trials. Average daily gain of each calf was calculated for both the winter and spring-summer periods and for the total trial. Data were analyzed by analysis of variance (GLM; SAS, 1979) and treatment means were compared by Duncan’s Multiple Range Test in the event that a treatment effect (P<.05) was detected.

Results

Performance of calves was different between the two locations (table 1; P<.0001). Calves in Trial 2 were heavier than in Trial 1 at the start of the study, but calves in Trial 1 gained faster in both the winter and summer months so that the average weights of calves at reimimplanting and weaning were heavier in Trial 1 than in Trial 2. Steers and heifers gained at a similar rate during the winter months, but steer calves gained slightly faster than heifer calves (1.00 vs .95 kg/d across all treatments) when green grass was available (P<.01). No interactions between locations, sex and implant treatments were detected, indicating that both sexes tended to respond similarly to implants at both of the trial locations (table 1).

In Trial 1, nonimplanted calves gained .57 kg/d during the winter months, and PE implants improved ADG approximately 7% to .61 kg/d (table 2; P<.05). However, during the winter months in Trial 2, ADG of all calves was approximately .2 kg/d, and no differences in growth rates of implanted vs nonimplanted calves were observed (table 3). Consequently, the combined results for both studies illustrate a trend toward improved ADG of implanted calves during the winter months (table 4), but the lack of response in the slower-gaining calves in Trial 2 precluded statistical significance.

The combined statistical analysis revealed that ADG of calves in the summer months was increased by PE implants regardless of when the calves had been implanted (table 4), and the same observation was apparent in both of the individual trials (tables 2 and 3). Calves that

<table>
<thead>
<tr>
<th>TABLE 1. ANALYSIS OF VARIANCE OF AVERAGE DAILY GAIN(^a) OF CALVES IMPLANTED OR REIMPLANTED WITH PE IMPLANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source of variation</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Treatment</td>
</tr>
<tr>
<td>Location X treatment</td>
</tr>
<tr>
<td>Sex</td>
</tr>
<tr>
<td>Location X sex</td>
</tr>
<tr>
<td>Treatment X sex</td>
</tr>
<tr>
<td>Location X treatment X sex</td>
</tr>
<tr>
<td>Error</td>
</tr>
</tbody>
</table>

\(^a\)Error mean square was used as the error term to compute all F-ratios.

\(^b\)Steers gained faster than heifers during Period 2.
TABLE 2. PERFORMANCE OF CALVES IMPLANTED WITH PROGESTERONE-ESTRADIOL BENZOATE (PE) IMPLANTS IN TRIAL 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control- Control</th>
<th>Synovex C- Control</th>
<th>Control- Synovex C</th>
<th>Synovex C- Synovex C</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of calves</td>
<td>75</td>
<td>75</td>
<td>70</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Initial wt, kg</td>
<td>63.9</td>
<td>63.0</td>
<td>60.5</td>
<td>62.4</td>
<td>1.8</td>
</tr>
<tr>
<td>Reimplant wt, kg</td>
<td>143.1</td>
<td>145.8</td>
<td>138.5</td>
<td>148.6</td>
<td>3.6</td>
</tr>
<tr>
<td>ADG (winter(^a)), kg</td>
<td>.57(^c)</td>
<td>.60(^d)</td>
<td>.56(^c)</td>
<td>.62(^d)</td>
<td>.02</td>
</tr>
<tr>
<td>Final wt, kg</td>
<td>237.5</td>
<td>247.9</td>
<td>241.6</td>
<td>246.9</td>
<td>4.5</td>
</tr>
<tr>
<td>ADG (summer), kg</td>
<td>.96(^c)</td>
<td>1.04(^d)</td>
<td>1.05(^d)</td>
<td>1.00(^cd)</td>
<td>.02</td>
</tr>
<tr>
<td>Overall ADG, kg(^d)</td>
<td>.73(^c)</td>
<td>.78(^d)</td>
<td>.76(^cd)</td>
<td>.78(^d)</td>
<td>.01</td>
</tr>
<tr>
<td>Increase, %</td>
<td>6.8</td>
<td>4.1</td>
<td>6.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\)Average daily gain (ADG) of calves implanted with Synovex C during Period 1 was .61 kg/d compared with .57 kg/d for nonimplanted calves (P<.05).

\(^b\)Length of trial was 139 d for Period 1 and 99 d for Period 2.

\(^c,d\)Means that do not have a common superscript differ (P<.05).

remained nonimplanted throughout the entire study gained .93 kg/d during the last 110 d of the trial (table 4). Average daily gain of calves that were implanted with PE implants only at the beginning of the trial was .99 kg/d, while ADG of calves implanted during the last 110 d and those implanted both at the beginning and middle of the study were 1.01 and .97 kg/d, respectively. Summer gains of calves that were implanted either at the start of the study, the middle of the study or at both times were greater than gains of calves that remained nonimplanted (P<.01), but no differences in ADG of calves among any of the three implanting schedules were observed.

Average daily gain of calves calculated over the entire study also was increased by PE implants regardless of the time of implanting. Growth rate of calves implanted either at the beginning of the study or at the midpoint was .70 kg/d compared with .66 kg/d for calves that were not implanted (table 4, P<.01). Reimplanted calves also gained faster than nonimplanted controls (.71 kg/d, P<.01), but no benefit of reimplanting was observed compared with a single implant either at the beginning or middle of the study.

Discussion

The growth rate of suckling fall calves implanted with PE implants averaged 6 to 7% faster than nonimplanted calves. Consequently, the final weaning weights adjusted for equal

TABLE 3. PERFORMANCE OF CALVES IMPLANTED WITH PROGESTERONE-ESTRADIOL BENZOATE (PE) IMPLANTS IN TRIAL 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control- Control</th>
<th>Synovex C- Control</th>
<th>Control- Synovex C</th>
<th>Synovex C- Synovex C</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of calves</td>
<td>45</td>
<td>44</td>
<td>42</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>Initial wt, kg</td>
<td>74.7</td>
<td>74.7</td>
<td>74.5</td>
<td>73.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Reimplant wt, kg</td>
<td>97.6</td>
<td>96.9</td>
<td>99.7</td>
<td>99.1</td>
<td>3.2</td>
</tr>
<tr>
<td>ADG (winter(^a)), kg</td>
<td>.19</td>
<td>.19</td>
<td>.21</td>
<td>.21</td>
<td>.01</td>
</tr>
<tr>
<td>Final wt, kg</td>
<td>211.9</td>
<td>217.7</td>
<td>224.6</td>
<td>221.6</td>
<td>5.0</td>
</tr>
<tr>
<td>ADG (summer), kg</td>
<td>.86(^a)</td>
<td>.92(^ab)</td>
<td>.95(^b)</td>
<td>.93(^b)</td>
<td>.02</td>
</tr>
<tr>
<td>Overall ADG, kg(^d)</td>
<td>.55(^a)</td>
<td>.57(^ab)</td>
<td>.60(^b)</td>
<td>.59(^b)</td>
<td>.01</td>
</tr>
<tr>
<td>Increase, %</td>
<td>3.6</td>
<td>9.1</td>
<td>7.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a,b\)Means that do not have a common superscript differ (P<.05).

\(^c\)Average daily gain.

\(^d\)Length of trial was 119 d in Period 1 and 132 d in Period 2.
TABLE 4. PERFORMANCE OF CALVES IMPLANTED WITH PROGESTERONE-ESTRADIOL BENZOATE (PE) IMPLANTS IN THE TWO COMBINED TRIALS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control-Synovex C-SE</th>
<th>Synovex C-Synovex C</th>
<th>Control-Synovex C</th>
<th>Synovex C-Synovex C</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of calves</td>
<td>120</td>
<td>119</td>
<td>112</td>
<td>118</td>
<td></td>
</tr>
<tr>
<td>Initial wt, kg</td>
<td>67.9</td>
<td>67.3</td>
<td>65.7</td>
<td>66.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Reimplant wt, kg</td>
<td>126.0</td>
<td>127.8</td>
<td>123.9</td>
<td>129.7</td>
<td>2.4</td>
</tr>
<tr>
<td>ADG(^c) (winter), kg</td>
<td>.43</td>
<td>.45</td>
<td>.43</td>
<td>.47</td>
<td>.01</td>
</tr>
<tr>
<td>Final wt, kg</td>
<td>227.9</td>
<td>236.7</td>
<td>235.2</td>
<td>237.3</td>
<td>3.3</td>
</tr>
<tr>
<td>ADG (summer), kg</td>
<td>.93(^a)</td>
<td>.99(^b)</td>
<td>1.01(^b)</td>
<td>.97(^b)</td>
<td>.02</td>
</tr>
<tr>
<td>Overall ADG, kg(^d)</td>
<td>.66(^a)</td>
<td>.70(^b)</td>
<td>.70(^b)</td>
<td>.71(^b)</td>
<td>.01</td>
</tr>
<tr>
<td>Increase, %</td>
<td>6.1</td>
<td>6.1</td>
<td>6.1</td>
<td>7.6</td>
<td></td>
</tr>
</tbody>
</table>

\(^a,b\)Means with different superscripts differ (P<.01).

\(^c\)Average daily gain.

\(^d\)Weighted average length of the two trials was 131 d for Period 1 and 110 d for Period 2.

starting weights, averaged approximately 10 kg heavier for calves implanted once during the trial and 11 kg heavier for calves which were reimplanted with PE implants. This 6 to 7% improvement in performance of fall calves agrees closely with the percentage increases previously observed when PE implants and other anabolic agents have been used in trials with spring calves (Lewis et al., 1978; Spires et al., 1983; Basarab et al., 1984; Gill et al., 1984; Lamm and Greathouse, 1984; Simms, 1984).

This study helped to allay some of our primary concerns regarding the use of growth-promoting implants in suckling calves pastured on dry winter pastures. It has been reported that the estrogenic implants (Synovex-S, zeranol, and formerly diethylstilbestrol) increase the concentration of thyroxin in plasma by increasing its secretion from the thyroid gland (Kahl et al., 1978; Gopinath and Kitts, 1982). In addition, slight increases in heart rate, fasting urinary nitrogen excretion and fasting heat production also have been observed in cattle fed or implanted with diethylstilbestrol (DES) and implanted with Synovex S, which suggest that the estrogenic implants slightly increase maintenance energy requirements (Rumsey et al., 1973). More recently, Rumsey and Hammond (1984) demonstrated a typical 22% increase in ADG of feedlot steers implanted with Synovex S implants and fed ad libitum, but they were unable to detect a response to Synovex S in steers fed a restricted energy diet which supported an ADG of only .86 kg/d. Consequently, one of the major concerns in designing this trial was the prospect that performance of calves over winter might actually be depressed if maintenance energy requirements were increased by the PE implants. Fortunately, no depression in growth rate of implanted calves over the winter was observed. Average daily gain of nonimplanted calves in Trial 2 was only .20 kg/d during the winter months and average growth rate of calves implanted with PE implants during that period also remained at the same rate of .20 kg/d. Calves on better pastures and gaining .57 kg/d during the winter in Trial 1, however, benefited from PE implants during that period. Consequently, maintenance energy requirements were not increased by PE implants to an extent that their use was contraindicated over the winter months. In previous studies conducted to identify the optimal steroid combination and optimal dose for suckling calves, it was found that eight-pellet testosterone propionate-estradiol benzoate implants\(^7\) were not as effective as a half dose of that formulation in calves gaining less than .45 kg/d (Spires et al., 1983). Likewise, the same tendency also was true with the eight-pellet PE implant\(^8\) was compared with the four-pellet implant used in this study. Those observations also support the hypothesis that the growth-
promoting implants may tend to increase maintenance energy requirements and, consequently, was a major reason that a four-pellet vs an eight-pellet PE implant was developed for suckling calves.

The extended effectiveness of PE implants in calves implanted only in the fall was unexpected. Overall ADG throughout the trials, which averaged 241 d, did not differ among any of the implant treatments, regardless of when the implants were administered. Furthermore, performance during the average 110 d in the spring-summer period of these trials was improved more than 6% (P<.01) by implanting calves during the preceding winter, 131 d before the spring-summer period began. Rumsey et al. (1984) recently reported that approximately 75% of the original doses of both progesterone and estradiol were absorbed by 60 d and 85% by 120 d in growing-finishing steers implanted with Synovex S. Those observations seem somewhat inconsistent with our observation that a larger improvement in the performance of suckling calves was observed during the period from 131 to 241 d after implanting than from 1 to 131 d. Greathead (1984) recently reviewed studies with zeranol implants and concluded that the response may be large and of relatively short duration in rapidly growing cattle on high levels of energy intake. However, smaller improvements in growth rate, but occurring over a longer duration, are more typically observed in cattle gaining less than about 7 kg/d. Observations we have made in studies with PE implants also tend to support that hypothesis (H. R. Spires et al., unpublished data). However, any differences in absorption, tissue distribution and(or) metabolism and elimination of the implant materials which may explain those different responses have not been elucidated. Nonetheless, the observation that a positive response from PE implants can be realized regardless of whether calves are implanted in the fall or the spring suggests that considerable flexibility may be used in administering an implant program for fall-born calves.

Literature Cited