Accelerated Lambing Using Exogenous Progesterone and the Ram Effect

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ABSTRACT: An experiment was conducted to determine whether controlled internal drug release devices-type G (CIDR-G) could be used in conjunction with the ram effect to advance the breeding season and lambing and thereafter could be reapplied to stimulate breeding of ewes to produce a second lambing in late summer. Finn crossbred and Columbia ewes were treated with CIDR-G from July 6 to 18. Rams, which had been isolated from ewes, were joined with the flock upon CIDR-G removal. All 59 CIDR-G-treated ewes exhibited estrus, and 55 lambed from breeding within a 30-d period after CIDR-G withdrawal. Eighteen of 19 contemporary control ewes (no CIDR-G) were bred, and 16 lambed. Ewes that had lambed from the CIDR-G and control groups were retreated as before, with CIDR-G inserted March 1 and withdrawn March 13, concomitant with sudden exposure to rams. Of 55 CIDR-G-treated sheep, 53 were bred and 45 lambed. All 16 control ewes were bred and lambed. A second experiment was conducted to determine whether treatment with CIDR-G and the ram effect was effective in mid-spring. The CIDR-G were applied for 12 d and removed on May 1 or 6 from Finn crossbred, Columbia, and Polypay ewes. Rams were introduced upon CIDR-G withdrawal. Of 59 CIDR-G-treated ewes, 58 exhibited estrus and 45 lambed. Twenty-three of 30 contemporary control ewes were bred, and 20 lambed. Intervals from CIDR-G removal to first estrus and lambing were shorter \( (P < .01) \) in CIDR-G-treated than in control ewes in both experiments. Results demonstrate that CIDR-G and/or the ram effect can be used successfully to reduce lambing intervals.

Key Words: Sheep, Anestrus, Fertility, Progesterone

Introduction

Exogenous hormonal regimens used to induce fertility in anestrous ewes consist of a 12- to 14-d treatment with a progestogen sponge followed by an injection of 500 to 750 IU of pregnant mare’s serum gonadotropin (PMSG). Progestogens, analogues of progesterone possessing enhanced biopotency, and PMSG are no longer licensed for commercial application in the United States. The controlled internal drug release dispenser-type G (CIDR-G), a solid silicone elastomer progesterone-releasing pessary currently marketed in New Zealand and Australia, was developed as an alternative to the progestogen sponge (Welch, 1984; Welch et al., 1984). Incorporation of progesterone into the device instead of an analogue may prove advantageous for future approval of CIDR-G in the United States by the Food and Drug Administration.

Elimination of PMSG from out-of-season breeding regimens would reduce cost, remove potential development of immunorefractoriness, and perhaps simplify licensing of progesterone pessaries. Welch et al. (1984) reported that injection of PMSG made little difference when, after CIDR withdrawal, rams were joined abruptly with anestrous ewes that had been isolated from rams. We reported recently that treatment of ewes in late July and early August with CIDR-G and the
sudden introduction of rams advanced onset of the breeding season (Wheaton et al., 1990).

Two experiments were conducted in the present investigation. The objective of the first experiment was to determine whether ewes that had been induced to breed in July/August would, after parturition and lactation, respond to treatment with CIDR-G and the abrupt introduction of rams in late winter/early spring. The second experiment assessed responsiveness of ewes to such treatment later in spring.

Materials and Methods

Experiment 1

July/August Breeding, 1989. At the University of Minnesota West Central Experiment Station at Morris (46°N), 27 parous Columbia ewes, 2 to 4 yr of age and weighing 92 ± 2 kg, were maintained in a lot with an open-faced shelter. Ewes were treated with CIDR-G (n = 20) or no pessary (controls; n = 7). Insertion of CIDR-G occurred on July 6, and devices were removed 12 d later (July 18 = d 0). Shelled corn (.45 kg per ewe) was fed in addition to hay while CIDR-G were in place. Rams were kept in a shelter 457 m away from the flock until d 0, when three proven 1- to 4-yr-old Columbia rams, fitted with marking harnesses, were placed into the flock. Ewes were checked for breeding marks twice daily. Rams were removed 30 d later. Breeding and lambing dates and number of lambs born were recorded.

At the University of Minnesota Northwest Experiment Station at Crookston (48°N), 51 multiparous Finn crossbred ewes (26, 25% Finn, 50% Suffolk and 25% Targhee ewes and 25, 50% Finn and 50% Targhee ewes) 4 to 5 yr of age and weighing 89 ± 2 kg were assigned randomly within crossbreed type and age to CIDR-G (n = 39) and control (n = 12) groups. Application and withdrawal of CIDR-G occurred on July 6 and 18, respectively. Alfalfa haylage was supplemented with barley (.45 kg/per ewe) during CIDR-G treatment. Rams were kept in a shelter 154 m away from the flock until d 0, when four proven 2- to 4-yr-old rams of ≥ 75% Suffolk breeding, whose briskets had been coated with a colored paste, were introduced. Rams remained with ewes through October.

At both locations ewes that had lambed in December/January from July/August breeding had lambs weaned at an average of 48 d (range = 36 to 54 d), after which ewes had a mean dry period of 30 d (range = 19 to 39 d) before they were reexposed to rams on March 13.

March/April Breeding, 1990. At the West Central Experiment Station, CIDR-G were administered on March 1 to the 18 ewes that had been previously treated with CIDR-G and that had subsequently lambed. Likewise, the six control ewes that were bred in summer and subsequently lambed served again as control animals. After a 12-d CIDR-G treatment period during which hay and shelled corn (.45 kg per ewe) were fed, CIDR-G were removed (March 13 = d 0) and four Columbia rams were brought in from the distant shelter and left with the ewes for 52 d.

At the Northwest Experiment Station, CIDR-G were inserted and withdrawn on March 1 and 13, respectively. The plane of nutrition was increased by addition of barley (.45 kg/per ewe) to alfalfa haylage during CIDR-G treatment. Thirty-seven ewes that had been previously treated with CIDR-G and that had subsequently lambed were retreated with CIDR-G, and 10 control ewes that had lambed remained as control animals. On d 0, ewes were abruptly exposed to four predominantly Suffolk rams. Rams were removed 52 d later.

At both locations ewes that had lambed in summer from March/April matings had lambs weaned at an average of 41 d (range = 35 to 49 d) followed by a mean dry period of 8 d (range = 0 to 14 d) before they were placed into lots for fall breeding at a spontaneous estrus.

Experiment 2

May/June Breeding, 1991. At the West Central Experiment Station, CIDR-G were administered to 19 Columbia ewes on April 19 and were removed on May 1 (d 0). Ten other Columbia ewes served as controls. Ewes were 2 to 5 yr of age and weighed 73.9 ± 2.1 kg. All 29 animals had lambed (1.8 ± .1 lambs born per ewe) from January 13 to February 6 and had lactated for 54 to 73 d. Lambs had been weaned 9 to 23 d before insertion of CIDR-G. None of the ewes had been included in previous experiments. On d 0, ewes were abruptly exposed to three Columbia rams. Rams were removed 30 d later. Corn was fed (.45 kg/per ewe) in addition to hay while CIDR-G were in place.

Two groups of ewes received CIDR-G at the Northwest Experiment Station. The CIDR-G were inserted into 21 of 31, 4- to 5-yr-old Finn crossbred ewes (25% Finn, 50% Suffolk, and 25% Targhee; 90.1 ± 3.7 kg) on April 19. All ewes had lambed (2.5 ± .1 lambs born per ewe) from February 12 to 25 and had lactated for 46 to 56 d. Lambs had been weaned 8 to 0 d before CIDR-G treatment. Devices were withdrawn on May 1 and five Suffolk rams, which had been isolated from ewes, were introduced. Rams remained with ewes for 70 d. The CIDR-G also were administered to 19 of 29, 3-yr-old (87.8 ± 3.4 kg) Polypay ewes on April 24. All ewes had lambed (2.8 ± .1 lambs born per ewe) from February 12 to March 3 and had lactated for 53 to 65 d. Lambs had been weaned 6 to 0 d before
Table 1. Responses of control ewes and ewes treated with CIDR-G in July\textsuperscript{a} at the West Central (WC) and Northwest (NW) Experiment Stations

<table>
<thead>
<tr>
<th>Experiment station</th>
<th>Trt</th>
<th>n</th>
<th>Estrus\textsuperscript{b}</th>
<th>Lambed\textsuperscript{c}</th>
<th>Days from CIDR-G removal to</th>
<th>First estrus</th>
<th>Conception\textsuperscript{d}</th>
<th>Lambing\textsuperscript{c}</th>
</tr>
</thead>
<tbody>
<tr>
<td>WC</td>
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<td></td>
</tr>
<tr>
<td>Control</td>
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<td>7</td>
<td>6</td>
<td></td>
<td>20.4 ± 1.2</td>
<td>20.2 ± 1.4</td>
<td>171 ± 1</td>
<td></td>
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<tr>
<td>CIDR</td>
<td>20</td>
<td>20</td>
<td>18</td>
<td></td>
<td>3.3 ± 1.1</td>
<td>9.7 ± 2.0</td>
<td>159 ± 2</td>
<td></td>
</tr>
<tr>
<td>NW</td>
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<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td></td>
<td>21.4 ± 0.9</td>
<td>21.2 ± 1.0</td>
<td>171 ± 1</td>
<td></td>
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<td>37</td>
<td></td>
<td>1.5 ± 1.1</td>
<td>0.1 ± 1.4</td>
<td>158 ± 1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
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<td>19</td>
<td>18</td>
<td></td>
<td>21.0 ± 0.7\textsuperscript{e}</td>
<td>20.3 ± 0.8\textsuperscript{e}</td>
<td>171 ± 1\textsuperscript{e}</td>
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</tr>
<tr>
<td>CIDR</td>
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<td>59</td>
<td>55</td>
<td></td>
<td>2.1 ± 0.4\textsuperscript{f}</td>
<td>9.3 ± 1.2\textsuperscript{f}</td>
<td>158 ± 1\textsuperscript{f}</td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{a}Controlled internal drug release devices-type G (CIDR-G) were withdrawn and rams joined at 0800 on July 18.
\textsuperscript{b}Chalk or dye-colored wool on rump.
\textsuperscript{c}Ewes that conceived within 30 d of CIDR-G removal.
\textsuperscript{d}Last estrus of ewes that lambed.
\textsuperscript{e,f}Means differ (P < .0001).

insertion of CIDR-G. Devices were removed on May 6 and ewes were exposed suddenly to five Polypay rams. Rams remained with ewes for 64 d. Barley (0.45 kg per ewe) was fed to both groups of ewes during CIDR-G treatment. The two groups of ewes were maintained separately in lots 55 m apart.

**Statistical Analyses.** Means ± SE are presented in text and tables. Length of intervals to estrus, conception, and lambing were analyzed in an \( 2 \times 2 \) factorial arrangement for treatment and location effects within season. Categorical data (e.g., lambing rate) were analyzed using SAS (1985) procedures for evaluation of three-way crosstabulation frequency tables. Length of various intervals were examined for effect of season in a split-plot design for repeated measures. Analyses for season effect included only data from ewes that had lambed from matings in both seasons.

**Results**

**Experiment 1**

*July/August Breeding, 1989.* Data from both Experiment stations were analyzed together for effects of CIDR-G treatment and location. Of the total 78 ewes exposed to rams in July, 99\% exhibited estrus within 30 d after CIDR-G withdrawal and 91\% subsequently lambed from conception within the 30-d breeding period. Animals not lambing were present in both treatment groups and locations (Table 1). One ewe did not exhibit estrus, whereas six were bred during the 30-d breeding period but did not lamb. These seven ewes lambed later from mating during the fall breeding season.

Intervals from introduction of rams to first estrus, conception, and lambing were shorter in CIDR-G-treated than in control ewes (Table 1). Treatment x location interactions were nonsignificant (P > .1). Of the 59 CIDR-G-treated ewes, 57 were bred within 3 d of CIDR-G withdrawal and 29 lambed. The two ewes not marked by d 3 were bred on d 17 and 18. Twenty-five of the CIDR-G-treated ewes returned to estrus by d 16 to 19. Twenty-six of the 27 ewes bred from d 16 to 19 lambed. Of the 19 control ewes, 5 were bred from d 15 to 19, 13 from d 21 to 25, and 1 was not detected in estrus. Sixteen of the 18 control ewes bred from d 15 to 25 lambed.

Percentages of Finn crossbred and Columbia ewes lambing from matings within 3 d of CIDR-G withdrawal were 51 and 50, respectively. Respective percentages were 93 and 94 for matings thereafter (d 15 to 25).

Lambing occurred from d 147 (December 12) to 174 (January 8) and had a bimodal frequency pattern (Figure 1). Mean gestation length was 149.0 ± .2 d (range = 144 to 154 d) and fecundity was similar among Columbia and Finn crossbred ewes bred in summer. Fecundity averaged 1.7 for ewes lambing from matings occurring by d 3 and 1.9 (P > .1) for matings thereafter.

*March/April Breeding, 1990.* Of the 71 ewes exposed to rams on March 13, 97\% exhibited estrus and 86\% lambed from matings during a 30-d period after CIDR-G withdrawal. Animals that did not lamb belonged to the CIDR-G treatment group and included seven Columbia and three Finn crossbred ewes (treatment = P < .05; location = P < .01; Table 2). Two of these 10 ewes were not bred and eight were marked but did not lamb.

Intervals from ram introduction to first estrus, conception, and lambing were shorter in CIDR-G-treated than in control ewes (Table 2). First estrus occurred sooner (P < .001) in Columbia ewes in the control group at the West Central Experiment Station than in Finn crossbred control ewes at the
CONTROLLED REPRODUCTION OF EWES

Northwest Experiment Station. Other treatment \times
location interactions were nonsignificant. Of the
55 CIDR-G-treated ewes, 49 were in estrus by d 3
and 28 lambed. One ewe was bred on d 6 but did
not lamb from mating at this time. Three ewes
expressed first estrus on d 19 and 20 and lambed
from matings on these days. Two ewes did not
exhibit estrus. Nineteen sheep were rebred from d
18 to 23 and 13 lambed from breeding at the
second estrus. Of the 16 control ewes, six were
bred from d 7 to 13 (of which five were Columbia
ewes), three on d 17 and 18, and seven from d 20 to
25. Matings of control animals were fertile except
for Columbia ewes bred early. Control Columbia
ewes were rebred from d 21 to 25 and lambed from
these matings.

Percentages of Finn crossbred and Columbia
ewes that lambed from matings within 3 d of
CIDR-G withdrawal were 70 and 31, respectively.
Respective percentages were 94 and 75 for mat-
ings that occurred from d 17 to 25. One of seven
ewes lambed from matings on d 6 to 13.

Lambing occurred from d 146 (August 6) to 174
(September 4; Figure 1). Mean gestation length
was 147.3 ± .2 d (range = 145 to 151 d), and
fecundity was similar among ewes bred in March.
Fecundity averaged 1.8 for ewes lambing from
conception before and after d 3.

Of the 81 ewes bred in March/April that lambed
in August/September and were subsequently ex-
posed to rams in the fall, 90% lambed in March
and early April, 1991. Animals that did not lamb
were from both treatment groups and locations.

Data from those sheep that had lambed from
matings in July/August 1989 and in March/April
1990 were analyzed for effect of season on inter-
vals from CIDR-G removal to estrus, conception,
and lambing, gestation length, and fecundity.
Intervals to lambing were shorter in ewes bred in
March/April than in those bred in July/August
(158.5 ± 1.3 vs 161.5 ± 1.2 d; \( P < .05 \)). Gestation
lengths also were shorter in the former group
(147.3 ± .2 vs 149.1 ± .3 d; \( P < .001 \)). Other traits
were similar.

Experiment 2

May/June Breeding, 1991. Of the 89 ewes exposed
to rams on May 1 or 6, 91% exhibited estrus and
73% lambed from matings during a 30-d period
after CIDR-G withdrawal. Animals that did not
lamb belonged to both control and CIDR-G treat-
ment groups and included Columbia ewes at the
West Central Experiment Station and Finn
crossbred and Polypay ewes at the Northwest
Experiment Station. Effects of treatment and
location on the number of ewes that lambed were
nonsignificant (Table 3). Eight of the 24 ewes that
did not lamb were not bred, whereas 16 ewes were

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Figure 1. Lambing distribution of ewes bred within a
30-d period after withdrawal of controlled internal drug
release devices-type G (CIDR-G) on July 18 (d 0; top
panel), on March 13 (d 0; middle panel), and on May 1
or 6 (d 0; lower panel). Each panel includes data from
the Northwest and West Central Experiment Stations.
Table 2. Responses of control ewes and ewes treated with CIDR-G in Marcha at the West Central (WC) and Northwest (NW) Experiment Stations

<table>
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<tr>
<th>Experiment station</th>
<th>Trt</th>
<th>n</th>
<th>Estrus</th>
<th>Lambed</th>
<th>Days from CIDR-G removal to First estrus</th>
<th>Conception</th>
<th>Lambing</th>
</tr>
</thead>
<tbody>
<tr>
<td>WC</td>
<td>Control</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>12.0 ± 1.8</td>
<td>22.7 ± .8</td>
<td>171 ± 1</td>
</tr>
<tr>
<td></td>
<td>CIDR</td>
<td>18</td>
<td>11</td>
<td>11</td>
<td>3.1 ± 1.0</td>
<td>10.8 ± 2.7</td>
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</tr>
<tr>
<td>NW</td>
<td>Control</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>20.0 ± 1.1</td>
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<td>167 ± 1</td>
</tr>
<tr>
<td></td>
<td>CIDR</td>
<td>37</td>
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<td>34</td>
<td>2.3 ± .7</td>
<td>6.9 ± 1.4</td>
<td>154 ± 2</td>
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<tr>
<td>Total</td>
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<td>16</td>
<td>16</td>
<td>16</td>
<td>17.0 ± 1.4e</td>
<td>21.0 ± .8o</td>
<td>168 ± 10</td>
</tr>
<tr>
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<td>CIDR</td>
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<td>53</td>
<td>45</td>
<td>2.8 ± .8o</td>
<td>7.9 ± 1.3f</td>
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*Control internal drug release devices-type G (CIDR-G) were withdrawn and rams joined at 0800 on March 13.

Intervals from ram introduction to first estrus, conception, and lambing were shorter in CIDR-G-treated than in control ewes (Table 3). Of the 59 CIDR-G-treated ewes, 55 were in estrus by d 3 and 35 lambed from the matings. Three ewes expressed first estrus on d 20, 21, or 28 and lambed from matings on these days. One ewe did not exhibit estrus. Eleven sheep were rebred from d 15 to 22 and seven lambed from mating at the second estrus. Of the 30 control ewes, 8 expressed first estrus from d 6 to 14 and 15 expressed first estrus from d 16 to 27. Seven ewes were not bred. Three of the eight ewes bred from d 6 to 14 lambed from the matings. The other five ewes returned to estrus by d 27, three of which lambed from the matings.

Fourteen of the 15 ewes first bred from d 16 to 27 lambed.

Percentages of Columbia, Finn crossbred, and Polypay ewes that lambed from matings within 3 d of CIDR-G withdrawal were similar and averaged 64%. Percentage of ewes that lambed from matings thereafter (d 6 to 27) was 71%.

Lambing occurred from d 146 (September 29) to 179 (October 27). Gestation lengths were similar in Columbia, Finn crossbred, and Polypay ewes and averaged 148.0 ± .3 d. Fecundity was lower (P = .05) in Columbia (1.3 ± .1) than in Finn crossbred (1.6 ± .1) and Polypay (1.7 ± .2) ewes. Fecundity resulting from May/June breeding was lower than that seen in the same ewes from spontaneous fall breeding (1.5 ± .1 vs 2.4 ± .1; P < .0001).

Table 3. Responses of control ewes and ewes treated with CIDR-G in April/Maya at the West Central (WC) and Northwest (NW) Experiment Stations

<table>
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<tr>
<th>Experiment station and breed</th>
<th>Trt</th>
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<th>Estrus</th>
<th>Lambed</th>
<th>Days from CIDR-G removal to First estrus</th>
<th>Conception</th>
<th>Lambing</th>
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<td>22.0 ± 2.3</td>
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<td>CIDR</td>
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<td>19</td>
<td>16</td>
<td>5.1 ± 1.9</td>
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<td>20</td>
<td>15</td>
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<td>6</td>
<td>19.3 ± 3.3</td>
<td>18.5 ± 3.8</td>
<td>166 ± 4</td>
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</table>

*Control internal drug release devices-type G (CIDR-G) were withdrawn and rams joined at 0800 on May 1 or 6.

Chalk or dye-colored wool on rump.
Ewes that conceived within 30 d of CIDR-G removal.
Last estrus of ewes that lambed.
Means differ (P < .0001).
Col = Columbia; FTS = 25% Finn, 25% Targhee, 50% Suffolk; Pol = Polypay.
Discussion

_July/August Breeding, 1989._ Ninety-one percent of the CIDR-G-treated and control ewes lambed from matings within a 30-d period after CIDR-G removal and joining of rams on July 18. Percentages of CIDR-G-treated and control ewes lambing were similar. Treatment with CIDR-G reduced intervals to first estrus, conception, and lambing. Responses resembled those from two previous experiments conducted at the Northwest Experiment Station (Wheaton et al., 1990). In those experiments, ewes were treated with CIDR-G and devices were removed and rams introduced on August 3 to 8. The present results demonstrate that application of CIDR-G earlier in the summer also is effective. Similar results at both experiment stations establish the responsiveness of Columbia and Finn crossbred ewes to CIDR-G treatment and the ram effect in mid-July. Variation exists among breeds in responsiveness to exogenous hormones (Laster and Glimp, 1974).

Introduction of rams into a ewe flock not exposed to sight, sound, or smell of rams for 1 mo will initiate a rapid increase in LH pulse frequency and a subsequent LH surge (Oldham et al., 1978; Martin et al., 1980). The endocrine response is greater when rams are introduced in the morning rather than in the evening (Martin et al., 1985). The LH surge is followed frequently by a small and transient increase in progesterone secretion (Oldham and Martin, 1978). Administration of progesterone before joining or rams increases incidence of behavioral estrus and enhances follicular development so that ovulated follicles form corpora lutea of normal life span (McLeod and Haresign, 1984; Pearce et al., 1985). In this regard, 97 and 0% of CIDR-G-treated and control ewes, respectively, exhibited estrus within 3 d after ram introduction. In ewes that did not conceive at the CIDR-G-induced estrus, all but two showed a second estrus form d 16 to 19. Length of estrus-to-estrous intervals were consistent with a full luteal phase and support a positive effect of progesterone priming on development of subsequent corpora lutea. Control ewes expressed estrus from d 15 to 25, with more ewes in the \( \geq 21 \) d range. This distribution conforms to that reported by Oldham (1980) and Martin and Scaramuzzi (1983). Accordingly, those ewes in estrus from d 15 to 19 (28% of control ewes) ovulated within several days after ram introduction and formed corpora lutea of normal life span. Ewes in estrus later likely formed initial short-lived luteal tissue and then had a silent ovulation that generated corpora lutea of normal life span.

Similar percentages of ewes lambing and fecundity of CIDR-G-treated and control ewes lead one to question the need to use CIDR-G. Responses of control ewes were probably augmented to some degree by their being commingled with CIDR-G-treated ewes that expressed estrus soon after the introduction of rams. The greater activity of rams when they are with estrous ewes and estrous ewes themselves may provide stimuli that provoke estrus in control ewes (Martin et al., 1986; Nugent and Notter, 1990).

_March/April Breeding, 1990._ Eighty-six percent of the CIDR-G-treated and control ewes lambed from matings within a 30-d period after CIDR-G removal and joining of rams on March 13. This demonstrates that in late winter/early spring Columbia and Finn crossbred ewes are responsive to exogenous progesterone and the ram effect.

Percentage of ewes lambing was higher for control (100%) than for CIDR-G-treated (82%) ewes and for ewes located at the Northwest Experiment Station (94%) than for those at the West Central Experiment Station (71%). Significant treatment and location effects arose mainly from two factors: 1) inclusion of a relatively small number (16) of control ewes and 2) lower percentage of Columbia ewes lambing. Had even one control ewe not lambed, the probability of a treatment effect would have been \( > .1 \). The location effect presumably reflects genotypes rather than differences in management or environmental conditions. Conditions were generally alike at both stations and past results have been much the same. Moreover, control Columbia, but not Finn crossbred, ewes exhibited an initial infertile estrus from d 7 to 13. This manifests a breed difference in underlying reproductive mechanisms.

Matings in July/August resulted in 92% of Finn crossbreds and 89% of Columbia ewes lambing. Respective percentages were 94 and 71 for March/April matings. Ewes not lambing from July/August matings were not retreated in March, precluding a statistical comparison of lambing percentages from summer and winter/spring matings. Percentages suggest, however, that the conception rate of Finn crossbreds was uniform across seasons. The conception rate of Columbia ewes seemed to be somewhat lower in March/April than in July/August. The diminished fertility of Columbia ewes and/or rams in March/April indicates that they may be more sensitive than Finn crossbreds to environmental influences at this time of year, or possibly to physiological factors persisting from parturition and lactation (Hulet and Stormshak, 1972).

Overall percentages of ewes lambing were 54 and 90 for matings occurring within 3 d of CIDR-G removal and from d 15 to 25, respectively. Decreased fertility at the progesterone-induced
estrous supports the postulation that a rapid rate of decline of progesterone concentrations after removal of progesterone-releasing sponges and implants impairs sperm transport (Haresign, 1985; Pearce and Robinson, 1985). The longer gestation lengths of ewes bred in July/August than of those bred in March/April agrees with the longer gestation lengths seen in ewes bred early vs late in the breeding season (Terrill and Hazel, 1947).

**May/June Breeding, 1991.** Seventy-three percent of the CIDR-G-treated and control ewes lambed from matings within a 30-d period after CIDR-G removal and joining of rams on May 1 or 6. This demonstrates that in mid-spring, Columbia, Finn crossbred, and Polypay ewes are responsive to endogenous progesterone and to the ram effect. Although lambing response (73%) was lower than that resulting from July/August (91%) and March/April (86%) breeding, it was nonetheless substantially higher than that reported in other studies in which workers attempted to stimulate fertility in anestrous ewes in spring. Treatment of Suffolk ewes in May with progesterone-releasing pessaries failed to induce a post-treatment estrus (Hamra et al., 1989). Incidence of Hampshire ewes that were mated and that ovulated in response to sudden introduction of rams was 28% in May/June and 52% in June/July (Nugent et al., 1988). Unpublished results indicate that differences in responsiveness may be attributable largely to breed. In a recent study CIDR-G and the ram effect were tested in 2- to 5-yr-old Finn crossbred (50% Finn and 50% Dorset/Rambouillet) and Hampshire ewes. Finn crossbred and Hampshire rams were used with ewes of the same type. The CIDR-G were removed and rams introduced on April 1. Thirteen of 15 (87%) Finn crossbreds lambed, whereas only 4 of 11 (36%) Hampshires lambed.

Responses resembled those from July/August breeding in that lambing percentages were similar for control and CIDR-G-treated ewes. As in Exp. 1, treatment with CIDR-G reduced intervals to estrus, conception, and lambing. Percentages of Columbia, Finn crossbred, and Polypay ewes that lambed were similar. The percentage of Columbia ewes that lambed after March/April mating was lower than that of Finn crossbred ewes. Similar lambing percentages of Columbia and Finn crossbred ewes mated in May/June stems mainly from a deceased lambing percentage of Finn crossbreds bred in May/June (68%) compared with March/April (94%). Overall fecundity of ewes lambing from May/June breeding was 37% less than that seen in the same ewes bred at a spontaneous estrus the previous fall. Seasonal changes in ovulation rate have been reported (Scaramuzzi and Radford, 1983).

**Implications**

Progesterone pessaries in conjunction with the ram effect and the ram effect alone were used successfully to advance the breeding season and lambing, and thereafter to stimulate breeding of the same ewes in March/April to produce a second lambing in late summer. Progesterone pessaries in conjunction with the ram effect and the ram effect alone also were effective in stimulating breeding in May/June to produce a second lambing in the fall. Both treatment regimens increased annual lamb production by about one lamb per ewe treated. Thus, progesterone treatment and the ram effect can be used successfully to improve efficiency of lamb production.

**Literature Cited**


