Management Considerations in Beef Heifer Development: Breed Type, Weight & Height, Reproductive Tract Scores

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Because decisions about selecting and managing replacement beef heifers can affect the future productivity of an entire cowherd, programs to develop breeding heifers have focused on the physiological processes that influence puberty. The timing of puberty is critical to whether a heifer remains in the herd and whether lifetime productivity is optimized.

Age at puberty can be decreased in three ways:
- by selecting a breed with a younger age at puberty,
- by selecting within a breed for younger age at puberty, or
- by crossbreeding with another breed that has a similar or younger age at puberty.

**Diversity Among Breeds**

Table 1 groups breed crosses as to their biological type and four other criteria. The table summarizes data from the Meat Animal Research Center for 19 F1 crosses grouped into seven biological types based on relative differences (X lowest, XXXXX highest) in growth rate and mature size, lean-to-fat ratio, age at puberty, and milk production. These data show that faster-gaining breed groups of larger mature size reach puberty at later ages than do slower-gaining breed groups of smaller mature size. Breeds that have had a history of selection for milk production (e.g., Gelbvieh, Brown Swiss, and Simmental) tend to weigh less at puberty than do those with the same genetic potential for growth and mature size that are not selected for milk production (e.g., Charolais, Limousin, and Chianina).

Heifers sired by breeds with a large mature size tend to be older and heavier at puberty than do heifers sired by breeds with a smaller mature size. The relationship between mature size and age at puberty is most important as a production trait when heifers are bred to calve as 2-year-olds and in systems that impose restricted breeding seasons. The number of heifers that become pregnant during their first breeding season and within a defined period correlates with the number that exhibit estrus early in the breeding season. Heifers that calve first as 2-year-olds produce more calves during a lifetime than do heifers that calve first at three years of age or older.

The decision to breed heifers as yearlings involves careful consideration of both the economics of production and of such characteristics as the reproduction status, breed type or genetic make-up of the heifers involved. Differences in the age at which heifers are first exposed for breeding depend on three factors: management systems, forage quality and availability, and adaptation of respective breed types to specific environmental conditions.

Numerous studies have reported both between-breed and within-breed differences in age and weight at puberty as well as subsequent reproduction in beef cattle. To achieve optimum production levels, it is important to know the relationships between puberty traits and measures of productivity for effective utilization of selection, heterosis and complimentarity. Breed differences, sire and dam effects within a breed, and heterosis or hybrid vigor contribute to genetic control of age at puberty.
at puberty can be offset by associa-
tions with milk production (i.e.,
heavier milking breeds or lines
within a breed, will reach puberty
at younger ages and lighter
weights). When these interpreta-
tions are expanded to mature cows,
it is evident that the additional
nutrient requirements of cows of
large size and higher milk produc-
tion potential must be met or the
intervals from calving to first estrus
will increase and conception rates
will decline.

**Matching the Development Program with Genotype**

We know that most components of
fertility that influence first calving
and subsequent reproductive
performance are not highly heri-
table. This suggests that manage-
ment practices are most likely to
influence the majority of factors
related to reproductive perfor-
ance. How we manage replace-
ment heifer calves from the time
they are weaned from their dams to
the beginning of the first breeding
period is extremely critical for their
subsequent performance.

Studies indicate that puberty
can be expected to occur at a
genetically predetermined size
among individual animals, and only
when heifers reach target weights
can high pregnancy rates be
obtained. In other words, heifers
with the genetic potential to reach a
heavier mature weight must attain a
heavier prebreeding weight before
their first breeding season. Using
the standard set by the Beef Im-
provement Federation for nine
frame-size classifications for U.S.
breeding cattle (Table 2), producers
can estimate body composition and
energy requirements per pound of
gain at various weights during the
feeding period.

Optimum growth rates for
replacement females of various
body types are also available. These
growth rates represent optimums
for heifers that vary in mature size;
they were established to maximize
female lifetime productivity. These
growth rates are listed in Table 3.
The target weight principle calls for
feeding heifers to a prebreeding
target weight that represents 65% of
the heifer’s projected mature
weight.

### Reproductive Tract Score (RTS)

Heifers must reach puberty by 15
months of age if they are to con-
ceive and calve by 24 months, but
as many as 35% of all beef heifers
fail to reach puberty by this time.
We know that first-service concep-
tion rates for heifers that are bred
on their first heat are lower than
those of heifers bred on a second or
subsequent heat. Therefore heifers
should reach puberty one to three
months before the average age at
which they are to be bred. Earlier
age at puberty in relation to breed-
ing is to ensure that a high percent-
age of heifers are cycling and that
the effects of lowered potential
fertility at the first estrus are mini-
mized.

Because age at puberty in beef
heifers is difficult and labor inten-
sive to measure directly, a method
for evaluating the reproductive tract
of yearling heifers has been devel-
oped. The reproductive tract scoring
(RTS) system was designed to
estimate pubertal status via rectal
palpation of the uterine horns and
ovaries. Scores are subjective
estimates of sexual maturity, based
on ovarian follicular development
and palpable size of the reproduc-
tive tract. Each heifer is assigned a
score of 1 (immature) through 5
(cycling) as described in Table 4.

The RTS values have been
shown to be predictive of reproduc-
tive performance of yearling heifers,
especially for pregnancy rates to
synchronized breeding and to
pregnancy rates at the end of the
breeding season. Heifers with more
mature reproductive tracts had
higher pregnancy rates and calved
earlier. Preliminary data indicate
that tract scores can be used to
evaluate the status of heifer devel-
opment and time synchronization
programs and the start of the
breeding season. Scoring can be
done as part of a yearling heifer
evaluation and health program in
conjunction with collection of
yearling weights, condition scores,
pelvic measurements, and general
processing.

An RTS of 1 is assigned to
heifers with infantile reproductive
tracts, indicated by small, toneless
uterine horns and small ovaries
lacking significant structures.
Heifers scored as 1 are likely the
furthest from cycling at the time of
examination. Heifers given an RTS
of 2 are thought to be closer to
cycling than those scoring 1, due
primarily to the presence of small
follicles and slightly larger uterine
horns and ovaries. Heifers assigned
an RTS of 3 are thought to be on
the verge of cycling based on slight
uterine tone in addition to the
presence of follicles. Heifers
assigned a score of 4 are presum-
ably cycling, as indicated by good
uterine tone, uterine size, and
follicular growth. However, heifers
with tract scores of 4 lack an easily
distinguished corpus luteum due to
the stage of the estrous cycle.
Heifers with tract scores of 5 are
similar to those scoring 4 except for
the presence of a palpable corpus
luteum.

### Summary

The target weight principle of
developing heifers to an optimum
prebreeding weight seems to be the
most feasible method ensuring that
a relatively high percentage of
yearling heifers reach puberty by
the breeding season. A better
understanding of the basic prin-
ciples that govern onset of puberty
in the heifer and the influence of
nutrition on this sequence of events
should lead to improved manage-
ment practices and more predict-
able methods of ensuring puberty at
an optimum age.
TABLE 1.
Breed crosses grouped in biological type on the basis of four major criteria

<table>
<thead>
<tr>
<th>Breed Group</th>
<th>Growth rate</th>
<th>Lean:fat ratio</th>
<th>Age at puberty</th>
<th>Milk Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jersey</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>XXXX</td>
</tr>
<tr>
<td>Hereford-Angus</td>
<td>XX</td>
<td>XX</td>
<td>XXX</td>
<td>XX</td>
</tr>
<tr>
<td>Red Poll</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
<td>XXX</td>
</tr>
<tr>
<td>Devon</td>
<td>XX</td>
<td>XX</td>
<td>XXX</td>
<td>XX</td>
</tr>
<tr>
<td>South Devon</td>
<td>XXX</td>
<td>XXX</td>
<td>XX</td>
<td>XXX</td>
</tr>
<tr>
<td>Tarentaise</td>
<td>XXX</td>
<td>XXX</td>
<td>XX</td>
<td>XXX</td>
</tr>
<tr>
<td>Pinzgauer</td>
<td>XXX</td>
<td>XX</td>
<td>XX</td>
<td>XXX</td>
</tr>
<tr>
<td>Brangus</td>
<td>XXX</td>
<td>XX</td>
<td>XXXX</td>
<td>XX</td>
</tr>
<tr>
<td>Santa Gertrudis</td>
<td>XXX</td>
<td>XX</td>
<td>XXXX</td>
<td>XX</td>
</tr>
<tr>
<td>Sahiwal</td>
<td>XX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXX</td>
</tr>
<tr>
<td>Brahman</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXX</td>
</tr>
<tr>
<td>Brown Swiss</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XX</td>
<td>XXXX</td>
</tr>
<tr>
<td>Gelbvieh</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XX</td>
<td>XXXX</td>
</tr>
<tr>
<td>Holstein</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XX</td>
<td>XXXX</td>
</tr>
<tr>
<td>Simmental</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
</tr>
<tr>
<td>Maine-Anjou</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
</tr>
<tr>
<td>Limousin</td>
<td>XXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>X</td>
</tr>
<tr>
<td>Charolais</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>X</td>
</tr>
<tr>
<td>Chianina</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>X</td>
</tr>
</tbody>
</table>

*X lowest XXXXXX highest.
Cundiff, 1986.

TABLE 2.
Body weight & height of breeding females of different frame sizes

<table>
<thead>
<tr>
<th>Frame score</th>
<th>205 day</th>
<th>426 day</th>
<th>Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Height</td>
<td>Weight</td>
<td>Height</td>
</tr>
<tr>
<td>1</td>
<td>35</td>
<td>356</td>
<td>41</td>
</tr>
<tr>
<td>2</td>
<td>37</td>
<td>375</td>
<td>43</td>
</tr>
<tr>
<td>3</td>
<td>39</td>
<td>396</td>
<td>45</td>
</tr>
<tr>
<td>4</td>
<td>41</td>
<td>418</td>
<td>47</td>
</tr>
<tr>
<td>5</td>
<td>43</td>
<td>438</td>
<td>49</td>
</tr>
<tr>
<td>6</td>
<td>45</td>
<td>458</td>
<td>51</td>
</tr>
<tr>
<td>7</td>
<td>47</td>
<td>480</td>
<td>53</td>
</tr>
<tr>
<td>8</td>
<td>49</td>
<td>499</td>
<td>55</td>
</tr>
<tr>
<td>9</td>
<td>51</td>
<td>521</td>
<td>57</td>
</tr>
</tbody>
</table>

1Hip height (in.) based on Beef Improvement Federation standards. Weights (lbs) are expected averages for flesh condition (body condition score 5; Fox et al., 1988).
TABLE 3.
Optimum growth rate for breeding herd replacement females

<table>
<thead>
<tr>
<th>Frame Size</th>
<th>1</th>
<th>3</th>
<th>5</th>
<th>7</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimum weight at first estrus, lbs</td>
<td>580</td>
<td>653</td>
<td>728</td>
<td>803</td>
<td>880</td>
</tr>
<tr>
<td>Mature weight, lbs</td>
<td>880</td>
<td>1027</td>
<td>1172</td>
<td>1320</td>
<td>1467</td>
</tr>
</tbody>
</table>

Optimum weight or target weights at which reproductive cycles are initiated are reinitiated as soon as possible without excess fat deposition that will inhibit milk production and reproduction (Fox et al., 1988).

TABLE 4.
Description of Reproductive Tract Score

<table>
<thead>
<tr>
<th>Reproductive Tract Score</th>
<th>Uterine Horns</th>
<th>Approximate Size</th>
<th>Ovarian Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length (mm)</td>
<td>Height (mm)</td>
<td>Width (mm)</td>
</tr>
<tr>
<td>1</td>
<td>Immature &lt;20 mm diameter, no tone</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>20-25 mm diameter, no tone</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>25-30 mm diameter, slight tone</td>
<td>22</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>30 mm diameter, good tone</td>
<td>30</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>&gt; 30 mm diameter, good tone, erect</td>
<td>&gt;32</td>
<td>20</td>
</tr>
</tbody>
</table>

Reproductive tract score was determined approximately 1 month prebreeding by rectal palpation. Anderson, et al., 1991.

References

