Table of Contents

New Concepts in Heifer Development  
Dr. Les Anderson

Supplementation and Management Strategies to Optimize Reproductive Performance  
Dr. John Hall

Genetic Implications for Beef Heifers  
Dr. Scott Greiner

Making Cows Out of Heifers  
Dr. Patsy Houghton

Recommended Estrous Synchronization Systems for Heifers  
Dr. John Hall

Bull Selection for Heifers  
Dr. Scott Greiner

Producer Panel “Our Heifer Development Program”  
Mr. Jimmy Osborne and Jennifer Ms. Meade  
Mr. Bill Tucker and Roger Morris

Heifer Marketing Strategies  
Mr. Matthew Miller & Mr. Bill Tucker

Selecting Heifers for Purchase  
Mr. David Cuddy  
Mr. Mark Davis

Management of Heifers from Purchase to Parturition  
Ms. Amanda Liles

Calving Emergencies in Beef Cattle: Identification and Prevention  
Dr. Dee Whittier

Management Factors to Improve Reproductive Efficiency in Young Cows  
Dr. Les Anderson
Supplementation and Management Strategies to Optimize Reproductive Performance

Dr. John B. Hall

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Females failing to conceive during the breeding season are still the principal reproductive loss in the beef cattle operation (Ringwall and Helmuth, 1999). Longevity of a cow and the number of calves she produces are critical factors affecting sustainability and profitability of a commercial beef operation (Hughes, 1999). Failure to rebreed is the primary reason for culling young cows, and removal of cows from the herd at an early age results in considerable economic and genetic loss.

An animal’s nutritional status can have profound effects on reproductive efficiency. For the past 40 years, considerable research has focused on nutritional management to increase reproduction. The challenge for the manager and the researcher is the myriad of environments and nutritional options in beef production. To further complicate the situation, rapid progress or changes in genetic selection often results in published nutritional research and nutrient requirements lagging behind current animal type.

Fortunately, there are several factors in the manager’s favor. First, cow nutrition and supplementation can be controlled by the producer. Next our systems that predict nutrient requirements are dynamic and can account for factors such as changes in cow size, milk production, and weather (NRC, 1996; NRC 2000). Finally, although cows and environments may change, the basic nutrition-reproduction interaction concepts presented by Dr. Funston remain true across all situations.

The principal management tools are increasing nutrient availability (supplementation) and decreasing nutrient demand (weaning). Nutritional maximization of reproduction is simple if capital for supplements, and weaning labor and facilities are not limited. The goal of nutritional optimization of reproduction is to maximize reproductive success while controlling feed and labor costs. The focus of this paper will be current concepts in the use of supplements, weaning, and other management strategies to enhance reproduction.

Analysis of nutritional status

The first step in developing a nutritional strategy is to analyze the current nutritional status of cows and heifers as well as available feed resources (Figure 1). While conducting this analysis seems intuitive, and most managers have a similar process, it is surprising the number of producers that begin an AI program with cattle in less than optimal nutritional status.

Nutrient needs of the cow can be calculated from the Nutrient Requirements of Beef Cattle (NRC, 1996; NRC, 2000). This program accounts for stage of production, cow body size, estimated milking ability and environmental factors when calculating nutrient needs. The cow production year can be divided into four nutritional periods: Precalving, Lactating & Breeding, Lactating & Pregnant, Gestation. Nutrient needs of the cow are highest during the Lactating & Breeding period and lowest during Gestation. Precalving is a critical nutritional period as well.
The changes in nutrient requirements of beef cows by different stages of production and varying levels of milk production are illustrated in Table 1. Energy and protein requirements increase by 1/3 between weaning and 1 month before calving, and nutrient requirements almost double from weaning to peak lactation. Note that the greatest nutrient demand is two months after calving which coincides with peak lactation as well as the beginning of the breeding season. Cows in early lactation and young growing cows will often need supplementation. Similarly, cows in late gestation may need supplementation if this period occurs when cows are grazing dormant forage or consuming hay. Cows with greater milking ability also have higher maintenance costs due to differences in basal metabolism (NRC, 1996). Therefore, even when they are not lactating, it takes more energy to maintain these high milking cows. For efficient production and reproductive success, animals need to be matched to the environment in terms of animal type and calving season (Adams et al., 1996).

The minimum required nutrient density of the diet needed to meet animal requirements is also listed in Table 1. Total digestible nutrients (TDN) and crude protein (CP) are older and less accurate measures of energy and protein than net energy – maintenance (NEm) and metabolizable protein (MP). However, they are included in the table because they are commonly reported measures on forage analyses.

Current nutritional status of animals can be assessed easily by use of body condition scores (BCS) for cows, and body weights and BCS for heifers. Cows should be in BCS 5 to 6 (1 = emaciated to 9 obese) at calving and maintain body condition through breeding. Ideally, BCS assessments should be made at weaning, 90 days before calving, at calving, and the beginning of the breeding season. Heifers should reach 65% (55%?) of their mature weight about one month before the breeding season with a BCS of 5 to 7. A review of body condition scoring is beyond the scope of this paper, but it is a critical management practice; therefore, BCS resources are included at the end of this paper.
Table 1. Protein and energy requirements of cows and minimum nutrient content of diets for 1250 cows with producing 18 or 25 lbs milk at peak lactation.

<table>
<thead>
<tr>
<th></th>
<th>Lactation/Breeding</th>
<th>Lactation &amp; Pregnant</th>
<th>Gestation</th>
<th>Precalving</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Months since Calving</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td><strong>18 lbs peak milk production (British cross)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk lb/day</td>
<td>15.0</td>
<td>18.0</td>
<td>16.2</td>
<td>13.0</td>
</tr>
<tr>
<td>Met-Protein&lt;sup&gt;a&lt;/sup&gt; g/day</td>
<td>798</td>
<td>869</td>
<td>827</td>
<td>751</td>
</tr>
<tr>
<td>NEm&lt;sup&gt;b&lt;/sup&gt; Mcal/day</td>
<td>15.6</td>
<td>16.6</td>
<td>16.0</td>
<td>15.0</td>
</tr>
<tr>
<td>%TDN&lt;sup&gt;c&lt;/sup&gt; needed</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>56</td>
</tr>
<tr>
<td>% CP&lt;sup&gt;d&lt;/sup&gt; needed</td>
<td>10</td>
<td>10.5</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td><strong>25 lbs peak milk production (Continental cross)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk lb/day</td>
<td>20.8</td>
<td>25.0</td>
<td>22.5</td>
<td>18.0</td>
</tr>
<tr>
<td>M-Protein g/day</td>
<td>936</td>
<td>1035</td>
<td>976</td>
<td>870</td>
</tr>
<tr>
<td>NEm Mcal/day</td>
<td>19.67</td>
<td>21.0</td>
<td>20.2</td>
<td>18.8</td>
</tr>
<tr>
<td>%TDN needed</td>
<td>63</td>
<td>63</td>
<td>63</td>
<td>60</td>
</tr>
<tr>
<td>% CP needed</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>10</td>
</tr>
</tbody>
</table>

a Metabolizable protein  
b Net Energy for maintainece  
c Percent Total Digestible Nutrients, a measure of energy typically reported on forage tests  
d Percent Crude Protein, a measure of protein less accurate than metabolizable protein but commonly reported on forage analysis.

Understanding the ranch forage resource (grazing and stored) is critical to strategic planning. Too often nutritional strategies are presented to ranchers by advisors or the media without regard to regional differences in forage type, quality, and availability. For example, protein supplementation is often mentioned as a strategy to enhance digestibility of forage and increase cow body condition. While this is an appropriate supplement for dormant range, it is virtually useless and may be detrimental as a supplement for eastern cool season hay. It is essential that managers understand the advantages and deficiencies of the resource in order to supplement the appropriate nutrients. Over-supplementing a nutrient that is not needed may be as detrimental as deficiencies.
Range and pasture forages in the growing vegetative state are highly digestible (65% -70%+) and contain sufficient to excess protein (10% - 20% CP; Adams and Short, 1988; Hall et al., 2004). Properly stockpiled fescue, brome, and orchardgrass exceed 60% digestibility and 10% crude protein as fall and winter grazing (Blaser et al., 1986; Kilgore and Brazle, 1994; Hall et al., 2004). At this stage, plants usually meet the nutrient requirements of lactating cows. In contrast, dormant range forage and over-mature pasture are lowly digestible (< 50%) and a poor source of protein (< 6% CP; Kilgore and Brazle, 1994; Lardy et al., 1997). These forages may require supplementation even to meet requirements of cows in the gestation period (mid-pregnancy).

Tremendous differences exist in forage quality and availability within the Midwest and Great Plains regions. The extremes in nutrient availability are represented in Figures 2 and 3. Native western range forages vary greatly in protein content with maturity (Figure 2.) and may not contain sufficient protein for proper rumen function resulting in a decrease in digestibility of dormant range. Much of the year range forage contains sufficient energy to meet mature cow needs but lacks protein. Supplementation of dormant range with protein increases digestibility and cow performance (DelCurto et al., 1990). In contrast, eastern cool season forages harvested through managed intensive grazing (Figure 3) may meet or exceed the nutrient needs of lactating cows during the summer and early fall (White, 2000). However, first cutting hays from eastern cool season forages usually lack quality as harvest is often delayed due to rainy weather. These over-mature hays are marginal in protein content, but are severely lacking in energy and digestibility (Blaser et al., 1986; Kilgore and Brazle, 1994). Energy is the primary limiting nutrient in mature eastern cool season pastures and hays (Rayburn et al., 1986). Supplementation of these hays with protein does little to improve digestibility or cow performance; however, supplementation of energy will enhance cow performance or reduce body weight loss.

Composition of the supplement can impact forage digestibility. Starch-based energy supplements such as corn, barley, or wheat can decrease the ability of cattle to digest forage if supplementation levels...
exceed 0.5 % of body weight (about 6 lbs for a mature cow) per day. High levels of starch shift the population of rumen microbes toward starch digesters. The resulting decrease in fiber digesting microbes impairs forage digestion. Fiber-based energy supplements such as soyhulls, wheat mids, and corn gluten feed do not suppress digestion of forage. Forages that are low in protein require supplementation with degradable intake protein (DIP) to enhance function and reproduction of rumen microbes. When forages are extremely low in protein, non-protein nitrogen sources of DIP such as urea may not be effective. In these situations, insufficient amount of amino acids are available to allow rumen microbes to utilize the non-protein nitrogen effectively.

Forage intake by cattle also affects nutrient availability. Typically, cattle consume approximately 2% of their body weight in dry matter per day. Forage intake is influenced by fiber content, available forage, and weather (NRC, 1996). Highly digestible pasture has a high passage rate through the digestive tract; thereby producing dry matter intake of 2.3 to 2.5 % of body weight (Gerrish et al., 1998). In contrast, cows may only be able to eat 1.5 to 1.7 % of their body weight in highly fibrous mature grasses (Kilgore and Brazle, 1994). Cows can easily eat enough high quality forage (CP ≥ 10 %; TDN > 65%) to meet their nutrient needs. However, cows many not be able to consume sufficient amounts of fibrous, mature, low quality forage to meet their nutritional needs. For example, a 1000 lb cow producing 20 lbs of milk per day would need to eat 50 lbs of 5.0 % CP range grass to meet her protein needs (Adams et al., 1986). Considering, her maximum intake would be 25 lbs or less of forage, the cow will be full but nutritionally starved.

Nutritional and management strategies for replacement heifers

Nutritional management of replacement heifers begins at or before weaning and continues through mid-gestation. The goal during this period is to optimize reproductive performance and heifer development costs. Results from current research indicate that some flexibility exists for heifer development programs.

Target weight. One of the most critical factors affecting the success of reproduction in replacement heifers is postweaning nutrition. Considerable research has investigated the role of nutrition and specific nutrients on puberty onset and reproduction in heifers (Schillo et al., 1992; Patterson et al., 1992). From a management perspective, the most important consideration is that heifers reach a critical or “target” body weight before the breeding season (Lamond, 1970).

Achieving the target weight before breeding insures that breeding success will not be limited by nutrition. For many years, the target weight for heifers suggested by research and experience has been set at 65% of mature weight (Patterson et al., 1992). In addition, heifers developed to 65% of mature weight by breeding had less calving difficulty than heifers developed to 55% of mature weight. The 65% level appears to be effective across a wide range of cattle biological types and nutritional environments. If supplementation of heifers can be achieved economically or if heifer value or pasture costs are high, raising heifer to 60% to 65% of mature weight is advantageous.

Recently, several articles focused on advantages and disadvantages to developing heifers to 53% compared to 58% of mature weight (MW) by the breeding season. These researchers found that developing spring calving heifers to 53 % of mature weight reduced heifer development costs without any impacts on initial pregnancy rates, dystocia, rebreeding rates or calf production traits (Funston and
It should be noted that these were crossbred heifers which tended to reach puberty early as evidenced by 74% of the 53% MW heifers and 85% of 58% MW heifers cycling by the start of the breeding season. A follow-up study (Creighton et al., 2005) indicated that developing heifers to 50% MW compared to 55% MW resulted in similar overall pregnancy rates, but decreased calf weaning weight from 2-yr old cows and delayed calving in 3-yr old cows. The decrease in calf value offset any gain by reducing heifer development costs. Ranches adopting a lower target weight strategy reduce heifer development costs, but may realize an increase in dystocia and slight reduction in numbers of pregnant heifers. Furthermore, ranches which can retain ownership and feedout open heifers may be able to better offset production losses than smaller operations.

Beef producers need to consider heifer biological type, breeding (purebred vs crossbred), development costs, and marketing options before selecting a target weight (percentage mature weight) goal. Reducing development costs for replacement heifers by lowering target weights are not without risks.

**Pattern of gain and feeding management.** Once a target weight is determined, managers can focus on the mechanics of heifer development. The route (pattern of gain) towards the target weight may not be as important as attaining the target weight by the breeding season (Table 2). Heifers managed to meet target weight by three different methods: 1) rapid gain followed by slow gain, 2) steady gain, or 3) slow gain then rapid gain had similar pregnancy rates (Clanton et al., 1983). Similarly, spring-born heifers that were roughed through the winter then pushed to gain a majority of their target weight during the last 60 days before the breeding season had pregnancy rates equal to (Lynch et al, 1997) or less than (Hall et al., 1997) heifers on a steady rate of gain. Heifers developed on stair step gain (fast-slow-fast) had enhanced or equal pregnancy rates to heifers on a steady gain system (Poland et al., 1998; Grings et al., 1999). Therefore, managers can design feeding programs to maximize gain during times of abundant forage or cheap feed supplies.

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of heifers</th>
<th>Even gain</th>
<th>Slow - Fast</th>
<th>Fast - Slow</th>
<th>Fast-Slow-Fast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clanton et al., 1983</td>
<td>180</td>
<td>82.0 %</td>
<td>75.0 %</td>
<td>73.0 %</td>
<td>--</td>
</tr>
<tr>
<td>Lynch et al., 1997</td>
<td>160</td>
<td>87.4 %</td>
<td>87.2 %</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Poland et al., 1998</td>
<td>96</td>
<td>75.0 %</td>
<td>--</td>
<td>--</td>
<td>89.6 %</td>
</tr>
<tr>
<td>Grings et al., 1999</td>
<td>210</td>
<td>81.8 %</td>
<td>--</td>
<td>--</td>
<td>86.6 %</td>
</tr>
</tbody>
</table>

Sorting heifers into feeding groups by body weight at weaning decreases feed costs and improves reproductive performance (Varner et al., 1977; Bellows and Hall, 1994). Light weight heifers at weaning benefited from separate feeding as indicated by increased body weights at breeding and enhance pregnancy rates. Feed costs are reduced because heavier heifers can be grown at a slower rate on less expensive feedstuffs.

Producers are often concerned about pattern of gain affecting subsequent productivity in heifers. Heifers that receive creep feed pre-weaning reach puberty earlier, but they have suppressed milk production as primiparous cows compared to non-creep fed heifers (Hixon et al., 1982; Buskirk et al.,
Even though milk production is reduced calf weaning weight may not be affected as calves may substitute forage for milk if forage quality is high (Buskirk et al., 1996; Sexton et al., 2004). Stair-step feeding regimes for replacement dairy heifers result in substantial increases in milk production. Studies in beef heifers have reported a 0 % to 6 % increase in milk production in response to stair-step development (Park et al., 1998; Grings et al., 1999). The variation in response appears to be related to breed and/or timing of different growth rates. Overall, although measurable changes in milk production can occur in response to feeding patterns of replacement heifers, lifetime productivity may not be altered as long as target pre-breeding weight are achieved.

Specific nutrients.

Metabolizable protein. In one study, feeding 250 g of UIP to heifers delayed puberty compared to heifers fed monensin (Rumensin), but did not hurt overall conception rates (Lalman et al., 1993). In contrast, feeding 100 g of UIP decreased age at puberty and increased pelvic areas (Graham, 1998; Table 3). In addition, UIP supplemented at 216 g or 115 g per heifer per day increased FSH production and/or secretion (Kane et al., 2004). The effect of UIP on replacement heifers appears to depend on the amount of UIP supplied as well as UIP in the base diet.

<table>
<thead>
<tr>
<th>UIP (grams per day)</th>
<th>0</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Daily Gain</td>
<td>1.86</td>
<td>2.1</td>
</tr>
<tr>
<td>Pelvic area (sq. cm)</td>
<td>150.6</td>
<td>162.8</td>
</tr>
<tr>
<td>Cycling %</td>
<td>54.0</td>
<td>77.0</td>
</tr>
</tbody>
</table>

Graham, 1998

Increasing dietary fat. The research on developing heifers is less extensive than studies on postpartum cows and heifers. Lammoglia and co-workers reported a high-fat diet increased pregnancy rates and cyclicity in heifers of a double muscled breed, but it had little effect or a negative effect in other breeds. In contrast, we have preliminary data that indicates an advantage to feeding whole cottonseed (5 % fat diet) to developing beef heifers (Figure 4). The difference between the two studies may be related to the length of time the high fat diet was fed before breeding. Our heifers were fed the high fat diet for 75 days before breeding compared to 162 in the other study. We are continuing further research to determine if short-term feeding of high fat diets, perhaps during synchronization, will improve reproduction in heifers.

Figure 4. Effect of High Fat Diet During the Peripuberal Period in Beef Heifers

Ionophores

Rumensin and Bovatec act by altering the types of microbes in the rumen, thereby enhancing digestion and growth rate. Addition of ionophores to replacement heifer diets can reduce age at puberty by 15 to 30 days while increasing growth rate (Mosley et al., 1982). Although some of the reproductive effect may be due to ionophores action in the rumen, evidence indicates there may be systemic actions as...
Response to ionophores appears to be less dramatic in light-weight or poorly fed heifers.

**Early weaning.** Control of replacement heifer nutrition by managers usually begins at weaning. Drought conditions or management strategies to improve reproduction in young cows (see next section) may result in potential replacements being weaned at 60 to 120 day of age rather than the traditional 7 to 8 months. Considerable research has focused on performance of early weaned calves in the feedlot, but few studies address reproductive impacts. Proper nutritional management of these early weaned heifers resulted in heifers that were lighter at breeding, but had improved conception rates compared to normal weaned heifers (Sexten et al., 2004).

**Nutritional and management strategies for two- and three-year old cows**

Young cows represent the greatest management challenge in the herd. The combination of lactation and continued growth creates a significant nutritional strain on young cows. This nutritional stress combined with the effects of suckling and presence of the calf results in prolonged intervals of postpartum anestrous (Short et al, 1990). Prolonged anestrous decreases the probability that young cows will conceive during the breeding season. In addition, primiparous cows have higher incidence of dystocia and retained placenta; conditions which result in decreased rebreeding success. Ranch and IRM data indicate that only 50 % to 60 % of the heifers that calve as 2-year-olds are on the ranch to calve at 4 years of age (Meeks et al., 1999; Hughes, 1999). Management strategies should focus on reducing or managing postpartum anestrous. Economic analysis by Meeks and co-workers (1999) indicated that investing money in heifers at this stage of production was more profitable than increasing costs on heifer development.

**Body condition and weight at calving.** Primiparous cows calving in body condition score 6 or 7 have reduced postpartum intervals and higher rebreeding rates than heifers calving in body condition score 5 or less (Spitzer et al., 1995). Similarly, three year old cows calving for the second time need to be in BCS 5 or 6. Management of heifers to reach 85-90 % of their mature weight by calving may reduce dystocia (Corah et al., 1975). Pattern of gain during the precalving period does not appear to be as important as the final body condition score at calving. However, there is limited evidence that heifers gaining weight during the precalving period may have improved reproductive rates during the breeding season.

**Precalving supplementation.** Numerous studies investigated the impact of different precalving nutritional strategies on cow performance and rebreeding success of young cows (Randel, 1990; Whittier et al., 2005). Overwhelmingly, these studies indicate that when supplementation provides sufficient nutrients so body condition scores are optimized at calving, there is limited impact on subsequent reproductive performance. The only exception may be diets balanced for metabolizable protein. Limited effects of supplement type have been reported on precalving weight gain and body condition. Alfalfa hay, soybean meal, cottonseed meal, sunflower meal, safflower meal, and feather meal are supplements that can provide sufficient protein to pregnant heifers grazing winter range. Soy hulls, corn gluten feed, wheat mids, corn, barley, and dried brewers grains are appropriate energy supplements for pregnant heifers consuming grass hay.

Balancing diets for pregnant heifers to meet metabolizable protein (MP) requirements rather than crude protein (CP) requirements may result in improved rebreeding performance on heifers provided native
range and meadow hay (Table 4; Patterson et al., 2003). Patterson concluded that spending an additional $1.81 per heifer for the MP based supplement increase value of the 2-year old heifer by $13.61. However, providing UIP to replace or in addition to CP did not improve reproduction in heifers grazing fescue (Strauch et al., 2001).

Table 4. Pregnancy rates in two-year-old cows, across two years and two locations, that were supplemented the previous winter to meet metabolizable protein (MP) or crude protein (CP) requirements while grazing sandhills range and consuming meadow hay.

<table>
<thead>
<tr>
<th>Year</th>
<th>Location A</th>
<th>Location B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MP req.</td>
<td>CP req.</td>
</tr>
<tr>
<td>1997-98</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td>1998-99</td>
<td>95</td>
<td>88</td>
</tr>
</tbody>
</table>

Patterson et al., 2003. Treatment × Year × Location interaction (P = .07).

Treatments differ at Location B (P = .01).

Treatments differ at Location A (P = .01) and Location B (P = .15)

Addition of high fat supplements to gestating heifer diets or both pre- and postcalving has varying impacts on postpartum reproduction. In a review by Funston (2004), he determined that the impact of prepartum high fat feeding on subsequent reproduction was inconclusive. In fact more studies noted no effect or a negative effect of high fat feeding on subsequent reproduction in young cows than a benefit. Positive effects of prepartum high fat supplementation appear to be dependent on pre- and postpartum forage availability (Bellows et al., 2001). Feeding high fat diets during gestation increases calf vigor and survivability in cold (Lammoglia et al, 1997; Geary et al., 2002), but not temperate (Dietz et al., 2004) calving seasons.

In practice, high fat supplements are usually whole or cracked oilseeds such as sunflower, safflower, soybean, or cottonseed, but other forms of fat or rumen protected fats can be fed as well. These supplements are fed at a rate of 1 to 5 lbs per animal depending on the fat content of the supplement. Overall, the diet should not exceed 5% dietary fat or rumen function may be impaired.

Choice of supplements for heifers in late gestation should be based on the most cost effective supplement that provides the missing nutrients. When protein is the limiting nutrient, there appears to be an advantage to balancing diets for metabolizable protein with a UIP protein source. High fat supplementation prepartum may be an advantage in cold climates if high fat supplements are approximately the same cost as normal supplements.

Postcalving supplementation. Although body condition at calving has the greatest impact on rebreeding success in young cows, postpartum nutrition can enhance or impair the effects of body condition. Young cows that lose weight postcalving have prolonged anestrous periods and poor rebreeding performance (Dunn et al., 1969). In contrast, young cows that gain weight rebreed earlier and have greater pregnancy rates than cows that maintain their weight (Figure 5; Spitzer et al., 1995; Ciccioli et al., 2003). Therefore, young cows must gain weight during the postpartum period to successfully rebreed. In most cases, energy supplementation will be required during early lactation (Table 5).
Most studies indicate little advantage to feeding young lactating cows specific forms of energy or protein as well as feeding nutrients in excess of requirements. Feeding high fat diets during the postpartum period influenced milk production, but did not affect pregnancy rates (Bottger et al., 2002; Lake et al., 2005). Added UIP or substituting UIP for DIP in diets for lactating young cows did not enhance reproduction in well fed cows (Alderton et al., 2000; Strauch et al., 2001). Increasing CP or MP in the diet above requirements does not significantly improve cow reproductive performance (Rusche et al., 1993; Waterman et al., 2006).

Supplementation and management strategies should include calving heifers before the cow herd, timing of calving relative to forage availability, and supplementation to provide a high rate of gain for lactating heifers. The extended postpartum interval in young cows, combined with high probabilities of dystocia and calf mortality in young dams, warrants calving heifers ahead of the cow herd.

Recently, there has been considerable interest in shifting calving seasons so maximum nutrient needs of the cow with maximum forage growth and quality. In studies in Montana and Nebraska, calving cows in June resulted in decreased cow costs and improved rebreeding rates (Adams et al., 1996; Grings et al., 2005). However, shifting to summer or late spring calving is not without risks or tradeoffs. In the Northern Plains, summer calving results in decreased forage quality coinciding with increased calf nutrient needs and forage intake. Producers either accept lower returns for lighter weight calves or must spend money on supplementing early weaned calves. In turn, these calf costs somewhat offset the savings in cow costs. In the Southern Plains or Midwest, late spring or early summer calving moves the breeding season to the hottest, most humid part of the year. Heat stress reduces fertility in cows and bulls resulting in reduced calf crop (Selk, 2001).

Fall calving is a viable option from eastern Texas and Oklahoma to southern Iowa and eastern Kansas. Fall calving cows in these regions enter the calving season in greater body condition than spring calving cows. In addition, cool season perennial grasses produce a fall flush of growth that coincides with high
nutrient needs of the cow. Finally, the breeding season takes place during November and December before severe winter weather hits.

### Table 5. Example diets (as-fed) for lactating primiparous cows gaining 1.5 lbs/day

<table>
<thead>
<tr>
<th>Feed Ingredients (lbs./hd/day)</th>
<th>Diet</th>
<th>Barley</th>
<th>Corn</th>
<th>Soyhulls</th>
<th>Corn Gluten Feed</th>
<th>Range, June</th>
<th>Pasture, Spring</th>
<th>Meadow Hay</th>
<th>Fescue Hay</th>
<th>Cost/hd/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>----</td>
<td>5.5</td>
<td>----</td>
<td>18</td>
<td>1.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>122*</td>
<td>0.84</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>3.5</td>
<td>----</td>
<td>8.5</td>
<td>----</td>
<td>19</td>
<td>0.95</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>135*</td>
<td>----</td>
<td>0.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a Based on NRC level 1 calculations for 1080 lb lactating 1st calf heifers and estimated feed prices based on 7/21/06 national feedstuff prices plus transportation.

* High rate of passage of these diets may reduce animal performance; therefore, energy or fiber supplementation may be needed.

**Weaning – early or temporary.** One of the most powerful tools to improve reproductive rate in two- and three-year-old cows is weaning. The tremendous reduction in nutrient demands as well as removal of influence of the calf results in positive effects on reproduction and body weight. Early weaning falls into two categories breeding season weaning or post/during-breeding weaning. Temporary weaning or calf removal is separation of the calf and dam for 48 hours at the beginning of the breeding season or during estrus synchronization.

Weaning calves at 60 to 90 days (breeding season weaning) reduces days to first estrus, increases pregnancy rates, and body condition of 2-year-old cows (Lusby et al., 1981; Thrift & Thrift, 2004; Waterman et al., 2006). Reported enhancement of pregnancy rates are between 15% and 38%. Early weaning was even beneficial when cows were synchronized with CIDR-based synchronization system which induces cycles in anestrous cows (Waterman et al., 2006). Early weaned heifers weigh between 100 lbs. and 150 lbs. more than their normal weaned counter-parts at time of normal weaning.

Weaning post-breeding (120 to 170 days of age) does not impact pregnancy rates in 2-year-old cows, but increases body weight gain and body condition of cows preparing for their second lactation (Basarab et al., 1986; Meyers et al., 1999). Increased weight gains for cows weaned after/during breeding ranged from 0.4 lbs to 1.2 lbs/day compared to cows weaning calves at 200 to 233 days (Thrift & Thrift, 2004). The resulting increase in body condition of young cows was positively correlated with pregnancy rate and percentage of live calves the following year despite a slight increase in calving difficulty (Richardson et al., 1978).

Temporary weaning or 48 hour calf removal improved (Kiser et al., 1980, Yelich et al., 1995; Geary et al., 2001) or had no effect (Fanning et al., 1995; Whittier et al., 1999) on conception and/or pregnancy rates to various synchronization protocols. The enhancement of response to synchronization by calf removal may depend on age of cow, synchronization system, or cow body condition (Warren et al., 1988). In general, multiparous cows in good body condition do not benefit from 48 hour calf removal as much as younger or thinner cows. However, cows that are deep in anestrous do not respond to temporary calf removal.
**Biostimulation.** Exposure of postpartum cows to bulls or testosterone treated cows reduces postpartum interval and increase the number of cows cycling at the beginning of the breeding season (Zalesky et al., 1984; Custer et al., 1990; Burns and Spitzer, 1992). Sterile bulls, bull urine, fenceline exposure to bulls, and exposure to testosterone treated cows are effective biostimulents (Fike et al., 1996; Berardinelli and Joshi, 2005). Impacts of biostimulation are greatest in primiparous cows resulting in a reduction in postpartum interval of 12 to 20 days compared to non-exposed cows. Cows appear to need approximately 30 to 60 days of exposure to the biostimulation to maximize the response. Biostimulation increased (Tauck, 2005) or had no effect (Fike et al., 1996) on pregnancy rates to synchronized AI (Table 6).

**Nutritional and management strategies for mature cows**

Multiparous cows are at reduced risk for reproductive failure due to lower nutrient demands, shorter postpartum intervals, and lower incidence of reproductive complications than younger cows. This group of cows represents the largest segment of the herd, and the greatest opportunity for flexibility in management. If cow genetics and calving season are matched to the forage supply and environment then only limited supplementation of mature cows should be required.

**Pre- and postpartum supplementation.** The most critical factor for multiparous cows is for them to calve in moderate body condition (BCS 5 or 6; Randel, 1990). Calving in good condition provides some buffer against nutritional deficiencies postpartum. However, cows losing greater than 0.5 BCS from calving to breeding may have reduced pregnancy rates. Cows can lose weight after the breeding season as long as body condition is regained before calving. For spring calving herds, supplementation strategies should focus on providing sufficient nutrients to maintain or add body condition during the winter months. Fall calving herds on eastern perennial pastures may require little additional supplementation. After calving, the forage resource should meet the nutritional needs of cows unless there is a drought or cows are not matched to the ranch resource.

Most of the details of supplementation strategies and response to specific nutrients have been covered in the section on two- and three-year-old cows. In general, multiparous cows derive less benefit from MP or high fat supplementation. A majority of the studies reviewed by Funston (2004) indicated no effect or a negative effect of high fat supplementation to multiparous cows.

**Biostimulation and early weaning.** Biostimulation reduces postpartum interval in mature cows, but the magnitude of the reduction is small (4 to 10 days) compared to young cows. Early weaning is a strategy that should be considered in times of drought or for thin mature cows. If range or pasture conditions deteriorate greatly after breeding then weaning at 120-150 days should be considered as a method to build cow condition and reduce winter feed costs. Conversely, when fall forage is abundant there is no disadvantage to weaning later than normal (Short et al., 1996).

Table 6. Reproductive responses in primiparous suckled beef cows estrous synchronized (ES) with CO-Synch after exposure to bull or bull excretory product (BE) or no bulls or bull excretory products for 60 day before synchronization.
Management for Successful Reproduction

Based on what we have discussed today, it is apparent that there are no nutritional supplements or technologies currently available that will greatly enhance reproduction in nutritionally mismanaged cattle. Therefore, nutritional management should focus on maintaining cattle in proper nutritional status or achieving that status by critical reproductive events (i.e. calving, breeding). Other management strategies should be considered in addition to supplementation especially in young cows or thin mature cows.

Key management strategies are:

1. **Understand the grazing resource and use it to advantage**
   a. Know seasonal and yearly variations in forage nutrient content and availability
   b. Optimize calving date to forage availability and quality as well as environmental temperatures and marketing options.
   c. Design supplementation strategies to meet cow nutrient needs

2. **Ensure sufficient energy is available to support reproduction**
   a. Body condition score cows and achieve BCS 5 in cows and BCS 6 in heifers by calving (latest) or 60 days before calving (preferred).
   b. Maintain cow body condition from calving through breeding for cows in proper body condition, and increase body condition in cows that are below optimal BCS at calving.
   c. Feed thin cows and 1st calf heifers in a separate group from main herd.
   d. Consider early weaning young cows or thin mature cows.
   e. Provide energy supplementation from the most economical local source.
   f. If fats are an economical source of energy, include oil seeds or fats to increase dietary fat up to 5% of total diet dry matter.

3. **Provide optimum level of dietary protein**
   a. Balance diets on MP if possible
   b. Provide sufficient DIP for adequate rumen function
c. Avoid over supplementation of protein
d. Inclusion of UIP in diets may not be effective

4. **Include ionophores in diets when possible**

5. **Base mineral supplementation on forage mineral content and local deficiencies**
   a. Supplement P only when needed
   b. Pay attention to trace mineral levels especially Cu, Se, Mn, and Zn
   c. Be aware of mineral antagonisms

6. **Use other management strategies**
   a. Render calving assistance early to reduce reproductive impacts of dystocia.
   b. Consider biostimulation, especially for young cows
   c. Alter weaning times based on cow condition and available forage

**Body condition scoring resources**

http://www.cowbcs.info/index.html
http://www.ext.vt.edu/pubs/beef/400-795/400-795.html
http://www.ansi.okstate.edu/exten/cc-corner/archbcs1to9.html

**References**


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Gerrish, J. R., F. A. Martz, V. G. Tate, and R. E. Morrow. 1998. Length of the grazing period: Does it really matter. Abstract. Missouri Agricultural Experiment Station

http://aes.missouri.edu/fsr/research/afge98gp.stm.

Graham, 1998 (Table). In Reproductive Management Tools & Techniques II. Univ. of Missouri


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Genetic Implications for Beef Heifers
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Introduction
Genetics play a vital role in the successful development, reproductive performance, and future productivity of beef heifers. As the factory of the beef enterprise, profitable females have the following attributes:

- Reach puberty early, calve at 2 years of age, and then annually thereafter with no calving difficulty
- Wean a calf annually which fits demands of marketplace and meets consumer expectations
- Highly adapted to environmental and managerial resources
- Generate high revenue at low cost over a long, productive life

Genetics play an important role in all of these factors. Therefore, the application of basic genetic tools that allows for balancing the large number of relevant traits is key. Not only do genetics provide the foundation for performance, the interaction of genotype with management, nutrition, and the environment have a profound impact on successful heifer development as well as cowherd profitability.

Genetics and Reproduction
Reproductive efficiency is the single most economically important trait for cow-calf producers. Unfortunately, limited tools are at our disposal to enhance reproduction through genetic selection due to the low heritability of reproductive traits and associated complexities involved in calculating EPDs. Capturing heterosis through the use of well-planned, structured crossbreeding programs provides the best genetic tool for enhancing reproduction. Maternal heterosis realized through the crossbred cow results in improvements in cow fertility, calf livability, calf weaning weight, and cow longevity. Collectively, these improvements result in a significant advantage in pounds of calf weaned per cow exposed, and superior lifetime production for crossbred females (see table).

<table>
<thead>
<tr>
<th>Trait</th>
<th>Units</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calving rate, %</td>
<td>3.5</td>
<td>3.7</td>
</tr>
<tr>
<td>Survival to weaning, %</td>
<td>.8</td>
<td>1.5</td>
</tr>
<tr>
<td>Birth weight, lb.</td>
<td>1.6</td>
<td>1.8</td>
</tr>
<tr>
<td>Weaning weight, lb.</td>
<td>18.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Longevity, yr.</td>
<td>1.36</td>
<td>16.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cow Lifetime Production:</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Calves</td>
</tr>
<tr>
<td>Cumulative Wean. Wt., lb.</td>
</tr>
</tbody>
</table>

With the lack of genetic predictors (EPDs) available to select directly for reproduction, heterosis is our best tool to genetically improve and maintain reproductive efficiency. Some level of heterosis is important, although maximum heterosis is not necessary. The use of artificial insemination or
Composite bulls are mechanisms to maintain heterosis while maintaining a sustainable crossbreeding plan.

Genetics contribute significantly to several traits which impact reproductive performance. Mature size and milk production both influence reproductive efficiency and are manifested through interactions with nutrition and the environment. Mature size and milk impact nutritional requirements, and therefore must be kept in balance with available feed resources to allow for optimum reproductive performance. The following table characterizes maternal performance of females sired by several breeds (Cycle VII Germplasm Evaluation Program, U.S. Meat Animal Research Center, Clay Center, NE).

### Sire Breed Means for Reproduction and Maternal Traits of F1 Females

<table>
<thead>
<tr>
<th>Sire breed of female</th>
<th>2 Year Olds</th>
<th>3-5 Year Olds</th>
<th>4 Year Olds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calf Crop</td>
<td>200-d Wt. (lb.) per</td>
<td>Calf Crop</td>
</tr>
<tr>
<td></td>
<td>Born % Weaned %</td>
<td>% Unassist. births</td>
<td>Calf Cow exp.</td>
</tr>
<tr>
<td>Hereford</td>
<td>92 70</td>
<td>74 413 292</td>
<td>96 93 98 498 464 1348</td>
</tr>
<tr>
<td>Angus</td>
<td>83 76</td>
<td>72 424 325</td>
<td>94 90 100 515 460 1342</td>
</tr>
<tr>
<td>Simmental</td>
<td>86 69</td>
<td>86 442 309</td>
<td>90 88 99 535 463 1353</td>
</tr>
<tr>
<td>Gelbvieh</td>
<td>79 68</td>
<td>64 447 307</td>
<td>89 86 99 527 452 1282</td>
</tr>
<tr>
<td>Limousin</td>
<td>85 73</td>
<td>68 429 313</td>
<td>94 89 100 513 456 1330</td>
</tr>
<tr>
<td>Charolais</td>
<td>87 73</td>
<td>69 430 315</td>
<td>94 91 97 522 475 1339</td>
</tr>
<tr>
<td>LSDa</td>
<td>14 15</td>
<td>19 10 68</td>
<td>7 8 6 10 45 51</td>
</tr>
</tbody>
</table>

*aSource: Cundiff, 2005.
*bBreed differences that exceed the LSD are significant (P < .05)

This research reveals several important points. First, there are no significant differences in reproductive rate and calf survival among females sired by these breeds. Calving ease and birth weight were also similar among females sired by these breeds. Differences were noted among breeds for growth and milk production, although British and Continental breeds are more similar today than they were 30 years ago. Perhaps one of the most revealing findings is the fact that female mature size is essentially similar for all breeds, with the exception of Gelbvieh which are lighter than other breeds. Consequently, these breeds can be used in a complimentary fashion in crossbreeding programs without large swings in traits such as mature size and milk production based on breed of sire. Substantial variation within any breeds exists, and needs to be managed through proper use of EPDs for calving ease, milk, growth, mature size, and other traits.

### Genetic Antagonisms

Mature size is an economically relevant trait from several aspects. Mature size is measured in weight and/or height (frame score), and these two measures are highly correlated (genetic correlation = 0.86) (Bullock et al., 1993). Mature cow size influences nutritional requirements- at the same stage of production (90 days post-calving) and moderate milk production, 1200 pound cows (frame score ~ 5-6) have a 10% higher energy requirement and 7% higher protein requirement than 1000 pound cows (frame score ~ 4). As cow size increases to 1400 pounds (frame score ~ 7), energy and protein requirements...
increase 19% and 13%, respectively, compared to 1000 pound cows (NRC, 1996). These differences are due in large part to higher maintenance requirements of larger cows, as they simply have more body mass to maintain. Increased nutritional requirements result in higher cow carrying costs throughout the production cycle. Similarly, mature cow size impacts stocking rates and supplemental feed resource needs. Mismatches between cow size and nutritional resources may compromise reproductive efficiency.

Mature cow size also influences the uniformity of the calf crop produced—particularly in single sire herds. Variation in mature cow size frequently results in large differences in feeder cattle grade. This variation in frame size is contributes to differences in finished weight/carcass weight (when fed to a constant body composition) as well as quality and yield grades (with a constant time on feed) in the finishing phase. Long calving seasons that result in large differences in calf age also contribute to lack of uniformity.

Mature size has a strong positive genetic correlation with birth weight (.64), weaning weight (.80), and yearling weight (.76) (Bullock et al., 1993). These relationships would suggest that selection for growth will result in a corresponding increase in mature cow size. Therefore, selection for extremes in growth traits can be detrimental. At the same time, small mature size—that may be advantageous in terms of costs of production, is associated with reduced growth. Therefore, optimization of growth and mature size is key. Optimum mature size will vary with production system and feed resources.

With increased focus on carcass traits in today’s beef breeding programs, the logical question arises—how does selection for carcass merit affect maternal traits? Specifically, does selection for improved carcass characteristics result in undesirable correlated responses in important maternal traits? Unfortunately, few selection experiments have been conducted that directly address these relationships.

The following tables present genetic correlations between selected carcass measures and maternal traits as reported by MacNeil et al. (1988) and Splan et al. (1998). Both studies were conducted utilizing data generated through the germplasm evaluation studies at the U.S. Meat Animal Research Center. MacNeil et al. (1988) evaluated the genetic relationship between fat trim weight and total retail product weight of steers and maternal traits of their female herdmates. All genetic correlation estimates for fat trim weight were antagonistic with female traits. Thus, selection for reduced fat trim (i.e. improved retail product % and yield grade) would be associated with a correlated increase in age at puberty, increased weight at puberty, reduced fertility, larger mature size, and more calving difficulty in females. Similarly, selection for enhance retail product weight (more saleable product) was found to have an undesirable genetic relationship with the female traits of age at puberty, weight at puberty, mature weight, and calving difficulty. Genetic correlations reported by Splan et al. (1998) also indicate that selection for decreased carcass fat (fat thickness, carcass % fat, and retail product %) would negatively affect fertility (calving rate) and maternal calving difficulty. In these same studies, neither ribeye area nor marbling was negatively associated with calving rate or calving difficulty. Thus, it appears the undesirable associations between maternal traits and carcass merit are mediated through reductions in carcass fat thickness.
Genetic Correlations for Maternal Traits with Carcass Fat and Retail Product Weight

<table>
<thead>
<tr>
<th>Female Trait</th>
<th>Fat Trim Wt.</th>
<th>Retail Prod. Wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at Puberty</td>
<td>-.29</td>
<td>+.30</td>
</tr>
<tr>
<td>Weight at Puberty</td>
<td>-.31</td>
<td>+.08</td>
</tr>
<tr>
<td>Conceptions/service</td>
<td>+.21</td>
<td>+.28</td>
</tr>
<tr>
<td>Mature Wt.</td>
<td>-.09</td>
<td>+.25</td>
</tr>
<tr>
<td>Calving Difficulty</td>
<td>- .36</td>
<td>-.02</td>
</tr>
</tbody>
</table>

*Adapted from MacNeil et al. (1988). Carcass traits adjusted to an age-constant basis.

Genetic Correlations Between Carcass Traits and Selected Maternal Traits

|  | Calving Rate | Calving Difficulty |
|  |--------------|-------------------|
| Fat Thickness         | +.19           | -.14              |
| Fat %                  | +.18           | -.23              |
| REA                    | +.15           | -.04              |
| Retail Product %       | -.13           | +.18              |
| Marbling               | -.05           | -.09              |

*Adapted from Splan et al. (1988). Carcass traits adjusted to an age-constant basis.

These genetic antagonisms present great challenges to beef producers. Traits such as age at puberty, fertility, mature size, and calving ease all contribute significantly to the economic viability of the cowherd. At the same time, we are challenged to produce a high quality, consistent end product with consumer appeal. Due to the unfavorable correlations between these maternal traits and carcass measures, these goals tend to be in conflict with one another.

**Genetic Tools and Implementation**

Substantial hurdles exist in the quest to genetically design the beef female which is reproductively efficient, highly adapted to the environment and low-cost, produces a profitable calf with carcass and consumer acceptance, and does so with longevity. Capturing heterosis and breed complementarity through systematic crossbreeding serve as the foundation for accomplishing these goals. Proper application of existing and new selection tools (EPDs) within breeds are also key.

As noted previously, there are few tools available to directly select for reproduction although efforts are ongoing to make these tools available. The American Red Angus Association publishes a Heifer Pregnancy EPD which predicts the likelihood of a bull’s daughters to conceive to calve as two-year olds. This EPD could be used to exert genetic selection pressure on fertility. Similarly, Red Angus also publishes a Stayability EPD which predicts the likelihood of a sire’s daughters remaining in the herd until six years of age (longevity). Since a large proportion of cows leave the herd as a result of reproductive failure, the Stayability EPD indirectly identifies favorable reproduction genetics. Several breed associations are in the developmental phases for similar genetic prediction tools which may be available in the near future to utilize for direct enhancement of reproductive efficiency.

Optimum growth, maternal ability, and end product merit are also paramount in the genetic design of heifers. These traits are directly related to revenue generated through progeny in the commercial sector. Genetic selection tools in the form of EPDs are widely available for these economically important traits.
and known to be effective. Selection strategies should be focused on defining optimum EPD values that are compatible with management and nutritional resources. The unfavorable relationship between growth and mature size, and the potential consequences associated with increased maintenance and feed costs and potential reduced reproductive efficiency underscore the importance of optimizing growth. Similarly, milk production must be matched to feed resources to avoid complications with reduced body condition and lower conception rates if nutritional resources are not met. Frame scores are an objective tool which can be utilized to control mature size. Mature Daughter Weight EPDs are also available, and can be used in conjunction with growth EPDs to keep cow size in check while allowing for genetic progress in weaning and yearling weight. In a similar fashion, maternal calving ease EPDs should be included as selection criteria for making replacements.

The beef industry also has recently introduced selection tools to enhance our capability to identify genetics which are favorable for reducing costs of production. Two examples include the Cow Energy Value EPD ($EN, American Angus Association) and Maintenance Energy EPD (American Red Angus Association). Both of these EPDs are associated with genetic differences in cow energy requirements, and can be used to enhance efficiency.

The final consideration involves carcass traits. The economic relevance of carcass merit needs to be evaluated, and will be dependent upon individual marketing systems. To date, there has been no evidence that selection for marbling is detrimental to traits associated with cow productivity and therefore improvements in quality grade can be made in concert with other traits described above. However, enhancements in yield grade may be best accomplished through breed complementarity (blend of British and Continental genetics). Due to the antagonisms between reproduction and reduced fatness, selection for extremes in cutability may be detrimental to cow productivity.

Fortunately, for many of the antagonistic relationships that have been discussed (growth and calving ease, growth and mature size), the associations are relatively small. Genetic correlations that are small enhance the likelihood that animals exist in the population that have a desirable combination of genes for these traits. This underscores the value of using predictable, proven genetics through AI in breeding programs.

There are a number of relevant traits for which we do not have objective genetic tools for selection. Examples include udder quality, feet soundness, fescue adaptability, hair coat, and fleshing ability. All of these traits arguably are related to cow productivity and profitability within given environments and therefore warrant attention in selection strategies.

**Summary**
Genetics have a pronounced impact on a number of cow traits, and genetics directly influence profitability through relationships with both revenue (production) and costs (management and nutritional requirements). Since reproductive efficiency is the single most economically important trait related to beef production, advantages in reproductive efficiency attained through heterosis need to be captured. Concurrently, traits such as mature size and milk production need to be matched to the environment. Selection of individual sires through EPDs allows for the design of genetically superior replacement females for economically important traits. In short, crossbred females out of genetically superior sires create the opportunity for a productive and profitable herd.
References
Develop Your Heifers for the Future

The replacement heifer is a mixed blessing for most cow-calf operators. On one hand, she represents future profitability and genetic improvement of the cow herd; thus her selection and development are of paramount importance to the continued success of any cow herd.

On the other hand, the replacement heifer is an inconvenience at best. Her smaller size and higher nutritional requirements dictate she be raised and managed separately from the rest of the herd; yet the fact that she is essentially non-productive for the first two years of her life makes her easy prey for mismanagement. Nevertheless, proper growth and development of the replacement female from birth until she produces her first calf is of critical importance for her to become a highly productive part of the cow herd.

Why Is Proper Heifer Management Profitable?

1. Reduced breeding costs. Stringent culling eliminates poor replacement prospects prior to investing time, labor and expense into breeding these heifers. Over the years, pre-breeding soundness exams at Heartland Cattle Company have resulted in an average 3 to 9% culling rate prior to breeding. Reasons for culling have included small pelvic area, infantile reproductive tracts and/or various functional soundness problems. When these poor replacement prospects are identified prior to breeding, it allows the rancher to merchandise them in a timelier manner, thus improving cash flow and reducing total carrying costs.

2. Increased conception rates. Only early born, efficient gaining heifers should be kept as replacement prospects. In addition, pre-breeding soundness exams can help identify those heifers that are the most likely to conceive. These advantages, combined with proper nutritional development, result in higher first service conception rates and pregnancy rates. Historical data from Kansas State University and Heartland Cattle Company indicate proper heifer selection and development increases pregnancy rate by an average of 8% across herds and location.

3. Heavier calves at weaning. Estrous synchronization results in an earlier average conception date within a defined breeding season. This translates into older, heavier and more uniform calves at weaning. In addition, the use of high accuracy expected progeny difference (EPD) sires can result in calves with superior genetics for gain efficiency. Please keep in mind that calves with superior growth genetics are not necessarily excessively large framed cattle. The key is to identify moderate framed cattle with superior growth traits that still have the ability to reach puberty at an early age.

4. More uniform calf crop. The use of high accuracy EPD service sires result in a calf crop with more uniform genetics for growth, frame, muscle, etc. This leads to increased quality and predictability of steer and heifer progeny, and makes retained ownership and grid marketing at harvest viable options.

1Contact at: 39057 Road 715, McCook, NE 69001; 308-345-4524, Fax 308-345-6695
Email: phoughton@heartlandcattle.com
5. **Decreased bull costs.** With the incorporation of an artificial insemination (AI) program, fewer bulls will be purchased and maintained by cow-calf producers. Supporting data from Colorado State University indicate the use of AI can result in savings when compared to natural service breeding programs.

6. **Less calving difficulty.** AI sires with high accuracy EPD’s for calving ease result in less calving difficulty, calf loss, heifers which breed back earlier and increased productivity of replacement heifers. Data collected from Kansas State University and Heartland Cattle Company indicate an average improvement in weaned calf crop by 7% and an average improvement in rebreeding for the second calf by 8% when heifers are placed in a developmental program with proper nutrition, along with estrous synchronization and AI.

7. **Decreased labor at calving.** Heifers that undergo estrous synchronization will calve in a shorter period of time. This decreases labor requirement at calving and increases the amount of time that could be devoted to other enterprises. More importantly, a concentrated calving season simplifies subsequent nutrition and health programs for the rancher.

**How Can I Achieve These Goals?**
The ideal heifer program has two components, (1) identifying the right heifer calves and (2) the developmental program. Once you have a genetically superior, healthy heifer calf on the ground, don't assume your work is over. Quite the contrary! In fact, the future success of your operation depends heavily on how you develop that heifer calf over the next two years. By following proper heifer development procedures, producers have a better chance of incorporating a female into their herd that will be productive for years to come. Research conducted at Heartland Cattle Company shows a successful program revolves around the following points.

1. Heifers should mature at 1100-1300 lbs, depending on available feed resources. The key is to match weight with appropriate frame. Be careful when selecting for lighter weight cattle going into hostile feed resource areas that you are not inadvertently selecting for hard-keeping, inefficient cattle. For example, a heifer that will mature at 1100-1150 lbs. should be in the “high four” frame score category. A frame score “six” heifer that matures at 1100-1150 lbs is simply a narrow, light muscled, hard fleshing female.

2. Heifers should be moderate framed. Data from Heartland Cattle Company shows that medium framed heifers, within a biological type, have the highest fertility year-in and year-out. Taller, larger framed heifers have a longer growth curve and tend to reach puberty later.

3. Color is a personal preference, but is an important perception when trying to establish a uniform cow herd. Our preference is a solid black or red bodied heifer. A white or mottled face is acceptable if there is pigment around the eye for reducing the incidence of pink eye.

4. Don’t forget the advantages of hybrid vigor! A planned crossbreeding or composite program will return big dividends in the form of improved fertility and growth. The key is to develop a closely controlled plan and stick to it so that consistency and uniformity are not sacrificed.

5. Heifers should have genetic merit for maternal ability, growth and carcass traits.
   a. **Maternal traits.** Select for a high quality udder and plentiful milk production; however, milk production should not be so high that it interferes with fertility within a particular feed resource environment. In addition, females should show natural protective behavior toward their calves without being over-aggressive when managed in their natural environment.
   b. **Growth traits.** Females should be able to produce moderate framed, fast gaining, and easy fleshing heifer calves for replacements. Feed yard progeny should mature at 1,150 to 1,400
lbs, with the ability to gain weight rapidly at minimal dry matter conversion rates. Exceptional cattle (depending on age and condition) can gain up to five lbs per day and convert feed to gain at a rate of five to one.

c. **Carcass traits.** Females should consistently produce calves that can be harvested by 13 to 14 months of age with Choice, Yield Grade 2 carcasses. Carcasses should be between 700-900 lbs and loin eye area (an estimator of red meat yield) should range from 12.0 to 15.5 square inches.

6. Heifers should have a calm disposition. Cattle with quiet dispositions exhibit better fertility, weight gain and meat quality. This also means less wear-and-tear on facilities and ranchers!

7. Heifers should have a permanent identification so genetic merit and production ability can be measured.

8. Heifers should be structurally sound and have functionally sound eyes, teeth, jaw, and udder.

9. Heifers should be fully vaccinated on a timely schedule. Research published by Heartland Cattle Company shows proper preconditioning programs can effectively reduce treatment rates by as much as 20%. Also, it is extremely important that heifer calves are officially calfhood vaccinated (OCV) for brucellosis prior to ten months of age. After ten months of age, heifers run the risk of showing a positive titer for brucellosis as a young cow.

10. Biosecurity issues cannot be ignored. High-risk cattle associated with Persistently Infected Bovine Viral Diarrhea (PIBVD), Johnne’s and Listeriosis should be eliminated via appropriate testing procedures.

11. Heifers should undergo a reproductive soundness exam 35 to 45 days prior to breeding, including a reproductive tract score, body condition score, pelvic measurements, body weight, frame score and functional soundness evaluation. When considering pelvic measurements, a conservative view is encouraged. Since we find there are differences between technicians and instruments when measuring pelvic area, we prefer to use these measurements to only sift out the obvious problems and bottom-end cattle. These measurements can also be useful in identifying and tracking sire lines that propagate potential pelvic area problems in their daughters.

12. Heifers should be fed at a controlled rate to weigh 715-845 lbs (65% of their mature body weight) when they are first bred. Optimum gain and breeding weight will vary according to body condition and estimated mature weight.

13. Body condition score should be 5.75 to 6.00 at time of first breeding.

14. Heifers should be synchronized to breed at 13 to 14 months of age.

15. Heifers should be bred artificially to proven calving ease sire/s at least 21 days ahead of the mature cow herd. This gives the producer at least one extra cycle to rebrand heifers and still keep them on a timely calving schedule. Additionally, the producer can devote all of their attention to first calf heifers if they calve before the mature cow herd.

16. At least 70% of all heifers should conceive by artificial insemination, on the first service, to a high accuracy EPD, multiple trait sire.

17. Heifers should be pregnancy tested at 45 to 90 days post-breeding so open heifers can be identified early for feeding and harvest.

18. Heifers should be developed on a high roughage nutritional program so they will achieve 85% of their mature body weight by the time they calve the first time.

19. Heifers should calve unassisted at 22-23 months of age.

20. Heifers should develop into a cow that will consistently rebreed on minimal inputs within a 365-day calving interval, over a productive lifetime of at least seven years.
Should I Consider "Professional Heifer Development"?
Since Heartland Cattle Company originated the concept of Professional Heifer Development in 1990, it has since become a recognized sector of the beef cattle industry. Since its inception, there have been countless articles written on the concept of professional heifer development and many people have attempted to establish similar programs. While this has been a positive move in the cattle industry, it has also led to confusion on the part of many producers as to whether they should consider professional heifer development in their own beef cattle enterprise.

When evaluating the need for professional heifer development, it is imperative that a rancher takes the following into account:

1. The opportunity value of his labor, feed resources and facilities.
2. Value per dollar spent.
3. Accountability of the heifer development program in question.

To properly evaluate these points a rancher might be ahead if he asked himself the following questions:

1. Do I have the labor force, technical expertise, and facilities necessary to handle a heifer development and breeding program?
2. Do I have the time to devote to a heifer development program or would it be more profitable for me to devote my time elsewhere? (I.e. My farming enterprise, an off-farm job, etc.)
3. Do I have enough heifers to make it economically feasible for me to devote my time, labor and facilities to developing and breeding heifers, or would I be ahead to forward contract professionally developed, bred heifers with known genetics?
4. Should I consider becoming a specialized terminal producer where I send all of my calves (heifers and steers) into a feeding program, and buy professionally developed bred heifers with the proper maternal genetics? Would this concept allow me to more efficiently market my entire calf crop, reduce my labor requirements, and increase my overall profitability?
5. Would it be more profitable for me to increase my mature cow herd numbers rather than devoting my grass resources to developing replacement heifers?
6. Should I develop my replacement heifers elsewhere so I can devote my best feed resources to my two and three year old cows in an effort to improve total cow herd management?
7. Should I consider using my crop ground differently? (I.e. plant cash crops with a higher opportunity value as compared to planting crops, which will be used to develop replacement heifers.)
8. What is the long-term comparative cost of buying replacement heifers from a sale barn with no known information behind them as opposed to purchasing professionally developed heifers with known genetics?
9. If I do commit to a heifer development program, is it managed in such a way that I am assured of AI pregnancies vs. clean-up bull pregnancies?
10. Does the heifer development program under consideration have any legitimate history of success, and can they document reproductive performance? Can they offer multiple references?
11. How much could I improve profitability by calving estrous synchronized heifers bred to high accuracy EPD bulls in terms of increased conception rate, earlier calving date, less calving difficulty, more uniform and predictable genetics and reduced bull requirements?
Information already discussed in these proceedings has reviewed the biology, history and research behind numerous estrous synchronization systems. The previous authors/speakers indicated which systems relating to the synchronization products they discussed (PG, GnRH, MGA®, CIDR®) were the most effective. However, this still leaves an amazing number of systems and combination of systems that producers can use to synchronize cows and heifers.

In 2004, a group of representatives from AI studs, the animal health pharmaceutical industry, academia, and veterinarians met in to discuss which synchronization systems should be recommended based on performance in research and field trials. In addition, the group considered the practicality of applying the systems. These systems are reviewed and updated annually. Diagrams of the recommended systems for heifers appear at the end of this article. These systems are currently included in most of the major AI studs catalogues.

The purpose of this section is to briefly review:
1) The recommended systems
2) Results with these systems
3) Advantages and limitations of the systems
4) Relative cost of the systems

**Systems Requiring Estrous Detection**
Three estrous synchronizations requiring detection of estrus are recommended - Modified one-shot PG (aka. AILE), MGA-PG, and CIDR-PG (see diagrams and Table 1 for descriptions). In general, these systems require the most labor, but have the lowest pharmaceutical cost. Labor is high due to twice daily estrus detection and AI. Conception rates are high because only animals observed in estrus are inseminated at the optimum time. Pregnancy rates depend on percentage of animals expressing estrus and estrus detection efficiency (Table 1). Estrus detection efficiency has been reported to range from 35% to 85%; therefore, depending on the skill and dedication of the estrus detection crew a portion of animals in heat will not be presented for insemination.

*Pregnancy rates with estrous detection systems*
Literature values for pregnancy rates among the three systems are varied and few studies compared the recommended systems to one another. The most appropriate method is to consider pregnancy rate range and average over a large number of studies. Synchronized pregnancy rate to the 1-shot PG systems averaged 45% (see Lauderdale in these proceedings).

Kesler, 2003 reviewed 22 studies using the MGA-PG system in heifers the average pregnancy rate for MGA-PG with PG 17 d after last MGA feeding was 48% (range 31% to 57 %) compared to 56% (range 49% to 62 %) for MGA-PG with PG 19 d after last MGA feeding. Although, MGA-PG with PG given any day between 17 and 19 after last MGA feeding is effective, the results are more consistent.
Recently, our laboratory (Dorsey, 2005) compared CIDR-PG to MGA-PG. Pregnancy rates were similar (P > 0.5) between the two systems with pregnancy rates of 54.9% (95/173) and 52.8% (93/176) for CIDR-PG and MGA-PG, respectively. Kesler (2003) reported no difference between the CIDR-PG and MGA-PG systems with average heifer pregnancy rate at 50%. Clearly, these systems utilizing detection of estrus are effect and producers can generally expect AI pregnancy rates of 50% to 60% in groups of well managed heifers with adequate estrous detection.

**Systems Combining Estrus Detection and Timed-AI (TAI)**

In general, these systems require a moderate to high amount of labor, and have a moderate to high pharmaceutical cost. Labor is higher than total TAI system due to twice daily estrus detection and AI in addition to more “trips down the chute”. Conception rates are high because most animals are observed in estrus and inseminated at the appropriate time. Pregnancy rates may be increased over estrus detection systems because all animals are presented for AI. Estrus detection efficiency is still critical to maximizing pregnancy rates.

The two recommended systems Select-Synch + CIDR & TAI and MGA-PG & TAI (see diagrams and Table 2 for description). These systems are often described as estrous detection with “clean-up Al” systems. Most research reports indicate little, if any, decrease in pregnancy rates and in some cases increases in pregnancy rates for the addition of TAI to these protocols. For MGA-PG & TAI, three separate studies indicated a range from 54% to 63.5% (Dorsey, 2005; Johnson and Day, 2004; and Kesler, 2003). Reports on Select-Synch + CIDR & TAI are less numerous; however, pregnancy rates are in the 50% to 56% range. In a large scale multi-state study (Larson et al., 2004) reported pregnancy rate of 57.3%. In our experience, pregnancy rate to the TAI in heifers not in estrus by insemination is between 25% and 35% with approximately 20% to 25% of heifers not in estrus; thereby, potentially increasing AI pregnancy rates by 4% to 7%.

**Systems Using Complete Timed-AI (TAI)**

In general, these systems require a moderate amount of labor, and have the highest pharmaceutical cost. Labor is lower than other systems as twice daily estrus detection and AI are eliminated without adding “trips down the chute”. Conception rates may be lower than other system categories as some heifers are inseminated at a less than optimum time relative to ovulation or are induced to ovulate. However, pregnancy rates may be increased over estrus detection systems because all animals are presented for AI.

The two recommend TAI systems are CO-Synch + CIDR TAI and MGA-PG TAI (see diagram and Table 3 for descriptions). Information on the performance of complete timed-AI protocols is limited, but initial results are encouraging. Pregnancy rates for CO-Synch + CIDR TAI were 53.1% (Larson et al., 2004) and 52.4% (Walker et al., 2005). Comparison of MGA-PG TAI to MGA-PG demonstrated a 17% reduction in the percentage of heifers pregnant to 1st service AI (Johnson and Day, 2004) with TAI pregnancy rates of 46.6%. Particular attention needs to be paid to the time of AI relative to PG. The time of 54 hours after PG for CO-Synch + CIDR TAI and 72 hours after PG for MGA-PG TAI are critical to success of these TAI protocols. Producers and advisor need to pay attention to the time of day of PG administration so TAI does not occur at an inconvenient time of day (or night). Timed-AI protocols for heifers will continue to improve as additional research is completed. At this time, these protocols will result in an acceptable percentage of AI pregnancies with reduced labor.
**Summary**

The recommended synchronization systems for heifers are all effective in synchronizing heifers and producing acceptable 1st service AI pregnancy rates. Producers and their advisors need to understand the limitations and advantages of each system. Systems selection should emphasize the best fit for developmental status of heifers, labor available, and expectations for pregnancy rates. Actual cash cost of the system should be a secondary decision. In most, cases costs of systems are similar.

Currently, the combination systems that incorporate estrous detection and TAI (clean-up AI) are my most commonly recommended systems. These systems, CIDR-PG & TAI and MGA-PG & TAI, provide the best combination of 1) effectiveness in mixed populations of cycling and non-cycling heifers, 2) consistent and acceptable pregnancy rates, and 3) reduction in labor associated with AI. For producers with a limited number of replacement heifers or those with labor constraints the CO-Synch CIDR TAI systems appears to be the appropriate choice for a TAI system.
<table>
<thead>
<tr>
<th>System description (see diagrams)</th>
<th>Modified One-shot PG</th>
<th>CIDR-PG</th>
<th>MGA-PG</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 d heat check, PG to unbred animals, 6 d heat check</td>
<td>7 d CIDR w/PG at CIDR removal, 5-7 d heat check and breed</td>
<td>14 d MGA w/PG 19 d after last MGA, 5-7 d heat check and breed</td>
<td></td>
</tr>
<tr>
<td>Length of system (d)</td>
<td>11</td>
<td>12 to 14</td>
<td>37 to 39</td>
</tr>
<tr>
<td>Number of days of estrus detection</td>
<td>11</td>
<td>5 to 7</td>
<td>5 to 10</td>
</tr>
<tr>
<td>Induces cyclicity/ovulation</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Advantages</td>
<td>- high conception rate - 2 trips through the chute - allows go-no decision</td>
<td>- high conception rate - 3 trips through the chute - induces cyclicity</td>
<td>- high conception rate - 2 trips through the chute - induces cyclicity - induced heifers bred on subsequent estrus</td>
</tr>
<tr>
<td>Limitations</td>
<td>- May require up to 22 sorting and breeding events - Only works in cycling heifers - dependent on estrus detection efficiency</td>
<td>- May require up to 14 sorting and breeding events - additional trip through the chute - dependent on estrus detection efficiency</td>
<td>- May require up to 14 sorting and breeding events - Requires daily feeding of MGA - Heifers may “break thru” - dependent on estrus detection efficiency - a low % of heifers may be in estrus before PG</td>
</tr>
<tr>
<td>Degree of synchrony</td>
<td>Low</td>
<td>Moderately high</td>
<td>Moderate</td>
</tr>
<tr>
<td>Reported range in pregnancy percentage</td>
<td>35% to 55 % ?</td>
<td>50% to 63%</td>
<td>49 % to 65 %</td>
</tr>
<tr>
<td>Pharmaceutical cost</td>
<td>Very low</td>
<td>Moderately low</td>
<td>Low</td>
</tr>
<tr>
<td>Labor cost</td>
<td>High</td>
<td>Moderately high</td>
<td>High</td>
</tr>
</tbody>
</table>
Table 2. Descriptions and comparison of estrous synchronization systems combining detection of estrus and timed AI (TAI) for beef heifers.

<table>
<thead>
<tr>
<th>System</th>
<th>Select-Synch + CIDR &amp; Clean-up TAI</th>
<th>MGA-PG &amp; Clean-up TAI</th>
</tr>
</thead>
<tbody>
<tr>
<td>System description (see diagrams)</td>
<td>7 d CIDR w/ GnRH at CIDR insertion and PG at CIDR removal, 3 d heat check and breed followed by TAI &amp; GnRH of non-responding heifers between 72-80 h.</td>
<td>14 d MGA w/PG 19 d after last MGA, 3 d heat check and breed followed by TAI &amp; GnRH of non-responding heifers between 72-80 h.</td>
</tr>
<tr>
<td>Length of system (d)</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>Number of days of estrus detection</td>
<td>3</td>
<td>3-4</td>
</tr>
<tr>
<td>Induces cyclicity/ovulation</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
| Advantages | - high conception rate  
- induces cyclicity  
- inseminates all heifers  
- partial compensation for estrus detection problems  
- allows for “go/no-go” decision for TAI | - high conception rate  
- 2 trips through the chute  
- induces cyclicity  
- induced heifers bred on subsequent estrus  
- inseminates all heifers  
- partial compensation for estrus detection problems  
- allows for “go/no-go” decision for TAI |
| Limitations | - May require up to 6 sorting and breeding events  
- additional trip through the chute | - May require up to 6 sorting and breeding events  
- Requires daily feeding of MGA  
- Heifers may “break thru” |
| Degree of synchrony | High | Moderate |
| Reported range in pregnancy percentage | 49% - 58% | |
| Pharmaceutical cost | Moderately high | Moderate |
| Labor cost | Moderately high | High |
Table 3. Description and comparison of complete TAI estrous synchronization systems for beef heifers.

<table>
<thead>
<tr>
<th>System</th>
<th>CO-Synch CIDR w/ TAI</th>
<th>MGA-PG w/ TAI</th>
</tr>
</thead>
<tbody>
<tr>
<td>System description (see diagrams)</td>
<td>GnRH at insertion of CIDR. CIDR (7 d) w/PG at CIDR removal followed by TAI &amp; GnRH of all heifers at 56 h</td>
<td>14 d MGA w/PG 19 d after last MGA followed by TAI &amp; GnRH of all heifers at 72 h</td>
</tr>
<tr>
<td>Length of system (d)</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>Number of days of estrus detection</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Induces cyclicity/ovulation</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Advantages</td>
<td>- all heifers inseminated on same day</td>
<td>- all heifers inseminated on same day</td>
</tr>
<tr>
<td></td>
<td>- induces cyclicity</td>
<td>- 2 trips through the chute</td>
</tr>
<tr>
<td></td>
<td>- inseminates all heifers</td>
<td>- induces cyclicity</td>
</tr>
<tr>
<td></td>
<td>- eliminates estrus detection</td>
<td>- inseminates all heifers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>eliminates estrus detection</td>
</tr>
<tr>
<td>Limitations</td>
<td>- additional trip through the chute</td>
<td>- Requires daily feeding of MGA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Heifers may “break thru”</td>
</tr>
<tr>
<td>Degree of synchrony</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Reported range in pregnancy percentage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmaceutical cost</td>
<td>High</td>
<td>Moderately high</td>
</tr>
<tr>
<td>Labor cost</td>
<td>Moderate</td>
<td>High</td>
</tr>
</tbody>
</table>

References


# Beef Heifer Protocols

## Heat Detection

**1 Shot PG**

- Heat detect & AI day 7 to 10 and TAI all non-responders 72 - 84 hr after PG with GnRH at TAI.

## Heat Detect & Time AI (TAI)

**Select Synch + CIDR® & TAI**

- Heat detect and AI day 7 to 10 and TAI all non-responders 72 - 84 hr after PG with GnRH at TAI.

**MGA®-PG & TAI**

- Heat detect and AI day 33 to 36 and TAI all non-responders 72 - 84 hrs after PG with GnRH at TAI.

## Fixed-Time AI (TAI)

**CO-Synch + CIDR®**

- Perform TAI at 54 hr after PG with GnRH at TAI.

**MGA®-PG**

- Perform TAI at 72 hr after PG with GnRH at TAI.

## Comparison of Protocols for Beef Heifers

### Heat Detection

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Cost</th>
<th>Labor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Shot PG</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>CIDR®-PG</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>MGA®-PG</td>
<td>Low</td>
<td>Low/Medium</td>
</tr>
</tbody>
</table>

### Heat Detect & TAI

#### Select Synch + CIDR®

- Heat detect and AI day 7 to 10 and TAI all non-responders 72 - 84 hr after PG with GnRH at TAI.

#### MGA®-PG & TAI

- Heat detect and AI day 33 to 36 and TAI all non-responders 72 - 84 hrs after PG with GnRH at TAI.

### Fixed-Time AI (TAI)

#### CO-Synch + CIDR®

- (TAI non-responders 72-84 hr after PG) High | Medium
- (TAI non-responders 72-84 hr after PG) Medium | Medium

#### MGA®-PG

- (TAI at 72 hr after PG with GnRH at TAI) High | Medium
- (TAI at 54 hr after PG with GnRH at TAI) Medium | Medium

- The times listed for “Fixed-time AI” should be considered as the approximate average time of insemination. This should be based on the number of heifers to inseminate, labor, and facilities.

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D.J. Schafer and D.J. Patterson
Division of Animal Sciences - University of Missouri – Columbia
These protocols are recommended by the North Central Region Bovine Reproduction Task Force.
Bull Selection for Heifers
Scott P. Greiner, Ph.D.
Extension Beef Scientist, Virginia Tech

The economics of cow-calf production emphasize the importance a high percentage of the calf crop being weaned and marketed. Nationally, estimates for average percent calf crop weaned range from 75-85%. Losses in percent calf crop can largely be attributed to failure to conceive and early embryonic loss, coupled with calf losses. Research has demonstrated that 50% of all calf death losses can be attributed to dystocia (calving difficulty). Along with decreased calf crop, increased cow mortality, increased calving intervals (delayed return to estrus), lower conception rates, reduced weaning weights, and increased veterinary and medical costs also contribute to economic losses caused by calving difficulty.

Calving difficulty has been shown to be a problem primarily in two-year-old first-calf heifers. The proportion of first-calf heifers requiring assistance at birth is commonly cited at 25%. Although dystocia is not uncommon in older females, it occurs at a much lower frequency. Calving difficulty in first-calf heifers has been shown to be three to four times higher than in three-year-olds. Incidence of calving difficulty is twice as high for three-year-olds as four-year-olds. Consequently, calving ease is the highest priority item when it comes to bulls selection for heifers.

Factors Contributing to Dystocia
Considerable time and effort have gone into research projects to gain an understanding of the causes of dystocia and determine the extent to which various factors are involved. Results of these studies have shown there are several factors are involved. However, no more than 50% of variation in calving difficulty can be explained by traits that can be defined or measured. Therefore, it is impossible to predict with 100% accuracy which heifers will have calving difficulty, even if we can quantify the various measurable factors that influence dystocia. Several of the most important factors contributing to differences in calving difficulty include:

- Calf birth weight
- Cow pelvic area
- Cow age
- Calf sex
- Gestation length
- Cow weight
- Sire breed
- Dam breed
- Calf shape
- Cow nutrition
- Season/temperature
- Cow body condition
- Calf presentation
- Heterosis

Classically, dystocia has been defined as a disproportion between calf size at birth (birth weight) and the dam’s birth canal (pelvic area). It has been well documented that heifers with small pelvic areas experience higher calving difficulty rates compared to heifers with large pelvic areas. A substantial amount of work has been done to quantify the relationship between pelvic area and birth weight as it relates to dystocia. Benchmark ratios between pelvic area and calf birth weight, as well as between pelvic area and heifer weight have been established for application at both pre-breeding and pregnancy check. These ratios can be used to predict a maximum calf birth weight that the heifer could deliver without assistance. This maximum calf birth weight can then be compared to threshold birth weights for a particular herd and selection/culling decisions made or specific management practices employed.
However, use of these ratios as a diagnostic tool has proven to over-predict dystocia, and have been unable to detect >25% of difficult births. The positive correlation between heifer frame size/weight and pelvic area, along with the positive relationship between calf birth weight and heifer weight, are likely contributing to the limited success of these ratios. Since pelvic area can be defined as a threshold trait, the most practical use is to imply minimum standards during a pre-breeding exam and eliminating heifers with small pelvic area that are more likely to be prone to calving difficulty. The Virginia Premium Assured Heifer Program employs a minimum yearling pelvic area of 150 cm² for qualification (180 cm² at pregnancy check), as an example.

Of the factors listed above, calf birth weight is most highly related to calving difficulty. As calf birth weight increases, the percentage of cows requiring calving assistance also increases. It is likely that some of the factors listed above manifest their effects through their relationship with calf birth weight (calf sex and gestation length). Birth weight is a trait that is easily measured, and is relatively high in heritability (.30-.40) suggesting that selection for lower birth weights is attainable as a means to reduce calving difficulty.

Genetic Management of Calving Difficulty
Calving ease, like any other trait, is controlled by two basic components: genetics and environment. Although environmental factors such as nutrition and season of the year play important roles in determining calf birth weight, research has shown that control of birth weight and calving ease is most effective through genetic selection.

Breed Differences
Over the past 25 years, considerable research has been conducted to characterize and compare the major beef breeds in the U.S. The most comprehensive studies have been conducted at the U.S. Meat Animal Research Center in Clay Center, NE. Since 1970, over 30 breeds have been evaluated in a common environment and management system for characterization of economically important traits. Many of the largest and most widely used breeds in the U.S. were characterized 25-30 years ago at Clay Center. Since that time, considerable changes have been made to these breed populations as the result of selection. Therefore, research has been initiated at the U.S. MARC to evaluate relative changes that have occurred among the prominent U.S. beef breeds since they were initially evaluated in the 1970’s, and to provide a current evaluation for these breeds. The following table present preliminary results from Cycle VII of the Germplasm Evaluation Program at the U.S. MARC.

Procedures for the evaluation of the breeds were similar to that utilized in previous GPE cycles. For the current breed characterization, sires from the seven largest U.S. beef breeds (based on number of registrations) were mated to mature Angus, Hereford and composite MARC III cows (1/4 Angus, ¼ Hereford, ¼ Pinzgauer, ¼ Red Poll). Approximately one-half of the sires sampled from each breed were among the top 50 in number of calf registrations in their respective breed, and about one-half were young unproven sires of each breed. Calves were born in the spring of 1999 and 2000. Sire breed effects for preweaning traits for calves born in 1999 and 2000 are shown below. Lighter birth weights and a higher percentage of unassisted births were reported for Angus and Red Angus compared to Hereford and the Continental breeds (Simmental, Gelbvieh, Limousin, Charolais). The three British breeds (Hereford, Angus, Red Angus) were similar for 200-day weaning weight. Limousin sired calves were lighter at weaning than all other breed groups. 200-day weaning weights for Gelbvieh topcrosses
were similar to those of the British breeds. Simmental topcrosses were heavier at weaning that all other breed groups. Charolais sired calves were heavier at weaning than Limousin, Hereford, and Red Angus.

### Sire Breed Means for Preweaning Traits

<table>
<thead>
<tr>
<th>Sire breed of calf</th>
<th>Gestation length, d</th>
<th>Unassisted calvings, %</th>
<th>Birth weight, lb.</th>
<th>Survival to wean., %</th>
<th>200-d wean. wt., lb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hereford</td>
<td>284</td>
<td>95.6</td>
<td>90.4</td>
<td>96.2</td>
<td>524</td>
</tr>
<tr>
<td>Angus</td>
<td>282</td>
<td>99.6</td>
<td>84.0</td>
<td>96.7</td>
<td>533</td>
</tr>
<tr>
<td>Red Angus</td>
<td>282</td>
<td>99.1</td>
<td>84.5</td>
<td>96.7</td>
<td>526</td>
</tr>
<tr>
<td>Simmental</td>
<td>285</td>
<td>97.7</td>
<td>92.2</td>
<td>96.7</td>
<td>553</td>
</tr>
<tr>
<td>Gelbvieh</td>
<td>284</td>
<td>97.8</td>
<td>88.7</td>
<td>97.1</td>
<td>534</td>
</tr>
<tr>
<td>Limousin</td>
<td>286</td>
<td>97.6</td>
<td>89.5</td>
<td>96.9</td>
<td>519</td>
</tr>
<tr>
<td>Charolais</td>
<td>283</td>
<td>92.8</td>
<td>93.7</td>
<td>97.1</td>
<td>540</td>
</tr>
<tr>
<td><strong>LSD^b</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.5  3.6  3.3  4.0  14</td>
</tr>
</tbody>
</table>

^a source: Cundiff et al., 2004, Germplasm Evaluation Program Progress Report No. 22

^Breed differences that exceed the LSD are significant (P < .05)

Results from these breed comparisons indicate that differences between British and Continental breeds are not as great for unassisted calving percentage and weaning weight compared to when the same breeds were evaluated in the 1970’s. British breeds have emphasized selection for growth rate, whereas Continental breeds have emphasized improvement in birth weight and calving ease. Consequently, smaller differences exist between British and Continental breeds for growth rate and calving ease as compared to 25 years ago. Despite this, British breeds remain superior to Continental breeds on average for siring calves that are lighter at birth and born with less assistance. Consequently, British breed sires are utilized with more frequency on commercial heifers. It is important to note that although significant differences exist between breeds exist for birth weight, there is as much variation within a particular breed as there is across breeds for these traits. Put another way, there are bulls within any breed that sire low birth weight calves (as well as those that sire heavy calves at birth). Identification of genetics for birth weight and calving ease within breed is most critical.

**Within-Breed Differences**

Expected progeny differences (EPDs) provide estimates of the genetic value of an animal as a parent, and serve as the most reliable tool for genetic selection. Specific EPDs relevant to genetic management of calving difficulty include Calving Ease, Birth Weight, and Maternal Calving Ease EPDs.

Calving Ease EPD: Several breed associations publish Calving Ease EPDs (also referred to as Calving Ease Direct). This EPD predicts the ease with which a bull’s calves are born to first-calf heifers. Calving ease EPDs are reported as deviations in percentage of unassisted births. Calving ease EPDs consider differences between animals in calf birth weights and actual observed levels of calving difficulty. The calving ease EPD directly predicts calving ease and should be used (when available) as the primary tool for avoiding dystocia problems in the cowherd.
Birth Weight EPD: Predicts differences in progeny birth weight. It is important to recognize that EPDs predict the expected difference in performance, not the actual performance. Actual birth weight will be impacted by the genetic merit of the cows they are mated to as well as environmental effects. Since birth weight accounts for the majority of calving difficulty, Birth Weight EPDs provide a useful tool for minimizing calving difficulty. There is a strong genetic correlation between calving ease and birth weight, suggesting that sires with favorable CE EPDs also tend to have lower BW EPDs. However, this relationship is not perfect. Calving Ease EPDs reflect multiple factors that contribute to calving ease genetics, including birth weight. Birth weight EPDs on the other hand only predict differences in genetics for birth weight. While both EPDs provide opportunity for managing calving difficulty in heifers, Calving Ease EPDs directly estimate the trait of economic consequence - calving ease, as reflected in the number of heifers that are expected to calve without assistance. Therefore, Calving Ease EPDs should be utilized as a primary tool in selecting heifer bulls, assuming accuracy of the EPDs is comparable.

Maternal Calving Ease EPD: As maternal implies, Maternal Calving Ease EPDs (also referred to as Calving Ease Daughters or Calving Ease Total Maternal) reflect the ability of a bull’s daughters to calve as first-calf heifers. Higher maternal calving ease EPDs indicates that a bull’s daughters will calve with a higher percentage of unassisted births.

**Benchmarking EPDs**
Tools are available to assist with establishment of benchmarks for EPDs, including breed averages and percentile rankings. Actual calving ease (% unassisted births) and birth weights within any herd will be a function of genetics and environment. The environment for any herd will be unique as a result in differences in management and nutrition. Additionally, the genetic merit of the cow herd a bull is mated to will influence observed calving ease and birth weights. Therefore, absolute recommendations in regard to threshold calving ease or birth weight EPDs are difficult to apply from one herd to the next. Documentation of the genetic merit of bulls used over time, and records on their progeny serve as the most useful basis to establish these thresholds within herds.

**EPD Accuracy**
Accuracy values are published for EPD values reported for an animal. Accuracy can be defined as the relationship between the estimated EPD of the animal and the “true” EPD of the animal. This relationship is expressed as a number between zero and one. As the accuracy value approaches 1.0, the reported EPD is more likely to represent the true genetic merit of the animal and is less likely to change as more progeny records accumulate. Conversely, low accuracy values (closer to zero) indicate that the reported EPD is less reliable. Accuracy is primarily a function of the amount of information available to calculate an EPD for any given trait. Information, primarily in the form of performance records, is derived from several sources to estimate EPDs on a given animal. These sources include records on the animal itself, its sire and dam, collateral relatives, and progeny records. As the volume and quality of records used in the estimation of an EPD increases, so does the confidence we have that the EPD has been estimated correctly (accuracy).

<table>
<thead>
<tr>
<th>Bull</th>
<th>Birth Weight EPD</th>
<th>Accuracy</th>
<th>Possible Change</th>
<th>“true” EPD Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bull A</td>
<td>+2.0</td>
<td>.25</td>
<td>±2.3</td>
<td>-0.3 to +4.3</td>
</tr>
<tr>
<td>Bull B</td>
<td>+2.0</td>
<td>.90</td>
<td>±0.3</td>
<td>+1.7 to +2.3</td>
</tr>
</tbody>
</table>
In the table above, Bull A and B have identical Birth Weight EPDs, but differ considerably in their accuracy values. Bull A would be typical of a yearling bull, with his EPD derived from pedigree information and his own individual performance. Most yearling bulls will have accuracy values ranging from .10 to .35 for growth traits. Bull B would be typical of a sire with a large number of progeny who has probably been used by AI in several herds. A practical way to evaluate accuracy is to put it in the context of associated possible change. Possible change defines how much we might expect the current EPD to change (plus or minus) as more information is collected and used in the estimation of the EPD. For Bull A, an accuracy value of .25 for BW EPD is associated with a possible change of ±2.3 pounds. From the definition of the possible change value, we expect there to be only one chance in three that the “true” BW EPD is less than –0.3 pounds (the EPD minus the possible change) or greater than +4.3 pounds (the EPD plus the possible change). Bull B, with a higher accuracy value, has a much lower possible change (±0.3) and therefore smaller range. We expect his true EPD to be between +1.7 and +2.3 pounds. It is important to recognize that EPDs are our best estimates of an animal’s genetic worth. We never know the “true” EPD for any trait on any animal, although EPDs for bulls with high accuracies are expected to closely approach the “true” value. Accuracy values, therefore, indicate how much we know about the animal’s true genetic worth and how confident we can be in the estimated EPD.

Accuracy values can be used to manage risk in a breeding program. If the two bulls previously discussed were being considered for use on heifers, there would be much lower risk associated with the use of Bull B. Due to his higher accuracy value, it is less likely Bull B’s “true” EPD will turn out to be substantially higher than the reported value. Comparatively, Bull A has a larger possible change and there is more risk that his “true” EPD could be higher than the reported value. This example illustrates a primary advantage of using high accuracy, low BW EPD sires through AI on heifers. In this example, accuracy values associated with Bull A would be typical of a performance tested yearling bull whereas accuracy values of 0.90 or higher (Bull B) would be available only through AI. Similar examples can be given for all EPD traits, and possible change values can be found in sire summaries of all breeds.

An important concept to understand is that EPDs, regardless of accuracy, are our most powerful tool to make genetic change in beef cattle. EPDs have been estimated to be several times more reliable than adjusted weight records, ratios, and visual appraisal. Even on young bulls with relatively low accuracy values, EPDs are our most objective indicator of the animal’s genetic merit. For all practical purposes, high accuracy sires are available only through AI. Therefore, most of natural service bull-buying decisions will be made using relatively low to moderate accuracy EPDs. Keep in mind when evaluating possible change that there is an equal chance that an EPD will go higher as opposed to go lower (or get “better” vs. “worse”). When evaluating young bulls, small differences in WW and YW EPD become less significant due to lower accuracy and higher possible change, permitting more overlap in the range of their “true” EPDs.

A common misconception is that accuracy is an indicator of expected variation in a resulting calf crop. Accuracy and possible change are not related in any way to progeny variation. High accuracy EPD animals would not be expected to have any more or any less variation in their calf crop compared to low accuracy EPD animals.
Multiple Trait Considerations
While calving ease is paramount, particularly in first-calf heifers, multiple traits are involved in profitable beef production. Sire selection, therefore, needs to have a balanced trait approach which considers calving ease with growth, maternal ability, end product, and other relevant traits. EPDs provide the basis for identification of sires which have favorable genetics for multiple traits. For many commercial producers which are buying bred heifers, the genetics of the fetus is an important consideration particularly if the progeny of the bred heifer can be developed into an additional replacement.

References
http://www.apsc.vt.edu/premiumheifers/index.html
Mountain Momma
VaPAH Bred Heifer
Sponsored by CGCPA

Sale Features:
• All heifers came from CGCPA members and were source and parental verified.
• Sale date – 1st Saturday in November
• 2006 was our 3rd sale.
• Goal – 80-100 heifers to calve the following spring
• The sires of all of the heifers had above average EPD’s on yearling weight.
• Breed – primarily Angus & Angus cross
• Hosted by Baker Livestock and sold under a tent.

Selection of Heifers:
• All heifers are evaluated according to VaPAH standards.
• All heifers are evaluated 3 times.
  • 1st – March or Early April on the producer’s farm
  • 2nd – When heifers are preg checked in around mid-August
  • 3rd – When heifers are delivered the day before the sale.
• Each evaluation review is done by a 3-member committee panel.
• Each evaluation is done by a different panel. A total of 9 reviewers evaluate the heifers.
• At each evaluation, the majority rules.

Genetics/Heifer-Sale Committee:
• Reviews the genetics of the heifers and selects the AI sires to be used.
• Helps locate clean-up bulls for the breeding program.
• Helps with the processing of heifers during pre-breeding, breeding, and preg-checks.
• Helps set up for the sale.

Sale Advertisement:
• Goal - $10-$15/heifer
• 2 advertisements are placed in the Virginia Cattlemen’s magazine as well as other states.
• VDACS has provided assistance.
• The auctioneer mails a flyer to a list of possible bidders.
• Around 1,000 flyers are placed in local & area agri-business establishments.
• Sale catalogs are mailing to our past bidders.
• The CGCPA has a secured web site to advertise the sale. (www.mountainmomma.com)
Sale-Heifer Breeding Program:

- About half of the heifers are kept on the farm and breed AI and/or natural service.
- The rest of the heifers are co-mingled at two locations from early April until mid-August.
- Extremely positive support from Knoll Crest and Echo Ridge Farms – Tremendous AI Sires as Clean-up Bulls

Sale Results:

- The quality of the heifers is high and has gotten better each year.
- Each of the 3 sales has averaged just over $1,390.
- Range of sale has been from $1,025 - $1,750.

Food for Thought for Future Sales:

- Our Association would like to suggest that each of the associations work together to promote the sale of high-quality heifers in Virginia. (Much like the Kentucky Elite sales)
- With the help of the Virginia Cattlemen’s Association, VDACS, and VA TECH and all the associations working as one, Virginia could offer Premier, very high-quality heifers all across the state.
Overview Scott County Cattle Association, Inc.
Jennifer Meade
Scott County Cattlemen’s Association

Our Scott County Cattle Association, Inc. is a relatively new group; this is our fourth year with approximately 80 members. Our association was formed not only to improve our cattle, but also to improve value-added marketing of our cattle. Over the last three years we have had many educational programs and demonstrations on cattle health and nutrition, upgrading facilities and marketing.

For the past three years, we have marketed over 350 head of co-mingled feeder calves through the Virginia Cattleman’s association. These calves have all been VQA certified, gold or purple tagged, weaned (feed and water trough broken). Our cattle have gone west and north to feedlots.

During the gathering of first year VQA calves (Fall 2004) we realized that a lot of good heifers were being sent to the feeder program rather than being retained within our herds or developed. Dr. Scott Greiner, VPI was our December program presenter. One of the topics he mentioned was the “Value-Added Virginia Premium Assured Heifer Program”. After the program some producers indicated an interest and willingness to explore this marketing option. Some had kept some heifers at home and thought they may like to develop and sell them. For the past two years we have held a Virginia Premium Assured Heifer Sale at the Washington County Fair Grounds in Abingdon, VA. This sale was organized through Smith Reasor, Auctioneer who had the knowledge and organization for this type of sale.

Our first sale (Fall 2005) was well received with 79 bred heifers and 20 open heifers being sold. The first year we organized the sale “from the bed of a pick-up”—who would do what, how we would do it, and when to do it! We learned many valuable lessons the first year; and how to be more efficient at these tasks!

I. Address all paperwork—especially sale and load out information—some minor mix-ups from sale desk to load-out area. Remedy: Have owner or truck driver to initial or sign the load-out sheet and we maintain a copy for our records.

II. Maintaining the facilities—lots of dust as cattle are moved into and through barn and pens. Remedy: Have someone hose down facility before first heifer arrives at sale barn and also the morning before the sale.

III. Identification of cattle sale lots—by producer, similar genotype, similar phenotype, breeding information, number of head per lot, etc. Remedy: Make plenty of pen sheets for each lot with producer’s name, tag numbers, and lot numbers. Label the pens as heifers arrive. Make a master copy as you label. Have plenty of blanks and duct tape so you can re-label if necessary morning of the sale. (Some heifers like to eat their signs off the pens during the night!)

Our second sale was held November 2006. This was a good sale although cattle prices were beginning to fluctuate by sale time. We corrected the problems of the first sale. We had a catalog and supplement sheets containing our breeding and ultra-sound information. As a new endeavor for this sale, the last
week of July 2006, we had a total of 147 heifers ultra-sounded for breeding data at seven producers’ locations. This took a total of approximately 6 ½ hours to complete.

Lessons learned from the 2006 sale:
   I. Catalog to be more precise------Remedy: Include additional breeding data and ultrasound data in the catalog
   II. More data posted at cattle pens------Remedy: Encourage producers to post information regarding their heifers.
   III. Advertise more aggressively------Remedy: More newspaper ads throughout region, post fliers at businesses, mail out fliers to past two years registration list.

Throughout these two sales many of our members helped even if they did not have cattle consigned. Some penned, hosed facility, helped with gates and alleys during sale, loaded-out, trucked, and assisted with clerking.

Future goals:
   I. We hope to build a larger base of producers willing to consign and develop heifers for our sale.
   II. We would like to develop follow-up procedures for all of our heifer buyers.
   III. We would like to continue to improve our sale and its promotion.

For 2007, we have received a Virginia tobacco Commission Grant for a lap-top computer, printer, RFID reader, and RFID tags. Our heifers will be sold with the RFID tags this year.

We hope to continue building on the genetic potential of our Scott County cattle; and to promote them in such a manner as to provide a value-added marketing option for our Association members and to provide excellent commercial replacement heifers for our buyers.

Heifer Development Program

I. Each individual producer develops their heifers on the farm according to their own program.
   The following is program from one of our producers.

II. D & J Meade Farm Heifer Development Program

   A. Heifer Selection Criteria
      a. Wean at 6-6 ½ month of age----target weight 600 lb.
      b. Date of birth December 1 through March 31
      c. Sound structure, good feet and legs
      d. Calm disposition
      e. Good genetics---good dam and sire EPD’s or performance within our herd
B. Weaning Protocol and Feed Ration
   a. 2\textsuperscript{nd} booster round of VQA medications, calf hood vaccinated, dewormed
   b. feed pre-conditioning ration for 14-28 days with good grass hay
   c. lutalyse shot before turning out on stockpiled grass—feed 2-3 lb. of a 5-way grain mix until mid January
   d. mid January until April 10 feed 3-5 lb. of a 5-way grain mix with good grass hay--target weight 800-900 lb.

C. Pre-Breeding
   a. Pre-breeding examination with all shots, and pelvic exam
   b. Feed MGA with a 5-way grain ration for 14 days—for a target breeding date of May 10-12
   c. Feed 5-way grain mix for 19 days no MGA added
   d. day 33 inject all heifers with lutalyse shot and place estrus alerts on tail head

D. Breeding---A.I.----Natural Service
   a. Observe and breed from days 33-36 ----breed as in heat (am/ pm)
   b. Time breed and inject with cystorelin GnRH at 72 to 84 hours---if time
   c. Wait 15 days and turn in natural service sire
   d. Continue to feed 3 lb. of a 5-way grain mix

E. Post-Breeding
   a. Heifers and natural service sire turned out on pasture for 50 days
   b. Ultra-sound end of July
   c. Heifer selection committee preview and those selected for sale are identified
   d. Any heifers not meeting VAPAH criteria are culled
   e. Natural service sire is removed from heifers

F. Pre-Sale
   a. 30-45 days before sale the sale heifers are separated from group and placed on stock piled meadows with 3-5 lb. of a 5-way grain mix until sale day
   b. Veterinarian conducts pregnancy check to confirm that all heifers are still bred, de-wormed and E. coli shot---VAPAH tagging
   c. day before sale heifers were weighed and hauled to sale barn
   d. Make data poster for sale pen

G. Post Sale
   a. Communicate with buyer—send Christmas card with personal note regarding heifers

Cattle are provided free choice high-magnesium minerals throughout the year.
1) Background
   A) History
   B) Resources
   C) Why Heifers
   D) Competition
   E) Niche

2) Technical Process of Development
   A) Selection
   B) Nutrition
   C) Management
   D) Technical Assistance

3) Breeding Philosophy
   A) Environment vs. Genetic
   B) Breed Complimentation
   C) Identity
   D) Evolving Customers Needs

4) Adapting to Input Variables
   A) Nutritional
   B) Genetic
   C) Market Driven
   D) Cash Flow
Buckingham Cattlemen’s Association
Heifer Development

Roger Morris
C.H. Morris & Sons
Vice-President, BCA

Value-Added Marketing (Bred Heifers)

- 2004 decided to have sale selling Bred Heifers
  - 1st selection in August; bottom ½ put in feeder calf sale
  - 2nd selection in October at Pelvic Measurement and Reproductive Tract Scoring
- In the past we did have some members selling heifers private treaty off the farm
- With past successes with VQA Buckingham Cattlemen’s Feeder Calf Sales decided to go with VAPAHL Program

Development of BCA Bred Heifers

- Unique genetic programs from other groups
  - Very successful 10 year genetic program
  - 2004, 2005, 2006 over 1500 cows and heifers bred AI to one bull
  - 25 different producer’s calf crop are ½ siblings or better
  - Due to purchasing power over ¾ of clean-up sires are ½ to full siblings
  - 1st Goal (genetic uniformity in feeder calves and replacement heifers)

Development of BCA Bred Heifers

- Uses of new techniques and practices to add value to heifers
  - Artificial Insemination to “curve bender” bulls
  - Estrus Synchronization in timely manner amongst producers (same time) by use of CIDR®
  - Use of Ultrasound Technology for Pregnancy Diagnosis (Fetal Sexed and Aged)
  - BVG (Bovine Virus Diarrhea) Certified Free
  - 3rd Goal (Adopt and test new practices which add value and strengthen the demand for our end product)
Thank you.
Heifer Marketing Strategies
Matthew Miller
Extension Agent ANR Farm Business Management / Southwest District

Bred heifer production is a tiring and meticulous process. The culmination of at least 16 to 20 months of effort will not result in a profitable venture unless steps are taken to maximize heifer exposure to a full complement of buyers. The following will offer questions and strategies for both small and large producers to reach their target audience and maximize sale opportunities.

- Know your costs of heifer development. Attention should be given to opportunity costs. Establish a value for heifers entering the additional time frame for becoming bred heifers versus being sold for feeding and subsequent harvest. Be careful to include all feed and time expenses as well. Knowledge of a development costs will be essential to establishing either a floor or private treaty base price.

- Establish an upfront goal. What are your objectives? Do you plan to sell 10 head or 200. Is this a long term program where you will sell heifers every year or are you just selling a few extra females? Are you trying to ride the cattle cycle or is this program where you will add value to females every year? Are you worried about a long term reputation or is this a short term venture?

- Small number producers: How will you reach your potential buyers? Advertising is critical but also expensive. Can you partner with other producers or groups to cost share on expense? Whether you work with three of your neighbors or a large association cost sharing will limit per head development expense and offer greater market exposure. Who are your target buyers? Are you selling down the road or across state lines? What differentiates your heifers from the thousands offered for sale each year?

- Large number producers: Is your goal quality, quantity, or both? Repeat customers offer marketing opportunities over time but also will require tremendous pressure be placed on the quality and stayability of previous heifers. Large producers have the ability to differentiate their product based on unique, high quality, and volume genetics. Opportunities exist to be a lower cost producer based on volume semen purchases and lower per head costs for feeding and breeding. Quality producers may want to investigate custom development for other smaller breeders. Will you mass market or let buyers pick and choose? Pick and Choose may offer more top end price return but also takes longer and can be very time consuming. Mass marketing (auction) may have higher sale costs but opportunities exist to reach a larger audience and move the entire heifer crop in a much shorter time window.

Regardless of producer size, bred heifer development is a time consuming and serious business. Long term sustainability will depend on the quality of product offered for sale as well as adjustments based on previous purchasers feedback. While the cattle market looks to be moderating in feeder price the opportunity to add value to heifers still exists. While top end sale price may diminish, attention should be given to the price margin between feeder and bred heifer sale price and the cost of production.
Heifer Marketing Factors and Strategies
Tucker Family Farms
William A. Tucker

FACTORS

1) Demand Side
   A) Customers’ Expectations
   B) Customers’ Perceived Needs
   C) Customers’ Actual Needs
   D) Customers’ Realities

2) Supply Side
   A) Genetic Background
   B) Generational Adaptation
   C) Environmental Pressure
   D) Internal Needs
   E) Calendar

STRATEGIES

1) Truth: Be true to yourself in order to be true to your customers
2) Knowledge: Know your customer and evolve with them
3) Change the Paradigm: Shift from Hopes, Dreams, and Aspirations to Value
4) Identify the Highest Value First: TIME
5) Psychology: The customer is NOT always right but easier if you ARE always wrong
6) Invest: Develop long term relationships
7) Grow: Provide flexible, value added incentives
8) Packaging: Grouping, Pricing, and the Bottom 20%
Selecting quality replacement females can be one of the most important and challenging management decisions for the cow-calf producer. By selecting quality replacement females that fit well into one’s operation, the genetic potential of the herd can be improved and profitability of the operation can be enhanced. If, however, the selection of replacement females is not made with an overall plan in mind, it can lead to a decrease in profitability and a failure to capture the benefits that can be achieved by introducing new genetics into a cow herd.

The list of options that cow-calf producers have to choose from when selecting breeding animals continues to grow, as does the information available on individual animals offered for sale. This can make the task of finding the right fit for your operation more difficult, but if the right approach is taken, it can provide great opportunities as well.

So what are the most important factors to consider when selecting a replacement heifer for your operation? The list will be a little different for each individual operation, however, there are a few things that should be somewhere on the list for everyone. While there is not room here to discuss all of the factors that might come into consideration, we will try to look at a few of the most important ones.

Regardless of any special considerations that you might make because of your particular operation, management style or marketing plan, the most important factor affecting the potential profitability of a replacement heifer is her ability to successfully have a healthy calf with a minimum of assistance from you, the producer. If purchasing a bred heifer, look for heifers that conceived earlier in the breeding season. This is a good indication of her reproductive potential and sets the tone for her lifetime production in the herd. Heifers that breed early in their initial breeding season will produce more pounds of calf over their lifetime and will generally have better longevity in the cow herd (Lesmeister et al., 1973). Many organized programs such as the Virginia Premium Assured Heifer Program have guidelines limiting the breeding season of bred heifers to a specific time period, ensuring that heifers become bred early in the season. If you are purchasing heifers private treaty, it might not be a bad idea to ask for information regarding the length of the breeding season and reproductive efficiency of heifers that you are interested in purchasing.

If you are considering a group of open heifers, then obviously, breeding data will not be available. In this case, a system has been developed to estimate the reproductive status of heifers (Anderson et al., 1991). Reproductive tract scores (RTS) can be assigned to heifers based on an examination performed by a veterinarian or other qualified evaluator, to determine a heifer’s reproductive status and can give insight into her potential to become pregnant early in the breeding season (See Table 1). In general, the older a heifer is, the higher her score should be. A heifer who is 12 months old and entering her initial breeding season should have an RTS of at least 3 to be considered for breeding, while an older heifer of 14 months or more should be at a 4 or 5.
**Table 1. Description of Reproductive Tract Score***

<table>
<thead>
<tr>
<th>Reproductive Tract Score</th>
<th>Uterine Horns</th>
<th>Ovarian Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Immature, &lt; 20 mm in diameter, no tone</td>
<td>No Palpable follicles</td>
</tr>
<tr>
<td>2</td>
<td>20 to 25 mm in diameter, no tone</td>
<td>8 mm follicles</td>
</tr>
<tr>
<td>3</td>
<td>25 to 30 mm in diameter, slight tone</td>
<td>8 to 10 mm follicles</td>
</tr>
<tr>
<td>4</td>
<td>30 mm in diameter, good tone</td>
<td>&gt; 10 mm follicles, CL possible</td>
</tr>
<tr>
<td>5</td>
<td>&gt;30 mm in diameter, good tone, erect</td>
<td>&gt; 10 mm follicles, CL present</td>
</tr>
</tbody>
</table>

*Adapted from Martin et al., 1992

Reproductive tract score has been shown to be highly correlated with subsequent reproductive success in virgin beef heifers (Table 2).

**Table 2. Relationship of reproductive tract score with reproductive traits in yearling heifers***

<table>
<thead>
<tr>
<th>Trait</th>
<th>Reproductive Tract Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response to synchronization (%)</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Pregnancy rate to synchronized breeding (%)</td>
<td></td>
</tr>
<tr>
<td>Pregnancy rate at end of breeding season (%)</td>
<td></td>
</tr>
<tr>
<td>Conception date (Avg. days into the breeding season)</td>
<td></td>
</tr>
</tbody>
</table>

*Adapted from Martin et al., 1992

Dystocia or calving difficulty is a nightmare for every producer calving heifers. When selecting heifers for purchase, careful planning and selection can reduce calving difficulties later on. Bred heifers should be bred to calving ease sires (bulls that are below breed average for birth weight), and both bred and open heifers should have a pelvic area greater than 150 sq. cm at breeding. There is some debate among researchers as to the ability of pelvic measurement to accurately predict whether or not a heifer will be able to successfully deliver a calf without assistance. In part, this is due to the many other factors that may affect the rate of dystocia in cattle, such as calf birth weight. It makes sense, though, to select heifers with a larger pelvic area if possible.

The other major factor that should be considered is the pounds of calf that a heifer has the genetic potential to produce over her lifetime. There are many factors that influence a heifer’s potential to produce more pounds of calf, but this is definitely a case of “the more you know the better off you are”. Among the pieces of information that may help give an indication of a heifer’s potential are milking ability, and the growth and muscle attributes that she will pass along to her offspring. In this case, some knowledge of the “pedigree” of the heifer can provide some clues. One important clue is the sire of the heifer. This can be an important piece of information and provide a clue to half of the genetic package which the heifer will bring to your herd. Even better is to know the sire as well as any information you can get about the dam. This will provide a good indication of the genetic potential of the heifer. At the very least, some knowledge of the heifer’s own performance can be a valuable tool (See Figure 1).
A heifer’s potential longevity in the herd can mean the difference between a good investment and a bad one. Even a high producing heifer will not produce a net profit if she is only in the herd a couple of years. There are many factors that contribute to the potential stayability of a heifer/cow in the herd. Structural soundness (feet and legs), udder soundness, breed composition, and genetics can all play a role in determining the potential longevity of a heifer in the herd. The most obvious of these characteristics may be structural soundness. A critical visual appraisal of all heifers should be made prior to purchase. Look for obvious structural deformities of the feet and legs. Heifers with major structural problems such as sickle hocks or legs and pasterns without enough flex should not be considered. Look out for heifers with bad feet. A heifer with a twisted toe or other deformity of the hoof is not a good candidate for a replacement.

Among other factors that should be considered before purchasing replacement heifers are factors such as your marketing plan for your calves, the makeup of your current herd, your management style and areas that you might be able to improve through the introduction of new genetics into the herd.

A key factor for profitability of a cow-calf enterprise is to know your market and have a plan to maximize profits within that market. Whether you sell your calves off the cow, or retain them through the feedlot to slaughter, the genetics of the cow herd will have a definite impact on your bottom line. Replacements should be selected that will produce calves that fit the marketing plan and enhance the traits that you need to maximize for profitability. Some producers may be able to concentrate on weaning weights and pounds of calf produced, while others who may retain cattle longer may also need to concern themselves with the potential carcass merit of the heifer and/or the calf that she is carrying (assuming she is bred). Color is also an important, if albeit a politically touchy subject. In some areas, cattle of a particular color simply do not sell well.

Match replacement heifers to your management system and the rest of your herd. Keep in mind the mature size of the heifer (frame score) and avoid purchasing heifers that are much larger than or much
smaller than the rest of your herd. Mature size can have an impact on several management factors including feed cost, pasture carrying capacity, calf size and more. If possible, get frame scores on potential replacements and evaluate them for adequate muscling.

Selecting a crossbred female may be a good way for many producers to capitalize on genetics through heterosis resulting in added economic benefit into the herd. There are two main reasons for utilizing crossbreeding in beef cattle. These are the benefits of heterosis or hybrid vigor and breed complimentarity – where breeds have characteristics that complement each other and fit well into their environment (Bullock and Anderson, 2004). There are several areas of economic importance which may greatly benefit from heterosis (See Table 3).

Table 1. Heterosis associated with various traits.*

<table>
<thead>
<tr>
<th>Trait</th>
<th>Heterosis (Relative Benefit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conception</td>
<td>High</td>
</tr>
<tr>
<td>Calf Survival</td>
<td>High</td>
</tr>
<tr>
<td>Longevity</td>
<td>High</td>
</tr>
<tr>
<td>Birth Weight</td>
<td>Moderate</td>
</tr>
<tr>
<td>Yearling Weight</td>
<td>Moderate</td>
</tr>
<tr>
<td>Milking Ability</td>
<td>Moderate</td>
</tr>
<tr>
<td>Carcass Traits</td>
<td>Low</td>
</tr>
</tbody>
</table>

*Adapted from Bullock and Anderson, 2004

In general, crossbred heifers and cows will have an increased calving rate of at around 3.5%, and the combined effect of increased milk and growth from crossbred females can result in calf weaning weights that are 25 to 30 pounds heavier just as a result of hybrid vigor. Make sure when selecting a crossbred heifer, though, that the breeding of the heifer is planned and that the breeds are complimentary to each other, and of course that the genetic package fits with your overall plan for your herd.

Finally, the health program of the operation or program where the heifers come from should also be considered. This may be one of the most, if not the most important consideration when bringing in animals from outside your herd. Heifers should at least be vaccinated for the basics such as respiratory and reproductive diseases. This improves the likelihood that a heifer will produce a live healthy calf and reduces the chances of introducing a disease into your herd. You should evaluate your own herd health plan and work with your veterinarian to develop a checklist of health considerations that are most important to you and your operation.

There are many other factors affecting the success of a heifer in any herd. Factors such as disposition are harder to quantify, but can be invaluable to you when you take her home. It is important to know as much as possible about the source of your heifers and to enter into the buying process with a plan. Know what you need and how much you can afford to spend. By making good choices in selecting replacements, you can improve your herd and ultimately your bottom line.
References


Selecting Heifers for Purchase

Mark D. Davis, Extension Agent,
Buckingham County & Dr. John B. Hall,
Extension Beef Cattle Specialist
VA Tech

Genetic Improvement Goals
- Where have we been?
- Where are we now?
- Where are we going?
- How do we get there?

Wanted Commercial Replacement Heifers!
Must be able to:
- Calve at 2-years old
- Calve every 365 d for next 7 to 8 years
- Wean a heavy calf that fits a target market
- Produce efficiently on forage as grain benefits are limited
- Be healthy, rugged and durable

Economically Important Traits
- Fertility
- Calving ease
- Calf survival
- Weaning Wt.
- Post-weaning growth
- Feed efficiency
- Mature size
- Red meat yield
- Palatability

Purchase Replacements
- Crossbred female
  - Maternal heterosis
- Mate to terminal sire
  - Calving ease, growth, carcass merit
- System advantages-
  - High heterosis
  - Management simple
  - Bull selection simplified

Why is Crossbreeding Crucial in Commercial Replacement Heifers?
- Increased reproductive efficiency
- Improved calf survivability
- Increased weaning weights
- Altogether up to 25% increase in lbs. weaned per cow exposed
Maternal Heterosis

<table>
<thead>
<tr>
<th>Trait</th>
<th>Units</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calving rate, %</td>
<td>3.5</td>
<td>3.7</td>
</tr>
<tr>
<td>Survival to weaning, %</td>
<td>1.6</td>
<td>1.8</td>
</tr>
<tr>
<td>Birth weight, lb</td>
<td>18.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Weaning weight, lb</td>
<td>1.36</td>
<td>16.2</td>
</tr>
</tbody>
</table>

**Lifetime Production**

<table>
<thead>
<tr>
<th>No. Calves</th>
<th>Cumulative Wean. Wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>.97</td>
<td>600</td>
</tr>
<tr>
<td>17.0</td>
<td>25.3</td>
</tr>
</tbody>
</table>

Impact of Heterosis

<table>
<thead>
<tr>
<th>Heritability</th>
<th>Heterosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reproduction</td>
<td>Very Low</td>
</tr>
<tr>
<td>Growth</td>
<td>Moderate</td>
</tr>
<tr>
<td>Carcass Merit</td>
<td>High</td>
</tr>
</tbody>
</table>

Which Breed is Right for Your Operation?

**Breed Differences: Growth Performance**

<table>
<thead>
<tr>
<th>Size breed of calf</th>
<th>Generation length</th>
<th>Usual calvings</th>
<th>Birth weight</th>
<th>Survival to wean.</th>
<th>20/4 wean. wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hereford</td>
<td>284 d</td>
<td>95.5</td>
<td>90.4</td>
<td>96.2</td>
<td>524</td>
</tr>
<tr>
<td>Angus</td>
<td>282 d</td>
<td>96.6</td>
<td>84.0</td>
<td>96.7</td>
<td>533</td>
</tr>
<tr>
<td>Red Angus</td>
<td>282 d</td>
<td>96.1</td>
<td>84.3</td>
<td>96.7</td>
<td>526</td>
</tr>
<tr>
<td>Simmental</td>
<td>283 d</td>
<td>97.7</td>
<td>90.2</td>
<td>96.7</td>
<td>533</td>
</tr>
<tr>
<td>Dalvich</td>
<td>284 d</td>
<td>97.8</td>
<td>88.7</td>
<td>97.1</td>
<td>534</td>
</tr>
<tr>
<td>Limousin</td>
<td>286 d</td>
<td>97.6</td>
<td>89.5</td>
<td>96.9</td>
<td>519</td>
</tr>
<tr>
<td>Charolais</td>
<td>283 d</td>
<td>98.8</td>
<td>93.7</td>
<td>97.1</td>
<td>540</td>
</tr>
</tbody>
</table>

Source: Coaddy et al., 2011, Sheep and Goat Evaluation Program: Progress Report No. 11

Breed Differences: Post-weaning Performance & Carcass Merit

<table>
<thead>
<tr>
<th>Size breed of calf</th>
<th>Average pH, %</th>
<th>Slope pH, %</th>
<th>Carcass weight, lb</th>
<th>Meat. yield %</th>
<th>Marb.</th>
<th>Warner-Bratzka</th>
<th>Yield Grade</th>
<th>Fat % of B.</th>
<th>RDA, eq. m.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hereford</td>
<td>3.46</td>
<td>1.63</td>
<td>532</td>
<td>57.1</td>
<td>3.35</td>
<td>22</td>
<td>12.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angus</td>
<td>3.48</td>
<td>1.97</td>
<td>57.1</td>
<td>532</td>
<td>22</td>
<td>12.48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Angus</td>
<td>3.40</td>
<td>1.82</td>
<td>59.9</td>
<td>53.8</td>
<td>60</td>
<td>12.31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simmental</td>
<td>3.47</td>
<td>1.90</td>
<td>53.6</td>
<td>61.2</td>
<td>2.95</td>
<td>42</td>
<td>13.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dalvich</td>
<td>3.35</td>
<td>1.84</td>
<td>51.6</td>
<td>43.6</td>
<td>2.86</td>
<td>29</td>
<td>13.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limousin</td>
<td>3.30</td>
<td>1.80</td>
<td>55.7</td>
<td>44.8</td>
<td>2.63</td>
<td>48</td>
<td>14.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charolais</td>
<td>3.43</td>
<td>1.97</td>
<td>54.5</td>
<td>57.7</td>
<td>2.77</td>
<td>45</td>
<td>14.01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Coaddy et al., 2011, Sheep and Goat Evaluation Program: Progress Report No. 11

Options/Locations to Purchase Heifers

- Private Treaty off the Farm
  - purchase at weaning?
  - purchase bred?
- Weekly Area Livestock Markets
  - do you know what you are getting?
- Area Virginia Premium Assured Heifer Sales

Successful heifer candidates will possess:

- documentation of early puberty
- high fertility and good mothering ability
- demonstrated potential (EPD’s)/for milking ability
- ability to calve with little assistance
- moderate frame size
- proven fleshing ability on forage based diet
- excellent disposition and character
- Crossbred heifers bred to bulls with low BW and high growth EPD’s preferred
Physical Requirements

- Age
  - stated birth date - month and year
  - 22 to 26 months at calving (Spring)
  - 22 to 30 months at calving (Fall)
  - 11 to 17 months at sale (open)
- Frame Size - 4.5 to 6.5

Physical Requirements (cont)

- No Physical Defects
  - no pinkeye
  - no frosted ears
  - no bob-tails
  - no rat-tails

Physical Requirements (cont)

- Structure
  - deemed correct by VA-PA heifer committee
- Muscling
  - grade of 1 to 2.5 USDA feeder calf grades
- Body Condition Score
  - 5 to 7
- Percent mature weight (open heifers)
  - at least 65% mature weight (12 mo +)
- Polled or properly dehorned

Set Benchmark by Using VA Premium Assured Heifer Program as Guidelines

- Heifers will have:
  - Screening for physical defects and consistency
  - Reproductive exam
  - Minimum genetic standards
  - Certified health program
- Genetic Edge

Genetic Requirements

- Breeds - Any breed or breed combination
- Sire of heifer
  - Sire identified
  - Minimum EPD’s (Premium Plus)
Service Sire (bred heifers)
- Service sire identified
- EPD's
  - BW - best 40%
  - WW & YW - Top 50%
  - Milk - no requirement, but reported

Minimum EPD’s - Premium Plus
- British X British, Straight British
- Sire - Top 50% for WW, YW; Top 70% for Milk
- Continental, Continental X
- Sire - Top 70% for WW, YW and Milk

Reproductive Requirements
- Bred Heifers
  - Conceived within 50 days of initial AI and/or natural mating
  - Pelvic area - 180-190 sq. cm or passed PA at 12 months

Reproductive Requirements
- Open Heifers - (12 - 15 months)
  - Reproductive exam
  - Repro. tract score - 3 or better
  - Pelvic area - 150 sq. cm

Health Program
- Vaccinations
  - Calfhood Brucellosis
  - IBR-P13, BVD, BRSV, 7-way clostridial, 5-way lepto
- Tests
  - VA is TB free; no TB required for in-state sales
- Parasite control
  - Fall sales - Endectocide w/in 60 days & before Nov 1
  - Spring sales - Endectocide w/in 30 days & after Feb 1

Other Recommended Practices
- Forage-based program with ADG of 1.25-1.75 lbs.
- Ionophores included in ration
- Estrus synchronization protocol with 60 day breeding season
Selection of Heifers at Weaning
- Structurally correct = longevity
- Heavier heifers = growth, early puberty, increased conception
- Moderate framed heifers = efficiency, target product
- Adequate muscling = target product
- From good performing cows = fertility, milking ability
- From bulls with good EPD’s for growth and milk = productivity

Selection of Heifers at Prebreeding
- Heifers are 65% of mature weight = growth, early puberty, increased conception
- Easy fleshing adequate muscle = efficiency, target product
- Passed reproto. tract exam = fertility
- Sufficient pelvic area and shape = calving ease
- Passed all criteria from weaning selection

Selection of Bred Heifers
- Conceived early in breeding season = fertility
- Bred to low BW EPD with adequate growth EPD’s = calving ease, target product
- Easy fleshing, adequate muscle = efficiency, target product
- Passed criteria from weaning and prebreeding - some you can see, some you will need information to know

What Does It Cost to Raise a Bred Heifer?
- Calculate on value of heifer + all costs until sale or calving.
- Value of a weaned heifers is MARKET value not just costs
- Variable costs usually run from $250 to $350 per heifer until sale + $25 to $50 from “sale” until breeding.

Cost of Raising a Bred Heifer - Example
- Value of weaned heifer
  - 583 lbs x 119.30/cwt = $ 695.52 (BCA Sale Avg. 06)
  - 583 lbs x 111.37/cwt = $ 649.29 (VA Sale Avg. 06)
- Variable costs $302.00
  - $75/d daily cost 236 days = $ 177.00
  - $ 25.00 A.I. Cost (Semen, Technician, Drugs)
  - $ 100 Vet Cost (Vaccinations, Vet Exams, etc.)
- Total cost of raising = $951.29
  - Range of $750 - $ 1000

Your costs may be higher if you are only raising a few heifers.
Duties of the Replacement Female:

Your job as a producer is not completed after purchasing a replacement female. She must be properly managed for a successful productive life. After purchasing her, there are several physiological stages she must be managed for, including: gestation and continuation of her own growth, parturition, lactation, and timely rebreeding. The duties of these replacement heifers is to calve at two years old, calve every 365 days for the next 7 to 8 years, wean a heavy calf, and to be healthy and durable. This is asking a lot of these females, however if they are managed properly, it is all possible.

In order for the heifer to fulfill her duties you must feed her to achieve desired rates of gain and to provide adequate nutrients for pregnancy. You must also insure that the heifer is of adequate size to deliver a live, healthy calf and that she is adequate body condition to rebreed in a reasonable time.

Weight Gain in Pregnant Heifers:

Heifers need to gain 1.5 pounds per day from breeding until 60-90 days prior to calving. Within 60-90 days of calving heifers should be gaining 2.5 pounds per day. The nutrition for this weight gain should be coming mostly from high quality forages. The goal is that the heifer will be 85-90% of her mature body weight at calving.

During this time period, many things will be happening to use the nutrition you are giving her. Prior to parturition, the fetus will be rapidly growing, the heifer should be gaining weight, her intake will decrease, and she will be preparing for lactation.

Nutritional Needs in Pregnant Heifers:

When using the NRC computer program and calculating for a 22 month old heifer at 220 days pregnant who should have a mature weight of 1300 pounds it showed that the heifer has higher requirements for calcium and phosphorous than an animal that was not pregnant. This is due in part to the rapid skeletal growth of the fetus.

<table>
<thead>
<tr>
<th></th>
<th>Calcium Requirements (grams/day)</th>
<th>Phosphorous Requirements (grams/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td>Maintenance</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>44</strong></td>
<td><strong>23</strong></td>
</tr>
</tbody>
</table>

Effect of BCS at Calving on Pregnancy Rates:

As shown below, body condition score in heifers at calving can greatly influence the percent pregnant. Not only do heifers that have a BCS of 6 at calving have a higher percentage pregnant, they also get pregnant earlier in the breeding season. Those that breed later in the season will calve later in the calving season next year. Cows that calve late have lighter calves at weaning and are less likely to get pregnant in a controlled breeding season.
Effect of Changing BCS Before Calving in First Calf Heifers:

The following table shows the effects of changing the body condition score prior to calving and how much their weight changed to get to that BCS. As shown in the chart, increasing more than 66 pounds of body weight to achieve a BCS of 6 or 7 has a 90.8% pregnancy rate, but gaining less than 66 pounds has an 86.7% rate. Ultimately, it does not make that much of a difference how you get to a BCS of 6 or 7; the important factor is that you get there.

<table>
<thead>
<tr>
<th>BW status with BCS at calving</th>
<th>Pregnancy Rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreasing BW, BCS 4 or 5</td>
<td>67.1</td>
</tr>
<tr>
<td>Increasing ≤ 66 lbs., BCS 4 or 5</td>
<td>66.2</td>
</tr>
<tr>
<td>Increasing &gt; 66 lbs., BCS 4 or 5</td>
<td>71.0</td>
</tr>
<tr>
<td>Decreasing BW, BCS 6 or 7</td>
<td>83.7</td>
</tr>
<tr>
<td>Increasing ≤ 66 lbs., BCS 6 or 7</td>
<td>86.7</td>
</tr>
<tr>
<td>Increasing &gt; 66 lbs., BCS 6 or 7</td>
<td>90.8</td>
</tr>
</tbody>
</table>

From DeRouen et al., 1994

Effects of the Gestation Diet of the Dam:

As shown in the table below, heifers that are fed a diet that is low in energy or proteins have a higher rate of dystocia, higher incidence of scours, and a lower percentage of calf survival. Although heifers that are fed adequately will have a heavier calf at birth than those heifers that are STARVED, this should not be a problem if the correct bull is used. Calves from well fed heifers should also have more brown fat reserves, which is a kind of fat that mammals have when they are born and is used for body heat. If a heifer is not fed well, she may run out of energy, thus needing to stop and rest.
However, this “resting” may cause her calf to be stillborn. A decrease in feed can lead to a decrease in colostrums, therefore lowering the calf’s immunity.

<table>
<thead>
<tr>
<th>Item</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calf birth weight (lbs)</td>
<td>63</td>
<td>69</td>
</tr>
<tr>
<td>Dystocia (%)</td>
<td>35</td>
<td>28</td>
</tr>
<tr>
<td>Calf Survival (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Birth</td>
<td>93</td>
<td>91</td>
</tr>
<tr>
<td>Weaning</td>
<td>58</td>
<td>85</td>
</tr>
<tr>
<td>Scours (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidence</td>
<td>52</td>
<td>33</td>
</tr>
<tr>
<td>Mortality</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Dam Traits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnancy (%)</td>
<td>65</td>
<td>75</td>
</tr>
</tbody>
</table>

**Summary:**
In the end, heifers that are managed correctly have a greater chance of calving healthy calves, weaning those calves at a higher weight, and rebreeding in a timely manner.

**References:**
Calving difficulty, technically called a dystocia, is a major cause of death loss in cow/calf herds. CHAPA (Cow/calf Health and Productivity Audit) studies indicate that dystocia is responsible for 33% of all calf losses and 15.4% of breeding beef cattle losses. While this is decreased from the 1992 CHAPA study, it still needs to be improved. Dystocia can have a large economic impact on producers due to calf death, veterinary costs, and injury or death to the cow. In three different studies, dystocia was the highest veterinary cost to cow/calf operations in Colorado, California, and Tennessee. Dystocia is also the number one cause of calf mortality in the first 96 hours of life. It has also been shown in one study, that pregnancy rates for the dam after loosing a calf are lower than for dams that have not lost a calf.

**General**

The average length of gestation for cattle is 280 days, with normal ranges of 273-296 days. A twin pregnancy will average 3-6 days less.

The normal calving:

There are three stages of labor in cattle.

1. **First stage:** The first stage of labor is when the cervix is dilating. This stage can last between 1 and 24 hours, but usually it is between 2 to 6 hours. Cows will often separate from the herd, and may be restless. They will not eat or drink and can have a vaginal discharge.

2. **Second stage:** The second stage begins when the cow starts contracting and continues until the calf is delivered. The amniotic sac, or water bag, will appear at the vulva. The fetus starts to enter the birth canal which then stimulates contractions that can be seen as abdominal press. A general rule is that delivery should be complete within 2 hours after the amniotic sac appears.

3. **Third stage:** The third stage is when the placenta (afterbirth) is delivered. The placenta usually passes within the first 8 hours after birth. It is considered “retained” at 12-24 hours, but manually removing the afterbirth is not recommended.

Dystocia is when it becomes difficult or impossible for the cow to deliver the calf without assistance. This interruption can occur in the first and/or second stage of labor. Producers may not know the exact time the cow goes into labor, but careful observation, and knowing the general guidelines will help identify dystocias early.

**Causes of Dystocia**

The most common causes of dystocia are maternal/fetal disproportion, abnormal position of the calf during delivery, incomplete dilation of the cervix, uterine inertia (the uterus will not contract, or becomes “exhausted”) uterine torsion, twins and abnormal fetuses.

Currently in the U.S., the most significant cause of dystocia is maternal/fetal disproportion. This is a condition when the calf is too large for the female to deliver without difficulty. Heifers are at the greatest risk of fetal/maternal disproportion. Current recommendations to maximize profitability and decrease dystocias are to calve heifers at 24 months of age. Calving heifers at 24 months of age minimizes the feeding expenses associated with developing heifers while keeping the heifers calving
during the same calving season as the mature cows. Well managed and properly grown heifers will only be 85-90% of mature cow size at 24 months of age and not have as much room in their pelvis (birth canal) as mature cows. Underdeveloped heifers may only be 60% of mature cows and are at much greater risk of dystocia.

Cow-calf producers get paid for pounds of calf produced. For many years there has been a trend towards selecting larger cows, and bulls that produce growthier calves. As genetics became better understood, it was apparent that there is a link between birthweight and calf growth. Calves that had higher growth potential also had higher birthweights. Another important factor that was discovered is that the bull primarily determines the birth weight of the calf. So the industry found that in breeding for more growth in their calves they were also creating many more dystocias.

**Diagnosis**

The big question is when is a delivery a dystocia rather than a normal birth? If the appearance of the amniotic sac at the vulva is seen, then a good rule of thumb is the calf should be born within 2 hours. For a cow, it will probably be closer to 1 hour. If it is unknown when the animal began labor, the most reliable way to assess if the animal is having trouble is the progress they are making. There should be visible progress every 20-30 minutes that a cow or heifer is in active second stage labor. Additionally, a cow or heifer that frequently tries to urinate or walks with her tail up and extended for more than 3-4 hours may have a uterine torsion (twisted uterus), abnormally positioned calf, or other conditions which block passage of the fetus and membranes so they are not visible.

If there is an extended second stage labor, progress is not being made, or frequent urinating posture for several hours, an examination should be done. When examining a cow, good sanitation is very important not to introduce infections which can cause future reproductive problems. The vulva should be cleaned with a mild soap and water and plastic OB sleeves should be worn to protect the cow and examiner from infectious agents. The vulva should be relaxed and free of obstructions like fat and pelvic fractures and the cervix should also be relaxed and dilated large enough for the calf to pass through. When the hand is passed along the birth canal, there should not be any band marking the border between the birth canal and uterus, that is, no cervix can be identified. The position and size of the calf should be determined next. The normal position of a calf during delivery is both front legs extended with the head following and facing forward in a “diving” position. If the cow is dilated and the calf is in the normal position, but still no progress is being made, fetal/maternal disproportion is likely. Never attempt to deliver a calf in an abnormal position without first correcting it as irreparable damage will likely be done to the cow.

**Prevention**

Because many of the causes of dystocia such as abnormal calf position and uterine torsion are sporadic and unpredictable, prevention is primarily focused on correcting fetal/maternal disproportion and nutrition.

**Maternal/fetal disproportion**

There are two factors to consider with maternal/fetal disproportion: the size of the dam at calving, and the size of the calf. Because heifers are generally smaller than cows, they have an increased risk of dystocia. The size of heifers at breeding should average 66% of their mature weight, with a minimum of
60%. This will make them 85-90% + 100 lbs at calving. The 100 lbs is important as that takes in consideration the weight of the calf and the associated fluids.

Table 1. Target sized to avoid dystocia.

<table>
<thead>
<tr>
<th>Mature Body Weight (BW) of cow * lbs</th>
<th>Breeding (66% of mature BW of heifer) lbs</th>
<th>Pregnancy check at 5 months (lbs)</th>
<th>Precalving (90% +100 lbs of mature BW)</th>
<th>After calving (90% of mature BW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>660</td>
<td>830</td>
<td>1000</td>
<td>900</td>
</tr>
<tr>
<td>1100</td>
<td>726</td>
<td>913</td>
<td>1100</td>
<td>1000</td>
</tr>
<tr>
<td>1200</td>
<td>792</td>
<td>996</td>
<td>1200</td>
<td>1100</td>
</tr>
<tr>
<td>1300</td>
<td>858</td>
<td>1079</td>
<td>1300</td>
<td>1200</td>
</tr>
<tr>
<td>1400</td>
<td>924</td>
<td>1162</td>
<td>1400</td>
<td>1300</td>
</tr>
</tbody>
</table>

*Projected mature body weight or average size of cows in herd

Table 2. Minimum size to avoid dystocia**

<table>
<thead>
<tr>
<th>Mature Body Weight (BW) of cow (lbs)</th>
<th>Breeding (60% of mature BW of heifer) lbs</th>
<th>Pregnancy check at 5 months (lbs)</th>
<th>Precalving (85% of mature BW +100lbs)</th>
<th>After calving (85% of mature BW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>600</td>
<td>800</td>
<td>950</td>
<td>850</td>
</tr>
<tr>
<td>1100</td>
<td>660</td>
<td>880</td>
<td>1035</td>
<td>935</td>
</tr>
<tr>
<td>1200</td>
<td>720</td>
<td>960</td>
<td>1120</td>
<td>1020</td>
</tr>
<tr>
<td>1300</td>
<td>780</td>
<td>1040</td>
<td>1205</td>
<td>1105</td>
</tr>
<tr>
<td>1400</td>
<td>840</td>
<td>1120</td>
<td>1290</td>
<td>1190</td>
</tr>
</tbody>
</table>

**The Minimum size is more likely to result in dystocia than the Target size and uses 60% of mature cow size.

_Nutritional Approaches to meeting target sizes_

Provided below are the nutrient requirements of beef replacement heifers at different stages of development and sample rations to meet these requirements.
Table 3. Nutrient Requirements of Beef Cattle

<table>
<thead>
<tr>
<th>Body Weight (lb)</th>
<th>Daily Gain (lb)</th>
<th>Dry Matter Intake (lb)</th>
<th>Crude Protein lb/day % of DM</th>
<th>TDN lb/day % of DM</th>
<th>Ca (%) P (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heifer calves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>1.5</td>
<td>10.2</td>
<td>1.17</td>
<td>11.4</td>
<td>7.0</td>
</tr>
<tr>
<td>500</td>
<td>1.5</td>
<td>12.1</td>
<td>1.25</td>
<td>10.3</td>
<td>8.3</td>
</tr>
<tr>
<td>600</td>
<td>1.5</td>
<td>13.8</td>
<td>1.32</td>
<td>9.5</td>
<td>9.4</td>
</tr>
<tr>
<td>Pregnant yearling heifers-last third of pregnancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>750</td>
<td>1.4</td>
<td>16.6</td>
<td>1.5</td>
<td>8.9</td>
<td>10.0</td>
</tr>
<tr>
<td>850</td>
<td>0.9</td>
<td>17.6</td>
<td>1.4</td>
<td>8.2</td>
<td>9.6</td>
</tr>
<tr>
<td>950</td>
<td>0.9</td>
<td>19.0</td>
<td>1.5</td>
<td>8.0</td>
<td>10.3</td>
</tr>
</tbody>
</table>

Sample Rations for Developing Replacement Heifers

Table 4. **Medium Frame Heifers with a Target Average Daily Gain (ADG) of 1.5 lbs**

<table>
<thead>
<tr>
<th>Heifer Weight 400lbs</th>
<th>Low Quality Hay</th>
<th>Average Quality Hay</th>
<th>High Quality Hay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hay</td>
<td>9.0 lbs</td>
<td>11.0 lbs</td>
<td>12.5 lbs</td>
</tr>
<tr>
<td>16% Supplement</td>
<td>5.0 lbs</td>
<td>3.5 lbs</td>
<td>2.0 lbs</td>
</tr>
<tr>
<td>Mineral Supplement</td>
<td>0.2 lbs</td>
<td>0.1 lbs</td>
<td>-----</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heifer Weight 600 lbs</th>
<th>Low Quality Hay</th>
<th>Average Quality Hay</th>
<th>High Quality Hay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hay</td>
<td>13.0 lbs</td>
<td>15.0 lbs</td>
<td>18.0 lbs</td>
</tr>
<tr>
<td>13 % Supplement</td>
<td>7.0 lbs</td>
<td>5.0 lbs</td>
<td>2.0 lbs</td>
</tr>
<tr>
<td>Mineral Supplement</td>
<td>0.1 lbs</td>
<td>-----</td>
<td>-----</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heifer Weight 800 lbs</th>
<th>Low Quality Hay</th>
<th>Average Quality Hay</th>
<th>High Quality Hay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hay</td>
<td>16.0 lbs</td>
<td>18.5 lbs</td>
<td>21.5 lbs</td>
</tr>
<tr>
<td>13 % Supplement</td>
<td>8.5 lbs</td>
<td>6.0 lbs</td>
<td>3.0 lbs</td>
</tr>
<tr>
<td>Mineral Supplement</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
</tbody>
</table>
Table 5. **Large Frame Heifers with a Target Average Daily Gain of 1.75 lbs**

<table>
<thead>
<tr>
<th>Heifer Weight</th>
<th>Low Quality Hay</th>
<th>Average Quality Hay</th>
<th>High Quality Hay</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 lbs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hay</td>
<td>10.5 lbs</td>
<td>13.0 lbs</td>
<td>15.0 lbs</td>
</tr>
<tr>
<td>16 % Supplement</td>
<td>6.5 lbs</td>
<td>4.5 lbs</td>
<td>2.5 lbs</td>
</tr>
<tr>
<td>Mineral Supplement</td>
<td>0.3 lbs</td>
<td>0.1 lbs</td>
<td>------</td>
</tr>
<tr>
<td>700 lbs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hay</td>
<td>13.5 lbs</td>
<td>16.5 lbs</td>
<td>20.0 lbs</td>
</tr>
<tr>
<td>13 % Supplement</td>
<td>8.5 lbs</td>
<td>6.0 lbs</td>
<td>2.5 lbs</td>
</tr>
<tr>
<td>Mineral Supplement</td>
<td>0.2 lbs</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>900 lbs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hay</td>
<td>17.0 lbs</td>
<td>19.5 lbs</td>
<td>23.5 lbs</td>
</tr>
<tr>
<td>13 % Supplement</td>
<td>10.0 lbs</td>
<td>7.5 lbs</td>
<td>3.5 lbs</td>
</tr>
<tr>
<td>Mineral Supplement</td>
<td>0.2 lbs</td>
<td>------</td>
<td>------</td>
</tr>
</tbody>
</table>

Note:
16 % Supplement = 82 % Total Digestable Nutrients (TDN), 16 % Crude Protein (CP) Examples = Corn gluten, corn and soybean, beef commercial products

13 % Supplement = 84% TDN, 13 % CP
Examples = Barley, corn and soybean, Beef commercial Products

Low Quality Hay = 52% TDN, 7% CP
Average Quality Hay = 56% TDN, 9.5 % CP
High Quality Hay = 60 % TDN, 12 % CP
Mineral Supplement = 12% Phosphorus (P), 12% Calcium (Ca), 12% salt

**Miscellaneous**
Measuring the pelvic area of the female prebreeding has been attempted to determine how big a calf she could deliver. This appears to have limited value at this point as there is so much variation between operators when taking these measurements.

**Decreasing Calf Size**
Decreasing the calf size will also significantly help prevent dystocias. Some breeds, such as longhorns, have smaller birth weights, but unfortunately they also have less growth. For most producers this will be unacceptable. In the bovine the heritability of birth weight is almost 48%. That means the female doesn’t control or “limit” the size of the calf. Therefore a cow bred to a bull that produces large calves is likely to have a large calf regardless of her size.

EPDs (Expected Progeny Differences) are used to predict how future progeny (offspring) will compare to other bulls future progeny within a breed. EPDs are much more accurate in predicting the performance of a bull’s progeny than looking at individual records because it incorporates the animals
records, its parents records, its siblings records and progeny records. EPDs are available for many desirable characteristics, but the most important EPD to evaluate for dystocia prevention is birth weight. In recent years, bulls that sire calves with low birth weights, have been identified. These are considered “calving ease” bulls. In the Angus breed, bulls with an EPD for birth weight of +2 or less are considered calving ease. Other breeds are compared with this using across breed EPDs (see below). Having a calving ease bull with good growth traits is highly desirable. Semen from sires is available for artificial insemination, or their calves may be purchased as bulls. For most producers that buy bulls to run with their cows, the only data that is known is how their sire performed. Because these characteristics are consistently passed on to their offspring, the sires information is generally reliable for the offspring as well. In this situation the sires EPD accuracy should be looked at closely.

The Accuracy Value (ACC) of EPDs is how reliable the EPDs are. The accuracy is based on the quantity and quality of information used in the EPD of a sire and is ranked from 0 to 1. The higher the ACC value the higher the accuracy. Therefore, in looking at birth weight EPDs, there is more risk that a bull will sire larger calves if the accuracy is 0 than if it is higher. An animals EPDs and ACC will change yearly as more information is available. In general, younger bulls have lower accuracy because there is less information available for them.

As mentioned before, EPDs are a way to compare bulls within a breed. An Across Breed Adjustment factor is now available to compare EPDs from bulls of different breeds. The adjustment factor uses the Angus breed as a reference point so the adjustment factor for all Angus EPDs is 0. To use across breed adjustment factors accurately, the latest charts for EPD adjustment and Breed Average EPDs need to be used. They are published and recalculated every year.

Table 6. Current Active Sires EPD Beef Breed Averages and EPD Adjustment Factors for Birth Weight 2006

<table>
<thead>
<tr>
<th>Breed</th>
<th>Breed Average EPD for Birth Weight</th>
<th>Across Breed Adjustment Factor for Birth Weight EPDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angus</td>
<td>+2.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Charolais</td>
<td>+1.2</td>
<td>10.0</td>
</tr>
<tr>
<td>Gelbvieh</td>
<td>+1.9</td>
<td>4.7</td>
</tr>
<tr>
<td>Herford</td>
<td>+3.7</td>
<td>2.9</td>
</tr>
<tr>
<td>Limousin</td>
<td>+2.3</td>
<td>4.1</td>
</tr>
<tr>
<td>Red Angus</td>
<td>+0.6</td>
<td>3.0</td>
</tr>
<tr>
<td>Simmental</td>
<td>+2.4</td>
<td>5.8</td>
</tr>
<tr>
<td>Beefmaster</td>
<td>0.0</td>
<td>9.2</td>
</tr>
</tbody>
</table>

To calculate Average across breed EPDs for birth weight, the Adjustment Factor for birth weight EPD is added to the Breed Average EPD for birth weight.

Example: (Using chart from Table 6.) Comparing average birth weights between the Red Angus and Simmental breeds:
Red Angus 3.0 (Adjustment factor for BW EPD) + 0.6 (Breed Ave EPD for BW) = 3.6
Simmental 5.8 (Adjustment factor for BW EPD) + 2.4 (Breed Ave EPD for BW) = 8.2
The Average Simmental bull will sire calves that are 4.6 lbs \((8.2 - 3.6 = 4.6)\) heavier than the average Red Angus bull when mated to an Angus cow (the reference point).

To compare two specific bulls from different breeds, the same calculation can be done by adding the Adjustment factor for BW EPD to that sires within breed EPD for birth weight. Within breed EPDs are also published and recalculated yearly, and the latest information is necessary for accurate comparisons. Across breed EPDs are helpful when multiple breeds are used in a breeding program to maintain uniformity and make sure there are not large fluctuations in birth weight and other characteristics when a new breed is introduced.

**General Nutrition**

Pregnant heifers and cows should be in good condition, especially in the last 1/3 of their pregnancy. Increasing the energy content in late pregnancy may have some helpful effects on shortening labor times and decreasing dystocia. Also, cows that were fed a severely restricted protein diet in late pregnancy had higher calf deaths and dystocias. For spring calving, heifers and cows are in late pregnancy in late winter. If these females have only been fed average to poor quality hay throughout the winter they will enter last trimester of pregnancy with a thin body condition. By the time they are due to deliver, they have a greatly increased chance of having problems with dystocias, calf deaths, or becoming a down cow. Because heifers have higher nutritional needs, they should be housed and fed separately during the last 2-3 months of pregnancy. This will also prevent cows from being overfed, which has also been shown to increase the likelihood of dystocias. Additionally separate housing is helpful during calving as “higher risk” heifers will be together and can be watched more closely. During the calving season checking late gestation cows and heifers every 2 to 4 hours is ideal.

**Summary**

Dystocias and their associated losses can have a huge economic effect on cow/calf producers. Good nutrition and breeding programs are essential to decrease the incidence of dystocias and maximize profitability. The major cause of dystocias in the United States is fetal/maternal disproportion. This is often a preventable condition. By making sure that heifers are adequately grown before breeding, and choosing bulls that produce smaller calves with good growth, the beef industry can continue producing quality calves while reducing the incidence of dystocias.

**References**

Management Factors to Improve Reproductive Efficiency In Young Cows

Dr. Les Anderson
Beef Extension Specialist
University of Kentucky

Effects of Reproduction

- Greatest determinant of revenue is percent calf crop weaned.
- Greatest determinant of production efficiency is pounds of calf weaned per cow exposed.
  - Pregnancy rate
  - Weaning weight = calf age + calving distribution
- Greatest inefficiency = young cows

What’s Wrong? Anestrus!

- Anestrus is the primary factor reducing reproductive efficiency in beef cow-calf operations.
- Anestrus can be defined as the lack or absence of the expression of estrus.
- Anestrus occurs annually; heifers are anestrus prior to puberty and anestrus occurs in cows after each calving.

Anestrus?

- The occurrence of anestrus does not limit reproductive efficiency but rather the length of the anestrous period.
- The anestrous period in postpartum cows ranges from 14-180 days in length. Normally, 45-90 days is observed.
- Anestrus in young cows typically ranges from 75-120 days.

“Cycling Cow”

Reproductive Cycle – 60 d Breeding Season

90 days of anestrus

120 days of anestrus

Calving Season
Breeding Season
Gestating Cows
Trailer-mycin

A Little Biology...

Postpartum Anestrus in Beef Cows

Mature Cows

Why Young Cows?

Two Year Olds

Nutrient requirements of young cows

Unnecessary energy reserves (BCS > 6)

Estrous cycles

Additional energy reserves (BCS = 4-5)

Lactation

Pregnancy

Basic energy reserves (fat)

GROWTH

Activity

Basal Metabolism
Factors Affecting Anestrus

Time
Calving Difficulties
Nutrition
Suckling

Time

• Time
  – For every 10 days after calving, the percentage of cyclic cows increases 7.5%.
  – Young cows even in optimal condition require 20-30 days more to recover from calving.

Time

• Recommendation
  – Breed yearling heifers to calve 20-30 days prior to cow calving season.
  • Advantages:
    – Increase the proportion of young cows that initiate estrous cycles prior to the breeding season.
    – Concentrate labor during most stressful time period.
  • Disadvantages:
    – Spreads out total calving window
    – Calves at undesirable times

Calving Difficulty

• Young cows account for 30-40% of all calving problems.
• Females that experience calving problems are 16% less likely to conceive during the breeding season.
• Young cows that endure a prolonged labor (more than 1 hour) deliver weaker calves and have extended PPI.

Calving Assistance

<table>
<thead>
<tr>
<th>Item</th>
<th>Stage II Labor</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Late</td>
<td>Early</td>
<td></td>
</tr>
<tr>
<td>PPI</td>
<td>51</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>% in heat</td>
<td>82</td>
<td>91*</td>
<td></td>
</tr>
<tr>
<td>Services/conception</td>
<td>1.24</td>
<td>1.15</td>
<td></td>
</tr>
<tr>
<td>Fall Pregnancy</td>
<td>78</td>
<td>92*</td>
<td></td>
</tr>
<tr>
<td>Calf Vigor</td>
<td>1.1</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Calf ADG</td>
<td>1.63</td>
<td>1.74*</td>
<td></td>
</tr>
<tr>
<td>Calf WW</td>
<td>387</td>
<td>422*</td>
<td></td>
</tr>
</tbody>
</table>

After 1.5 h of stage II labor, every 30 min. delay in assistance results in a 6 day longer interval to pregnancy!!
Techniques to Reduce Calving Difficulty

- Calving problems occur when there is a discrepancy between the size of the pelvic canal of the female and the size of the calf.
- Two components
  - Birth weight EPD
  - Pelvic area

Influence of Nutrition

- Nutritional status and its influence on body condition score (BCS) and reproductive function has been well characterized.
- Basically, calve cows at a BCS of 5 and breed cows at BCS of 5.
- Recent data indicates that reproductive performance of young cows may be enhanced if we increase BCS at calving.

BCS and Reproductive Performance of Young Cows

<table>
<thead>
<tr>
<th>BCS</th>
<th>Preg n</th>
<th>Rate %</th>
<th>Days to n</th>
<th>Pregnancy days</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>73</td>
<td>65</td>
<td>47</td>
<td>92</td>
</tr>
<tr>
<td>5</td>
<td>157</td>
<td>71</td>
<td>100</td>
<td>82</td>
</tr>
<tr>
<td>6</td>
<td>120</td>
<td>87</td>
<td>96</td>
<td>74</td>
</tr>
<tr>
<td>7</td>
<td>73</td>
<td>91</td>
<td>61</td>
<td>76</td>
</tr>
</tbody>
</table>

Tools to Enhance Reproductive Performance

- Goal
  - Ideal = every cow calve on the first day of the calving season
  - Realistic = 60-70 day calving season, >90% calf crop weaned, 80% calve in the first 30 days
- Tools
  - Estrus synchronization
  - Short-term calf removal

Short-term Calf Removal

- Suckling is the major inhibitor to estrous cycles
- Calf-removal for 48 hours induces estrus in anestrous cows.

Response of Anestrous Postpartum Cows to Early Weaning

<table>
<thead>
<tr>
<th>Reference</th>
<th>n</th>
<th>Days Postpartum</th>
<th>Weaning to estrus (d)</th>
<th>% Short Estrous Cycles</th>
<th>Length of Short Estrous Cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odle et al., 1990</td>
<td>25</td>
<td>44 (19-61 d)</td>
<td>&lt; 10 d (80%)</td>
<td>81.3%</td>
<td>7 - 10 d</td>
</tr>
<tr>
<td>Smith et al., 1986</td>
<td>17</td>
<td>29.5 (26-33 d)</td>
<td>5 ± 1.5 d (100%)</td>
<td>88.8%</td>
<td>7 - 12 d</td>
</tr>
</tbody>
</table>
Estrus Synchronization

- Advantages:
  - enhances the percentage of cows that are in estrus early in the breeding season
  - shifts calving distribution
  - increases calf weaning weights
  - increases calf uniformity
- increases pregnancy rates
- nearly doubles pounds of calf weaned per cow exposed

Select Sync + CIDR & TAI

- Timed insemination (72 h) and GnRH for cows NOT in heat

Day of Treatment

Co Synch + CIDR + CR & TAI

"Kitchen Synch"
- Should provide maximal stimulus to anestrous cows
- Sum of stimulatory effects of progestin withdrawal, calf removal and + GnRH treatment

GnRH & TAI
(48-72 h)

Estrus Synchronization for Natural Service

Estrus Synchronization and Natural Service

Turn in bulls

MGA or CIDR

Tuesday

Turn in bulls

MGA or CIDR

Monday

Tuesday

Estrus Synchronization and Natural Service

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Numbers</th>
<th>Preg Rate</th>
<th>1st 30 d</th>
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<tr>
<td>Control</td>
<td>621</td>
<td>83</td>
<td>47</td>
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<td>MGA</td>
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<tr>
<td>Control</td>
<td>419</td>
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<tr>
<td>CIDR</td>
<td>421</td>
<td>91</td>
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</table>

Bull:Cow range from 1:23 to 1:42 (91% PR)
Keys to Managing Young Cows

- Breed yearling heifers to calve 20-30 days before the cow herd. Use heifers with acceptable pelvic sizes and breed to proven calving-ease bulls.
- Manage BCS of bred yearling heifers such that they calve with a BCS of at least 5, preferably 6. Supplementation of fat may enhance rebreeding performance.

Keys to Managing Young Cows

- Synchronize estrus.
- Manage first-calf heifers separate from mature cow herd. Feed supplements to maintain a BCS of at least 5 until WEANING! Alternatively, separate after weaning and add body condition from weaning until calving of second calf.
Presenters:

Dr. Les Anderson  
Extension Beef Specialist, University of Kentucky

Mr. David Cuddy  
Extension Animal Science Agent, Floyd County

Mr. Mark Davis  
Extension Animal Science Agent, Buckingham County

Mr. Rich Dietz  
Boehringer Ingelheim--Vet Medica

Dr. Scott Greiner  
Extension Beef/Sheep Specialist, Virginia Tech

Dr. John Hall  
Extension Beef Specialist, Virginia Tech

Dr. Patsy Houghton  
President and General Manager, Heartland Cattle Co.

Ms. Amanda Liles  
Graduate Student, Animal & Poultry Sciences, Virginia Tech

Ms. Jennifer Meade  
Scott County Cattlemen

Dr. Andy Meadows  
Springwood Livestock Management Services

Mr. Shelton Miles  
Amelia Area Cattlemen, LLC

Mr. Matt Miller  
Extension Farm Management Agent, Smyth County

Mr. Tom Nixon  
Central Virginia Cattleman’s Association

Mr. Jimmy Osborne  
Carroll-Grayson Cattle Producers Association

Mr. Bill Tucker  
Tucker Family Farms

Dr. Dee Whittier  
Extension Veterinarian, VA-MD Regional College of Veterinary Medicine