2024 Pacific Northwest Animal Nutrition Conference Proceedings

Developing beef heifers for the long run

Twig Marston
Field Beef Nutritionist
Hubbard Feeds, a division of Alltech Inc.
Manhattan, KS 66503
Tel: 785-551-3153
twig.marston@alltech.com

Introduction

Every commercial and seedstock beef operation depends on heifer development programs to maintain their cowherd populations. Most beef producers will either retain heifers that are produced on the ranch home grown or they purchase bred heifers from other operations. Therefore, heifer development is an integral part of the beef production chain and thus, has received much notoriety and attention because of its necessity and expense.

Most of the cow herd genetic progress is directed through the replacement heifers. The investment required to develop a beef female from weaning through first calving is substantial and can takes years of production to generate a return on this investment. It is imperative that beef heifers become pregnant early in the first breeding season, successfully calve as a 2-year-old with no assistance, breed back in a timely manner, and then continue to be productive for at least 4 to 6 more years (Patterson et al., 1992). Therefore, it is critical that replacement heifers be selected, grown, and managed for reproductive performance. Heifer development programs should put into practice the nutrition and management factors that will ensure that heifers are meeting targeted parameters that include age, growth, and sexual maturity.

Reproductive traits are generally considered lowly heritable. This means the environment will have a proportionately large influence on whether a female is either fertile or infertile. Of the many components of the environment, nutrition is always one of the most important factors that will either support or postpone sexual maturity and fertility in young females.

Defining a Successfully Development Program

Annually, the U.S. beef cow inventory will have about a 15 to 20 percent replacement rate (USDA APHIS, 2007). Reproductive failure is the major reason for culling cows. Culled cows must be replaced to maintain or expand herd size and they are usually replaced by heifers. Boyer and Delong (2020) reported the cost of raising or buying replacement heifers is a substantial investment for cattle operations and the new herd matrons may need to wean 4 to 6 calves before they become profitable.

Even though Patterson et al., 1992, defined a successful heifer development program as one that produces heifers which obtain puberty early, conceive at no later than 15 months of age, and deliver their first calf by their second birthday. Frist-calf females must also become pregnant during the first 21 days of the subsequent breeding season to favor their reproductive success to succeeding years of production. For this cascade of events to occur, heifers must be developed so that age, size, stature, and body composition allows ovarian and endocrine glands to be functional prior to the first breeding season (Rosasco et al., 2020). In older cows, Stevenson found that body condition was one of the most important factors indicating cows would be cycling at the start of the breeding season (Stevenson,

personal communication). Because the estrous cycle is 21 days long, daily observations of standing heat during the 30 to 45 days prior to a breeding season should equate to about 5% of the heifers. Producers should use both visual observations and actual body measurements to determine if heifer development is proceeding as needed.

This article will focus on the heifer developmental stage between weaning and first calving because this period largely influences when puberty, first pregnancy, and first parturition will occur. However, one should not underestimate epigenetics and its effect on female development and functions while in utero. Environmental effects experienced during the fetal stage and after first parturition have also been shown to affect animal productivity. Epigenetic studies (fetal programming) continue to investigate the environmental effects taking place during pregnancy which will change gene expression in offspring (Funston and Summers, 2013). Additionally, Oklahoma State University and Kansas State University researchers have found that nutrition driven weight loss or gain before and after parturition (regardless of age) will affect reproductive success.

Pre-weaning management

Research has shown the pre-weaning weight gain influences age at puberty more than post-weaning growth (Cardoso et., 2014; Roberts et al., 2017). Robert also reported that heifers born in the first 21 days of a calving season had a greater chance of reaching puberty prior to the breeding season. Using a stair-step feeding system, heifers weaned at four months of age and subsequently fed to a greater weight gain by seven months of age than contemporaries nursing their dams to seven months of age reached puberty at a younger age. The same study found heifers experiencing restricted weight gains from four to six months of age would respond favorably when fed for increased weight gain for the following 90 days improved the probability that they would by pubertal between 11 and 14 months of age. These results suggest that the timing of puberty can be achieved prior to the first breeding season by providing adequate nutrition allowing heifers to gain weight during their juvenile periods that let them reach their target weights.

Target Breeding Weight – Post-weaning Growth

First-breeding target weight calls for feeding heifers (in moderate body condition) to a body weight that represents a percentage of the heifer's projected mature weight (Yelich et al., 1991). Research has shown that successful target weights range from 55 and 65% of mature weight (Funston and Deutscher, 2004; Marston et al., 1994; Patterson et al., 1992). Several factors make this a difficult decision to make. First, the mature weight will need to be estimated when the heifers are only seven to fifteen months of age. Puberty can be expected to occur at a genetically predetermined age and size of a female (Lamond, 1970; USDA-MARC., 1982, Taylor and Fitzhugh, 1971) and only when heifers reach genetically predetermined target weights can high pregnancy rates be obtained. This also implies frame score (hip height), and weight are involved in determining the onset of puberty. This makes logical sense because puberty is expected to occur when age, size, body composition, and weight requirements are simultaneously met (Burg and Butterfield, 1976). Yelich et al. (1991), reported with heifers developed at different rates of weight gain from weaning to puberty began to cycle at a similar body condition score. In their study slow and moderate average daily gains allowed heifers to become pubertal after achieving a body condition score of 5.7. The treatment that supplied excessive caloric intake and caused body condition scores greater than 5.7 prior to the heifers genetically set minimum age of puberty did achieve puberty at the youngest age but at greater body fat percentage (greater body condition score).

2024 Pacific Northwest Animal Nutrition Conference Proceedings

A target weight at first parturition is another milestone that has been identified (DeRoune et al., 1994)... Thin and fat, first calf heifers show compromised dystocia scores and rebreeding rates when compared to moderate body condition contemporaries. Beef production literature suggests two-year-olds should weigh about 75 to 85% of mature weight prior to calving (Bolzes and Corah, 1991; Deroune et al., 1994; Diskin and Kenny, 2014: Marston et al. 1994).

Diet Selection and Feeding Management

There are many sources and combinations of feed ingredients and management systems that can be utilized to successfully develop replacement heifers. If enough forage resources are available, grazing plans, supplementation regimens, and harvested forage-based diets can be implemented. If forage resources are in short supply, then drylot and limit-feeding programs can be implemented to produce adequate weight gains (Funston et al., 2012; Marston et al., 1993; Marston et al., 1994; Rasasco and Moriel, 2022). Summarizing the results of numerous replacement heifer trials, it appears the practical approach to developing replacement heifers it to implement programs that allow heifer calves to have a moderate body condition score by 45-60 days prior to the start of their breeding season. This will allow them to be old enough, to be adequately grown in frame score and weight, along with having the proper body composition to become puberal and remaining cycling until first conception (Credille et al., 2023).

Conclusion

In conclusion, developing replacement heifers is an important segment of cowherd management Nutrition is one of the most influential segments of heifer development and deserves much attention a to planning and detailed implementation. From the beginning, nutrition is a component of epigenetics (in utero) and then continues throughout her lifetime as it will control body weight, rates of weight gain, and body composition (body condition score) and reproductive ability. Depending on the feed resources, feed availability, and feedstuff's nutrient composition, different heifer development programs can be designed and implemented to successfully develop herd replacements.

Literature Cited

Bolze, Ron, and Larry Corah. 1993. Selection and Development of Replacement Heifers. Kansas State University. Extension Rep. C-841.

Boyer C.N. and K.L. Delong. 2020. Reproductive failure and long-term profitability of spring- and fall-calving beef cows. J Agric Resour Econ. 45:78.

Burg, R.T. and R.M. Butterfield. 1976. New Concepts of Cattle Growth. Halsted Press, a Division of John Wiley & Sons, Inc., New York.

Cardoso, R.C., B.R.C. Alvas, L.D. Prezotto, J.F. Thorson, L.O. Tedeschi, D.H. Keisler, C.S. Park, M. Amstalden, and G.L. Williams. 2014. Use of a stair-step compensatory gain nutritional regimen to program the onset of puberty in beef heifers. J. Anim. Sci. 92:2942.

Credille Brent C., Jason D. Duggin, Arthur L. Jones, Grace Nyhuis, Pedro L.P. Fontes, R. Lawton Stewart Jr., and Roy D. Berghaus. 2023.Physical traits, performance data, and reproductive tract maturity score can be used to predict fertility and likelihood of early conception in beef replacement heifers consigned to a heifer development program in the southeastern United States. JAVMA 261:1193.

DeRoune, S.M., D.E. Franke, D.G. Morrison, W.E. Wyatt, D.F. Coombs, T.W. White, P.E Hunus, and B.B. Greene. 1994. Prepartum body condition and weight influences on reproductive performance of first calf beef cows. J. Ani. Sci. 72:1119.

Diskin, M.G. and D.A. Kenny. 2014. Optimising reproductive performance of beef cows and replacements heifers. Animal 8:27.

Funston, R.N., and A.F. Summers. Epigenetics: Setting up lifetime production of beef cows by managing nutrition. Annual Rev. Animal Biosciences 1:339.

Funston, R.N., and G.H. Deutscher. 2004. Comparison of target breeding weight and breeding date for replacement beef heifers and effects on subsequent reproductive and calf performance. J. Ani. Sci. 82:3094.

Lamb, G.C. 2013. Criteria for selecting replacements at weaning, before breeding, and after breeding. Vet Cli North Am Food Anim Pract. 23:567.

Lamond, D.R. 1970. The influence of undernutrition on reproduction in the cow. Anim. Breed. Abstr. 38:359.

Marston, T.T. K.S. Lusby, and R.P. Wettermann. 1994. Development of heifers on range or range-programmed feeding. Ok. Agric. Exp. Stat. Res. Rept. p 99.

Marston, T.T., K.S. Lusby, and R.P. Wettemann. 1993. Effects of different supplements and limited-drylot feeding on replacement heifer development. Ok. Agric. Exp. Stat. Res. Rept. p 100.

National Academies of Sciences, Engineering, and Medicine (NRC). 2016. Nutrient requirements of beef cattle, Eighth revised edition. Washington DC: The National Academies Press, DOI: 10.17226/19014.

Patterson, D.J. R.C. Perry, G.H. Kiracofe, R.A. Bellows, R.B. Staigmiller, and L.R. Corah. 1992. Management considerations in heifer development and puberty. J. Amin. Sci. 70:4012.

Roberts, A.J., A Comes da Silva, A.F. Summers, T.W. Geary, and R.N. Funston. 2017. Development and reproductive characteristics of beef heifers classified by pubertal status at time of first breeding. J. Anim. Sci. 95:5629.

Rosasco, S.L., E.A. Melchior, S.H. Cox, R.L. Dunlap, J.A. Hernandez Gifford, E.J. Scholljegerdes, R.A. Cushman, and A.F. Summers. 2020. Effect of stair-step nutritional programming on ovarian development in replacement beef heifers. Transl. Anim. Sci. 4: S32.

Rosasco, Shelby and Philipe Moriel. 2022. Nutritional strategies for developing Replacement *Bos taurus* and *Bos indicus*-influenced beef heifers. Proceedings, Appl. Repro. Stat. in Beef Cattle, San Antonio, TX.

Stevenson JS, Johnson SK, Milliken GA. 2003. Symposium Paper: Incidence of postpartum anestrus in suckled beef cattle: Treatments to induce estrus, ovulation, and conception. Prof Anim Sci: 19:124-134.

Summers, A.F., S.L. Rosasco, and E.J. Scholljegerdes. 2019. BEEF SPECIES-RUMINANT NUTRITION CACTUS BEEF SYSPOSIUM: Influence of management decisions during heifer development on enhancing reproductive success and cow longevity. J. Ani. Sci. 97:1407.

Taylor, St. C.S., and H.A. Fitzhugh, Jr. 1971. Genetic relationships between mature weight and time taken to mature within a breed. J. Ani. Sci. 33:726.

USDA APHIS, Animal Health. 2007. NAHMS Beef Cow-Calf Studies. Part II. Reference of Beef Cow-Calf Management Practices in the United States.

USDA Meat Animal Research Center. 1982. Beef Research Program, Progress Report No. 1.

Varner, L.W., R.A. Bellows, and D.S. Christensen. 1977. A management system for wintering replacement heifers. J. Ani. Sci. 44:165.

Yelich, J.V., R.P. Wettemann, K.S. Lusby, H.G. Dolezal, and D.K. Bishop. 1991. Influence of growth rate on body composition of beef heifers at puberty. Ok. Agric. Exp. Stat. Res. Rept. p 48.