Replacement Heifer Development Programs

Megan S. Hindman, DVM
Terry J. Engelken, DVM MS

College of Veterinary Medicine
Iowa State University
Ames, IA
engelken@iastate.edu

Abstract:

The replacement heifer represents the next generation of genetic progress for the cow herd. Producers invest a substantial amount of capital in these females, even if they fail to become pregnant. In order to get a return on this investment, it is imperative that these heifers become pregnant early in the first breeding season, calve with a minimum of dystocia, breed back in a timely fashion, and then continue to be productive for a number of years. Therefore, it is critical that replacement females be selected, grown, and managed to ensure adequate reproductive performance. This presentation will highlight the critical points associated with heifer development programs that ensure that these females are meeting a set of performance parameters.

Keywords: Heifer, Puberty, Economics, Nutrition

Introduction

Annual replacement rates of 14.9% make intensive management of replacement heifers a requirement for cow-calf producers.[1] Well programed replacement heifers are a vital component of cattle herds nationwide. Herds may become desolate and obsolete with old genetics and have a decrease in reproductive efficiency without quality replacement heifers. A significant amount of capital goes into purchasing or raising replacements. Making the selection process of a quality

replacement heifer, ever more important. Veterinarians can provide a value added service to farmers and ranchers when developing replacement heifers.

Economics

There are two options to introduce replacement heifers to a herd: purchase externally or retain from within. Farmers and ranchers may choose to purchase, if there is a concern of overall lack of genetic diversity or lacking facilities to develop their own replacements. An example of why purchasing may lead to herd genetic improvements can include selecting for traits such as heifer puberty age, growth rate, and calving ease.[2] The advantage to retaining genetics from within the herd resides in the fact that in most cases, production costs are lower.[3] The greatest cost associated with producing a replacement heifer is the lost income when she joins the replacement pool (rather than being sold). The costs associated with nutritional management is the next most expensive part of the developmental phase.[4] Feeding costs can fluctuate based on land availability, season, and grain prices yearly. Partial budget analysis for feedstuff can be beneficial to determine a break even for raising replacement heifers versus purchasing heifers. Table 1 illustrates the cost summary to produce a replacement heifer.

Weaning Selection

The ultimate goals for replacement heifers include:

1. Reach puberty at approximately 12-15 months of age
2. Conceive in the first 21 days of breeding season
3. Calve without dystocia
4. Breed back in a timely manner the following year

To achieve these goals it is important to focus on selecting appropriate replacement heifers for the individual herd. Weaning is the initial time point for this selection process. Calves born in earlier groups traditionally weigh more at weaning compared to calves born in later groups.[5] Heifer calves born in the first 21 days of spring calving season had a greater weaning, pre-breeding, and pre-calving body weight.[6] A greater percentage of these heifers were cycling and had greater pregnancy rates compared with heifers born in the third period. This could be attributed to the common practice of weaning a group of calves at the same time. Older calves innately weigh more than younger calves and weight and age are two of the main factors in reaching puberty in cattle. Selecting for the historical performance of the dam is an important tool aiding for the selection for superior genetics in the herd. Heifers born from multiparous dams have been shown to have higher antral follicle counts, which equivalents to a greater reproductive longevity compared to heifers born from primparous dams.[7] Milking ability, fertility, calving ease, temperament, and weaning weight are all economically important traits that should be considered when looking at the dams. Cows that consistently calve in the first 45 days of the calving indicate they "fit" the management scheme and forage base of the ranch. Selection of replacements from these females should be emphasized. Structural correctness is also important in the selection process to minimize early culling and improve longevity in the herd.

Nutrition

Appropriate nutrition is a large contributing factor to the economics of raising replacement heifers. An adequate nutrition plane must be obtained to conceive and maintain a pregnancy. On average heifers after weaning should gain 0.57 - 0.8 kg/day in order to reach a target mature body weight prior to breeding. Creep feeding prior to weaning and after can provide extra

nutrients in order to obtain mature body weight efficiently. Typical target mature body weight percentage has been documented from 53-65% in order to reach puberty prior to breeding. Table 2 provides a summary of previous studies comparing target mature weight and pregnancy rates in replacement heifers.[8-16] The benefit of using a target of 55% of mature body weight resides in the fact that it allows producers to use lower quality feedstuff or grazing without supplementation to lower feed costs. An additional way to lower feed costs, increase the ovarian reserve, and increase reproductive longevity is to provide a single stair step ration from weaning until breeding.[17] This has shown to improve reproductive performance compared to uniform ration with no caloric increase prior to breeding. Ionophores and growth-promoting implants are two tools to increase feed efficiency and lowering overall feed costs when used appropriately. Ionophores, such as lascosolid and monensin can be fed at 60-300 mg/hd/day and 200 mg/hd/day respectively.[18-19] Ionophores function to increase feed efficiency and controls coccidiosis. Implants have anabolic steroids present, and are looked at as an effective tool for increase weight gain in animals intended for market. It is important to select a labeled implant for replacement heifers as to not disturb or overlook reproductive maturity while trying to achieve an increase in weight gain. Health management during heifer development should include appropriately timed vaccinations and anthelmintic administration before and after weaning. Vaccinations should be targeted toward reproductive diseases and prevalent diseases on farm to optimize growth rate and reproductive potential.

Pre-Breeding

The second replacement heifer selection point occurs 30-60 days prior to breeding. At this time reproductive tract scores, frame scores, pelvic area measurements, body condition scores (BCS), and body weights are collected. Research has shown heifers bred on their third estrus have a

higher first service to conception rate compared to heifers bred on their pubertal estrus.[20] Reproductive tract scoring (RTS) is a tool veterinarians can use to determine if a heifer is cycling. These systems typically assign a score to the heifer's tract by evaluating uterus size, horn diameter, and ovarian structures present. RTS is used to estimate pubertal status in individual heifers and predict heifer reproductive performance.[21] Information obtained by RTS can be related to body weight and used to adjust feeding program to ensure heifers are cycling prior to estrus synchronization and insemination. Frame scores provide an acceptable way to predict estimated body weight. It also provides information to cull large frame scores and small frame scores lowering the standard deviation between heifers. Pelvic area measurements allows the veterinarian and producer to identify abnormally small heifers and make culling and breeding decisions. Body condition scores and weights are important to evaluate current nutrition strategy to make adjustments post breeding and for future heifer developmental groups. Recent studies have looked at antral follicle counts in replacement heifers as an indicator of fertility and reproductive longevity.[22,23] Antral follicle counts are determined by ultrasonography and are considered highly repeatable even if heifers are at different stages of their estrous cycle. Selecting for bulls with low birthweight and calving ease in combination with a large scrotal circumference, will allow for a smaller return to estrous window and future progeny reaching puberty earlier.[24] Progestin based synchronization protocols show a benefit compared to other synchronization protocols because they provide a primer to prepubertal heifers to induce puberty.[25]

Breeding-Post Breeding

Heifers need to calve at 80-85% of their mature body weight with an average BCS of 5.5-6. Heifers calving too light or too heavy are at an increased risk for dystocia, longer postpartum

interval, and a lower pregnancy rate for subsequent breedings. Nutrition post calving needs to incorporate appropriate protein and energy based on NRC guidelines.[26] As gestation progresses the caloric intake should increase due to an increase in demand and growth rate of the fetus. Research shows nutrition has an impact in fetal programming during gestation.[27] Pregnancy detection at 60-70 days post AI or bull turnout is ideal to determine conception, allowing for better timing in parturition, sire determination, and to make culling decisions if failure of conception occurs. By detecting pregnancy under 150 days post breeding, fetal age can be determined by 10-20 days of gestational age window. Additional data can be obtained by pregnancy evaluation by determining sex of fetus at 60-90 days gestational age, presence of twins, and fetal viability. Sex determination could allow for increase market value for the fetus if selling a bred heifer as well as adequate planning on the future of the replacement herd. Presence of twins allows for preparation of parturition and can be used to make culling decisions. Fetal viability can be assessed by evaluating the heartbeat of the fetus to determine if it is viable. Overall pregnancy determination not only gives an accurate prediction of parturition timeline, it also provides economic value to prevent waste feed costs by making culling decisions early in gestation on replacement heifers if not calving in the first 21 day window. Additional health program pre-parturition to consider is vaccinations. Vaccinations pre-calving may provide extra immunity to the calf after parturition, such as tetanus and scour vaccinations.

Replacement heifers represent a large capital investment for cow/calf producers. Monitoring at critical time points will ensure proper development and so culling decisions can be made early can reduce overall development waste. Heifer development programs need to optimize development costs, female growth rate, and reproductive efficiency. This will ensure new females match the cow/calf herd's predominant forage base and management plan to ensure for

reproductive longevity. Veterinarians have a unique opportunity to provide value added service in all aspects of heifer development to ensure the future of their client's herds.

Conflict of Interest:

Authors has no conflicting interests at this time.

References

1. University ND. Cow Herd Appraisal Performance Software 2000. 2018.
2. Martin LC, Brinks JS, Bourdon RM, Cundiff LV. Genetic effects on beef heifer puberty and subsequent reproduction. Journal of Animal Science. 1992;70(12):4006-17.
3. Hagerman AD, Thompson JM, Ham C, Johnson KK. Replacement Beef Cow Valuation under Data Availability Constraints. Front Vet Sci. 2017;4:185-.
4. Hughes H. Raised Replacement Heifers: Some Economic Considerations. Veterinary Clinics of North America: Food Animal Practice. 2013;29(3):643-52.
5. Lesmeister JL, Burfening PJ, Blackwell RL. Date of First Calving in Beef Cows and Subsequent Calf Production. Journal of Animal Science. 1973;36(1):1-6.
6. Funston RN, Musgrave JA, Meyer TL, Larson DM. Effect of calving distribution on beef cattle progeny performance. Journal of Animal Science. 2012;90(13):5118-21.
7. Tenley SC, Gomes RS, Rosasco SL, Northrop EJ, Rich JJJ, McNeel AK, et al. Maternal age influences the number of primordial follicles in the ovaries of yearling Angus heifers. Animal Reproduction Science. 2019;200:105-12.
8. John B. Hall and J. Benton Glaze J. Heifer Nutritional Developmental Strategies. Applied Reproductive Strategies in Beef Cattle. 2017:116-35.
9. Patterson DJ, Perry RC, Kiracofe GH, Bellows RA, Staigmiller RB, Corah LR. Management considerations in heifer development and puberty. Journal of Animal Science. 1992;70(12):4018-35.
10. Funston RN, Deutscher GH. Comparison of target breeding weight and breeding date for replacement beef heifers and effects on subsequent reproduction and calf performance1. Journal of Animal Science. 2004;82(10):3094-9.
11. Martin JL, Creighton KW, Musgrave JA, Klopfenstein TJ, Clark RT, Adams DC, et al. Effect of prebreeding body weight or progestin exposure before breeding on beef heifer performance through the second breeding season1. Journal of Animal Science. 2008;86(2):451-9.
12. Roberts AJ, Geary TW, Grings EE, Waterman RC, MacNeil MD. Reproductive performance of heifers offered ad libitum or restricted access to feed for a one hundred forty-day period after weaning1. Journal of Animal Science. 2009;87(9):3043-52.
13. Eborn DR, Cushman RA, Echternkamp SE. Effect of postweaning diet on ovarian development and fertility in replacement beef heifers1. Journal of Animal Science. 2013;91(9):4168-79.
14. Mulliniks JT, Hawkins DE, Kane KK, Cox SH, Torell LA, Scholljegerdes EJ, et al. Metabolizable protein supply while grazing dormant winter forage during heifer development

alters pregnancy and subsequent in-herd retention rate. Journal of Animal Science. 2013;91(3):1409-16.
15. Lardner HA, Damiran D, Hendrick S, Larson K, Funston R. Effect of development system on growth and reproductive performance of beef heifers1,2. Journal of Animal Science. 2014;92(7):3116-26.
16. Bailey BL, Griggs TC, Rayburn EB, Krause KM. Beef heifer growth and reproductive performance following two levels of pasture allowance during the fall grazing period1. Journal of Animal Science. 2014;92(8):3659-69.
17. Amundson OL, Fountain TH, Larimore EL, Richardson BN, McNeel AK, Wright EC, et al. Postweaning nutritional programming of ovarian development in beef heifers1,2. Journal of Animal Science. 2015;93(11):5232-9.
18. Purvis HT, II, Whittier JC. Effects of ionophore feeding and anthelmintic administration on age and weight at puberty in spring-born beef heifers. Journal of Animal Science. 1996;74(4):736-44.
19. States ZU. Bovatec 2018 [Available from: https://www.zoetisus.com/contact/pages/product_information/msds_pi/pi/Bovatec_91.pdf.
20. Byerley DJ, Staigmiller RB, Berardinelli JG, Short RE. Pregnancy Rates of Beef Heifers Bred Either on Puberal or Third Estrus. Journal of Animal Science. 1987;65(3):645-50.
21. Holm DE, Thompson PN, Irons PC. The value of reproductive tract scoring as a predictor of fertility and production outcomes in beef heifers1. Journal of Animal Science. 2009;87(6):1934-40.
22. Cushman RA, Allan MF, Kuehn LA, Snelling WM, Cupp AS, Freetly HC. Evaluation of antral follicle count and ovarian morphology in crossbred beef cows: Investigation of influence of stage of the estrous cycle, age, and birth weight1,2. Journal of Animal Science. 2009;87(6):1971-80.
23. Ireland JLH, Scheetz D, Jimenez-Krassel F, Themmen APN, Ward F, Lonergan P, et al. Antral Follicle Count Reliably Predicts Number of Morphologically Healthy Oocytes and Follicles in Ovaries of Young Adult Cattle1. Biology of Reproduction. 2008;79(6):1219-25.
24. Engelken TJ. Developing replacement beef heifers. Theriogenology. 2008;70(3):569-72.
25. Leitman NR, Busch DC, Bader JF, Mallory DA, Wilson DJ, Lucy MC, et al. Comparison of protocols to synchronize estrus and ovulation in estrous-cycling and prepubertal beef heifers1. Journal of Animal Science. 2008;86(8):1808-18.
26. Larson RL, Randle RF. CHAPTER 59 - Heifer Development: Nutrition, Health, and Reproduction. In: Youngquist RS, Threlfall WR, editors. Current Therapy in Large Animal Theriogenology (Second Edition). Saint Louis: W.B. Saunders; 2007. p. 457-63.
27. Martin JL, Vonnahme KA, Adams DC, Lardy GP, Funston RN. Effects of dam nutrition on growth and reproductive performance of heifer calves1. Journal of Animal Science. 2007;85(3):841-7.

Table 1 Projected cost summary for developing a raised heifer based on 2013	
Period 1: Conception to weaning	$881
Period 2: Weaning to breeding	$341
Period 3: Breeding to pregnancy diagnosis	$153
Sub total	$1375
Adjust for 85% heifer conception rate	$1618
Adjust from cull heifer credit[a]	$1418
Calculated heifer development costs (born 2013)	$537

[a]assumes 431 kg heifer at $3.08/kg=$1328.60 x .15= $199.26

Source: Hughes H. Raised Replacement Heifers: Some Economic Considerations. Veterinary Clinics of North America: Food Animal Practice. 2013

Table 2. Summary impact of target weight on pregnancy rates in replacement heifers			
	Target weight* of (% of Mature weight)		
Study	No. Heifers	55	65
Patterson et. al., 1992	137	84%	89%
Funston and Deutcher 2004	240	92%	88%
Martin et. al., 2008[a]	261	87%	90%
Roberts et. al., 2009	397	87%	92%
Eborn et. al., 2013	360	77%	83%
Mulliniks et. al. 2013	191	91%	84%
Lardner et. al., 2014	176	86%	88%
Bailey et. al, 2014	203	74%	77%

*65: Range 58-65% and 55: Range 48-56%

[a]55=50% and 65%=56%

Source: John B. Hall and J. Benton Glaze J. Heifer Nutritional Developmental Strategies. Applied Reproductive Strategies in Beef Cattle. 2017:116-35.

Conflict of Interest: The author has no conflicts to report