

Management and Economic Considerations in Dairy Heifer Development

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Introduction

The purpose of the heifer herd is to provide replacements for cows leaving the herd and to improve genetic progress. First-lactation cows significantly contribute to herd production and profit. A recommended goal for dairy replacement heifers is to calve at 24 months of age with a targeted post-calving body weight of 1,250 pounds. A common misconception is that this goal is either unattainable or uneconomical. Feeding heifers for rapid gains costs more per day than feeding for low gains; however, development of replacement heifers is an investment in the future. The replacement heifer program should rear heifers to reach a desired age and body weight at a minimum cost.

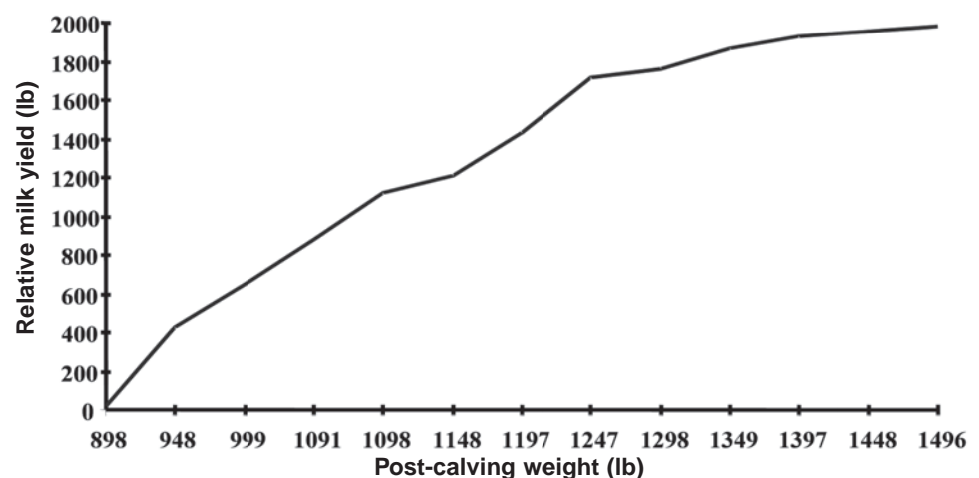
Why 1,250 Pounds?

Why should producers strive for a target weight of 1,250 pounds after

calving? A large field study conducted from 1980 to 1984 involving Holstein records found that heifers calving between 1,195 to 1,250 pounds had the greatest first-lactation milk yield (Keown and Everett, 1986). The importance of achieving calving weight goals is illustrated by the dramatic decline in milk yields when post-calving weights were below 1,100 pounds (Figure 1). A first-lactation cow that weighs 1,250 pounds produces 1,775 pounds more milk than a first-lactation cow calving with a weight of 900 pounds or less. Calving weight had a greater impact on first-lactation performance than did calving age, suggesting heifers should be bred by weight not age.

Over 50,000 DHIA records were evaluated to determine the relationships between age at first calving, post-calving body weight and first-lactation milk yield (Bethard, 1997).

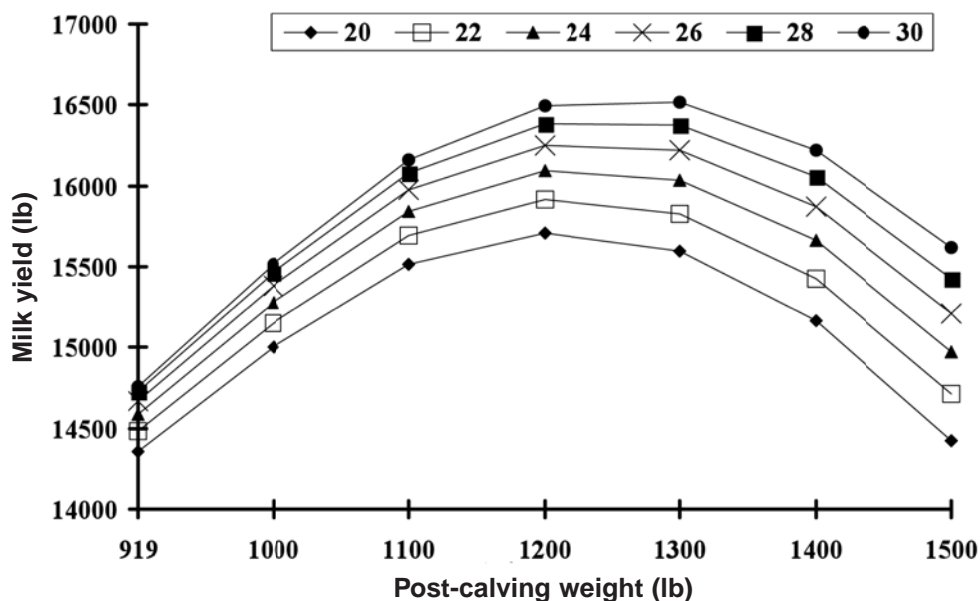
FIGURE 1. Effect of post-calving body weight on relative milk yield during first lactation (adapted from Keown and Everett, 1986)



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FIGURE 2. Prediction of first-lactation milk yield for Holstein heifers at varied body weight for 20-, 22-, 24-, 26-, 28- and 30-month calving age



Optimum first-lactation milk yield occurred when post-calving body weight was approximately 1,200 to 1,300 pounds, independent of calving age (Figure 2). Heavier heifers produce more milk than smaller heifers because they have less growth remaining to reach mature body size, so nutrients can be used for milk production instead of growth. Smaller heifers may have reduced feed intake at the feed bunk due to the competition of heavier, more aggressive heifers. Milk yields declined (Figure 2) when post-calving body weight exceeded 1,300 pounds, suggesting that overconditioned heifers have reduced milk yields. Fat heifers may be predisposed to fatty liver, which may lead to ketosis and reduced feed intake. Overconditioned heifers have reduced lactation performance and a higher incidence of calving difficulty. These results support the recommended 1,200- to 1,250-pound post-calving target weight. It is important to remember that a 1,200- to 1,250-pound post-calving weight translates to a 1,300- to 1,350-pound pre-calving weight.

Why 24 Months?

It is well established that heifers should be between 23 to 26 months of age at first calving. Heifers that calve early spend more of their life producing milk than heifers that calve late. A large investment (\$1,150 to \$1,200) is required to rear heifers from birth to calving and \$55 to \$65 per month thereafter. The earlier heifers enter the milking herd, the sooner the return on the initial investment. Increased age at first calving dramatically increases herd costs. An extra day to first calving is estimated to cost 13 times as much as an extra day open (Cady and Smith, 1996). Delayed calving can

increase rearing costs \$50 per heifer for each month beyond 24 months. The number of replacements needed to maintain herd size increases when calving is delayed (Table 1). Assuming a 30 percent cull rate, increasing age at first calving from 24 to 28 months results in 11 percent more heifers needed to maintain herd size, or 11 more heifers on a 100-cow dairy. Alternatively, decreasing age at first calving from 28 to 24 months results in 11 surplus heifers that can be sold. Heifers should calve between 22.5 and 23.5 months of age to maximize lifetime performance.

What About 21 Months?

Calving before 21 months may be a risky option due to problems associated with rapid growth. Since calving weight, not calving age, is the major factor affecting first-lactation milk yield, successfully calving heifers at 21 months would require daily gains near 2.0 pounds/day from birth to calving for large breed heifers. To reduce calving age to 21 months, age at first breeding must be reduced to 11 to 12 months, which would require excessive prepubertal gains to achieve breeding weight goals. Body weight gains in excess of 2.0 pounds/day may be detrimental to mammary development in heifers under 12 months of age.

Attaining 1,250 Pounds in 24 Months

Heifers must gain an average of 1.7 to 1.8 pounds daily from birth to calving to achieve a pre-calving weight of 1,350 pounds. Overall feeding cost from weaning to calving is less when heifers are fed to gain 1.7 pounds/day compared with heifers gaining 1.3 or 1.5 pounds/day. Remember, a 1,250-pound post-calving weight translates to about a 1,350-pound

TABLE 1. Effect of age at first calving and culling rate on numbers of replacements needed to maintain a herd size of 100

Culling Rate (%)	Age at First Calving (months)							
	22	24	26	28	30	32	34	36
20	40	44	48	51	55	59	62	66
22	44	48	52	56	61	65	69	73
24	48	53	57	62	66	70	75	79
26	52	57	62	67	72	76	81	86
28	56	62	67	72	77	82	87	92
30	61	66	72	77	82	88	94	99
32	65	70	76	82	88	94	100	106
34	69	75	81	87	94	100	106	112

pre-calving weight. This goal is attainable with intensive management, even with less than optimal facilities and feed quality.

Weaning to Breeding

Age at onset of puberty is positively related to body weight. Sexual maturity of Holstein heifers begins at approximately 550 to 650 pounds independent of age. Consequently, nutrition has a dramatic impact on age at puberty and first breeding. Too little or too much body weight gain during this period of growth is a problem.

Low body weight gains pose a problem.

Decreased weight gain before breeding is an obvious problem because it delays puberty, breeding and calving. Average daily gains between 1.5 and 1.7 pounds are needed to achieve a breeding weight goal of 800 pounds at 14 months of age for large breed heifers. Therefore, average daily gains below 1.5 pounds for large breed heifers are unacceptable and costly because of delayed sexual maturity.

Rapid body weight gains are risky. Gains greater than 2.0 pounds/day for large breed heifers prior to puberty are risky. Holstein heifers fed diets to gain 2.8 pounds/day had larger mammary glands but less total secretory tissue, due to increased mammary fat tissue, than heifers gaining 1.4 pounds/day. Growth rate did not influence mammary composition when similar treatments were applied to post-pubertal heifers. Prepubertal heifers gaining 2.2 pounds/day between 19 and 39 weeks of age had decreased (7.1 percent) first-lactation, fat-corrected milk compared with heifers gaining 0.9 pound/day (Lammers et al., 1999).

Excessive prepubertal gains may reduce milk yield during the first and later lactations due to a lack of secretory tissue in the mammary gland. However, critics argue that heifers in these studies were fed

for an unusually high rate of gain, approaching that of feedlot cattle. Research consistently supports the theory that rapid prepubertal gains impair mammary development, although gains are greater than the normal range in many studies. Limited research suggests no relationship between rapid prepubertal weight gains and impaired mammary development when high crude protein diets are fed. Further research is needed to recommend rates of gain exceeding 1.8 pounds/day for prepubertal dairy heifers. The recommendation for average daily gains for growing dairy heifers prior to puberty is between 1.5 to 1.8 pounds/day.

Breeding Age Heifers

An ideal time to evaluate heifers for body weight, wither height and body condition is at breeding. Other than the preweaning period, this is one of the few times when heifers are observed closely. Heifers need to be bred in a timely fashion (14- to 15-month average age at first breeding) to achieve a successful replacement program.

Conception by 14 to 15 months is necessary if heifers are to calve by 23 to 26 months of age. Heifers need to gain weight (1.5 to 2.0 pounds/day) and have adequate body condition to achieve high conception rates. Rations should be balanced in energy (64 to 68 percent TDN) and protein (13 to 15 percent).

Conception problems occur when heifers experience weight loss or are in poor body condition. Balancing rations is critical to avoid these problems. Research has shown that heifers experience a body weight loss of up to 60 pounds for a one- to two-month period after leaving a confinement facility and moving to pasture. Increased exercise on pasture may reduce energy available for growth. Therefore, breeding should occur before leaving confinement or two months after entering pasture to avoid breeding problems.

Breeding to Calving

Animals with the lowest priority on a dairy farm are usually the bred heifers. This group does not require the management intensity of younger heifers. Calving dates have already been set, so the major goal is for heifers to gain sufficient body weight to achieve desired calving weight and body condition. Average daily gain must be 1.7 to 2.1 pounds during gestation if heifers were bred at 750 to 850 pounds. Body weight gains above 2.0 pounds/day are acceptable for bred heifers during the first six to seven months of gestation. Body weight gains in excess of 2.0 pounds/day should be avoided one to two months prepartum to prevent calving and postpartum problems because fetal and mammary growth are accelerated during this time. Also, excessive body condition (> 4.0 on a 5-point scale) at calving can lead to postpartum health problems.

Monitor Gains

It is essential that body weight gains and wither heights of heifers are monitored due to the narrow window of recommended gains (1.5 to 1.8 pounds/day).

A scale or weight tape and a wither height stick should be available to periodically monitor heifer performance at all ages. At a minimum, heifers should be weighed every time they are worked (deworming, vaccination, breeding, etc.). Recommended body weights and wither heights for growing heifers at various ages are indicated in Table 2. Heifers that achieve body weight goals but are lacking in wither height likely have excessive body condition. Body condition may be difficult to objectively measure, particularly in younger heifers.

An alternative to visual scoring is to calculate a wither height index (pounds body weight/inches of wither height) to estimate body condition. The subjectivity and bias of body condition scoring are avoided with wither height indices. Average wither height indices for a group of heifers should be similar to those in Table 2. Monitoring groups, not individuals, is recommended due to the large variation among heifers. If wither height indices are low, indicating poor body condition, rations should be evaluated to assure nutrient intake is adequate. A common cause of high wither height indices (excessive body condition) is a diet deficient in protein but excessive in energy. Many corn silage based diets are in this category.

TABLE 2. Recommended ranges of body weight, wither height and wither height index for Holstein heifers

Age (months)	Body Weight (pounds)	Wither Height (inches)	Wither Height Index ¹ (pounds/inch)
1	130-135	31.7-33.2	4.1-4.2
2	177-189	33.5-35.2	5.3-5.4
3	226-244	35.2-37.1	6.4-6.6
4	275-299	36.9-38.8	7.4-7.7
5	323-354	38.4-40.4	8.4-8.8
6	372-408	39.8-42.0	9.3-9.7
7	420-463	41.1-43.3	10.2-10.7
8	469-518	42.3-44.5	11.1-11.6
9	518-572	43.4-45.7	11.9-12.5
10	566-627	44.0-46.7	12.9-13.4
11	615-682	45.4-47.6	13.5-14.3
12	664-737	46.3-48.5	14.3-15.2
13	712-791	47.1-49.3	15.1-16.1
14	761-846	47.8-50.0	15.9-16.9
16	858-956	49.0-51.2	17.5-18.7
18	956-1,065	50.2-52.1	19.0-20.4
20	1,053-1,174	51.0-53.0	20.6-22.2
22	1,150-1,284	51.7-55.0	22.2-23.3
24	1,247-1,393	52.2-56.5	23.9-24.7

¹Pounds of body weight/inches of wither height

Rations

Rations formulated to attain 1.8 pounds gain/day will be adequate to achieve the pre-calving target of 1,350 pounds at 24 months. Three example heifer rations are shown in Table 3. These rations assume that forage quality is average and grain supplementation does not exceed 3.7 pounds/day. High-quality forages would require less grain supplementation. Large quantities of grain are not needed to achieve high rates of gain. Feed costs can be reduced with pasture without decreased daily gains. To achieve high rates of gain, pastures must be managed intensively. Rotational grazing can allow heifers to continually consume immature, high-quality forage. Mature grasses are lower in quality and will result in lower gains. The important component is ration balancing, or supplying nutrients in the proper proportions. A ration balanced in energy and protein will promote high rates of lean gain. However, a ration high in energy but deficient in protein may result in high gains, but with excessive condition. Therefore, rations need to be periodically evaluated, similarly to the lactating cow rations.

All three of the rations contain a mineral with ionophores, either Bovatec™ or Rumensin™. Ionophores improve energy metabolism and protein utilization in the rumen, resulting in improved gains and/or feed efficiency. Additionally, ionophores have coccidial properties when fed at recommended dosages (200 mg/day) and are inexpensive to supplement (about 1.2 cents/day).

Economics of 1,250 Pounds at 24 Months

The bottom line for the heifer replacement enterprise is profitability. The benefits of a 1,250-pound post-calving weight at 24 months must

outweigh the production costs to be profitable. Two questions must be answered: (1) Is it profitable to feed for a 1,250-pound post-calving weight? (2) For a target calving weight, is it profitable to decrease calving age to 24 months or less?

Is It Profitable to Feed for a 1,250-Pound Post-Calving Weight?

The benefit of achieving 1,250-pound post-calving weight is increased first-lactation milk yield. The increased milk yield should pay for the increased feed costs. Body weight and total feed cost increase as average daily gain increases. Heifers with post-calving body weight of 1,250 pounds have increases in first-lactation milk yield of approximately 1,000 pounds compared with heifers with a post-calving weight of less than 950 pounds. Therefore, it would be profitable to achieve a post-calving weight of 1,200 to 1,250 pounds. However, there is little benefit and possibly harm in post-calving weights exceeding 1,300 pounds.

Is it Profitable to Decrease Calving Age to 24 Months or Less?

Decreasing age at first calving decreases total feed costs from birth until calving, assuming a similar pre-calving weight. Although early-calving heifers will have a higher feed cost per day, total feed costs until calving are lower. This alone is an economic incentive to decrease first calving age because milk yields should be similar if body weights are similar. Decreasing first calving age will also increase surplus heifers available to sell (Table 1). Heifers that calve early return income (milk sales) sooner than later-calving heifers. Considering all the advantages, there is little doubt that reducing age at first calving is profitable. However, calving ages less than 22 months may not be feasible due to the excessive prepubertal gains required.

TABLE 3. Rations for 600-, 800- and 1,000-pound Holstein heifers gaining 1.8 pounds/day

Ration Component	Heifer Weight (pounds)		
	600	800	1,000
Corn silage ¹ , pounds (as fed)	15.0	18.0	20.0
Grass hay ² , pounds (as fed)	8.0	10.0	12.0
Shelled corn, pounds (as fed)	1.0	1.5	1.5
48% soybean meal, pounds (as fed)	2.0	2.0	2.2
2:1 mineral, pounds (as fed)	0.1	0.1	0.1
CP, % of DM	14.4	13.5	13.4
TDN, % of DM	64.7	64.5	64.0
ADF, % of DM	31.6	32.0	32.7

¹Corn silage: 67% TDN, 7.5% CP, 28% ADF, 38% DM

²Grass hay: 55% TDN, 10.4% CP, 45% ADF, 87% DM

CP: Crude protein

DM: Dry matter

TDN: Total digestible nutrients

ADF: Acid detergent fiber

Raising Versus Purchasing Heifers

Many factors should be considered in the decision to raise replacement heifers on-farm, contract raise or purchase.

On-farm. One advantage of raising heifers on the farm is maximum control of heifers, which reduces the biosecurity risks. Further, management and genetic makeup of the animals are known. Disadvantages include additional labor and, if not already on the dairy operation, additional facilities may be required.

Contract raising. The advantage of contracting heifers for rearing to a custom heifer grower is that it frees up facilities and labor. Further, the genetics of the heifers are known and biosecurity risks are generally decreased compared to purchasing heifers. Current cash flow and overall availability of capital on the dairy may be increased if the grower purchases the heifers and the original owner pays later when the heifers are near calving. Loss of management control and quality of management could be major drawbacks to contract raising of heifers. Strict guidelines for rearing the heifers should be outlined in the contract prior to heifer delivery to the grower.

Purchasing. The primary advantage of purchasing heifers as needed is that it frees capital, facilities and labor so the dairy producer can concentrate on the milking herd. However, disadvantages of purchasing heifers include the availability of quality replacement heifers, the biosecurity risk associated with bringing animals into the herd, the time required to acquire heifers and often the risk of paying higher prices for the heifers. Historically, heifers of high quality are sometimes in limited supply.

Summary

Development of replacement heifers is critical since first-lactation cows account for between 30 and 38 percent of all milking cows. Research indicates that the goal of dairy replacement heifers calving at 1,250 pounds and 23 to 24 months of age is attainable and economically viable. To achieve this goal, gains must be monitored and rations must be routinely evaluated. Monitoring performance and balancing rations to provide adequate but not excessive nutrient intake will help ensure well-grown heifers that perform to their potential. Proper management of the heifer herd is one area on most dairy operations where production costs can be reduced and herd productivity and profitability increased.

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