

Heifer rearing within a sustainable dairy industry

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Dairy heifers represent the future of the herd. The aim of every heifer-rearing enterprise should be to rear enough healthy, well-grown individuals with excellent fertility that are well equipped to join the herd at first calving. Such animals are then more likely to achieve their full lifetime potential in terms of fertility, milk yield and survivability. This, in turn, reduces the number of animals lost prematurely due to involuntary culling and so fewer replacements are needed in the future. However, a short productive life continues to pose a challenge to the dairy industry, severely limiting opportunities for on-farm selection of breeding cows and causing financial losses on farms.

CALF AND HEIFER LOSSES

Many potential replacement heifers fail to even reach their first lactation due to mortality or culling during the rearing period (Table 1). Calf mortality is often poorly

documented and may be underestimated because a dead calf is not always recorded at the farm level. A study of 19 commercial dairy farms milking Holstein-Friesian cows in southern England recorded details on all calves (male and female, n=1097) born alive or dead over a two-month period on each farm in 2003 and 2004¹. Overall, perinatal mortality – defined as stillbirths and deaths during the first 24 hours post-partum – was 7.9%, ranging from 3% to 14% on individual farms. Neonatal mortality, defined as female calves born alive that died between 24 hours and 28 days, averaged 3.4%, ranging from 0% to 12% on individual farms. On average, a further 3.4% of heifer calves died between one and six months of age, but this was unduly influenced by a particularly high death rate of 29% on one farm, with the rate on the other farms ranging from 0% to 9%. A further 3.5% of heifers died or were culled before the start of the first breeding period at around 15 months of age, with accidents the main causes

of mortality in this age group. Of the heifers bred for the first time, 4.2% failed to actually calve due to conception failure or abortion. Overall, on average 14.5% of liveborn heifers failed to reach their first lactation.

Dairy cows do not become profitable until at least half way through their second lactation (although this depends largely on age at first calving), so improving survivability will clearly pay dividends. However, on average, 19% of heifers were culled during lactation¹, and 24% in lactation two, with infertility, mastitis/high somatic cell count, skeletal injuries and lameness the main reasons for culling². Overall, only 55% of live born replacement heifers successfully calved for a third time, ranging from 80 to 32% across individual farms². These figures show that a large number of heifers never become productive or are culled before they reach their full lactation potential.

Table 1. Summary of calf and heifer losses during the rearing period¹

Stage	Mortality	
	Mean	Range
Perinatal mortality (<24 hours)	7.9%	3-14%
Neonatal (1 day to 1 month)	3.4%	0-12%
Calf (1 month to 6 months)	3.4%	0-29%
Juvenile (6 months to first breeding)	3.5%	0-19%
Heifer (15 months to first calving)	4.2%	0-21%

AGE AT FIRST CALVING

Age at first calving (AFC) is a strong driver of farm profitability due to the high costs of raising replacements but it also affects heifer performance in later life. Holstein-Friesian heifers calving at 23-25 months outperformed their later calving compatriots in terms of fertility, milk production and survival over their first five years of life, according to a study of 17 dairy farms in southern England³.

Heifers with poor initial reproductive efficiency will clearly calve later than those that conceive first time. Although maiden heifer fertility is often superior to cow fertility, the overall first service conception rate for heifers in the study was 67%⁴. Heifers calving for the first time at less than 23 months of age were on average seven months younger at first breeding compared to heifers calving at greater than 30 months³. These younger heifers (13-14 months) had the best fertility with 84% conceiving to first service, compared with only 51% of those served for the first time at 17 months of age (Table 2).

Table 2. Fertility as a maiden heifer and during lactation 1 and 23

	Age at first calving				P-value
	<23 months	23-25 months	26-30 months	>30 months	
Starting no. heifers	60	129	155	44	
First service CR, maiden heifer	84%	69%	51%	67%	0.009*
Days to conception, L1	128±11	117±7 ^b	137±9 ^b	170±18 ^a	0.072
Days to first service, L2	81±4	72±3 ^b	70±2 ^b	92±7 ^a	0.001
No. cows at 3 rd calving	37/60 (62%)	90/129 (70%)	92/155 (59%)	22/44 (50%)	0.091*

Values are mean ± SEM; within rows a>b using mixed model analysis; *Analysed using Chi square.

Good heifer fertility is key in helping to maintain a tight spring calving pattern, which is often only a three-month period from January through March. Maiden heifers requiring several services for conception will clearly calve later in the calving period than those animals that conceive to first service. These heifers will then have less time after first calving to get back in calf, in order to maintain a tight calving pattern. For animals conceiving very later as a maiden heifer, they will either have to be kept and calve down as a three year old, or alternatively be sold or culled. Neither option is desirable since our data indicate that animals calving for the first time at greater than 30 months have poorer fertility during the first two lactations compared to younger calving heifers.

Heifers calving at 23 to 25 months required fewer days to conception in lactation one, and fewer days to first service in lactation two compared to those calving for the first time at greater than 30 months (Table 2)³. Dairy cows continue to grow until the end of their third lactation, although growth rate slows at approximately 450 days of age⁵. Therefore, younger calving cows must continue to grow to a greater extent after calving and this nutrient demand for growth will be at the expense of fertility. On the other hand, older calving animals tend to become too fat and these heifers calve with higher body condition and subsequently mobilise more body tissue after calving which has deleterious consequences on fertility.

Dairy producers often associate a younger AFC with lower first lactation milk yields, yet there were no significant differences in first lactation milk production between any of the AFC groups (Table 3)³. In fact, younger calving animals (<26 months) produced the most milk per cow over their first five years of life associated with both more lactations per unit of time and a higher survival rate. All animals calving at less than 26 months had similar productivity, spending 45% to 46% of their lives in milk in the less than 23 month and 23-25 month AFC groups, respectively, compared to animals calving at greater than 30 months that spent only 34% of their lives in milk production. Milk produced per day of life therefore decreased progressively from 12.0±0.4kg in the less than 23-month AFC group to 9.0±0.6kg in the greater-than 30-month AFC group.

Younger calving animals were also more likely to survive to third calving (Table 2). As AFC increased beyond 25

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Research published in *Parasitology* (2008) 138, 101-108.
²Canine Coccidiosis Therapy, also used as a prophylactic against the parasite in the dog. *Parasitology* (2007) 137, 101-108.

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months, proportionately fewer animals achieved a third calving - a total of 70% of heifers calving for the first time at 23 to 25 months calved for a third time, compared to only 50% of those calving for the first time at greater than 30 months³.

The recommended AFC for Holstein Friesian cows is 24 months, at approximately 85-90% of their mature body weight. Although most dairy producers aim for first calving at two years, the mean AFC for Holstein Friesian cows across the globe is often greater than 24 months, and is 28 months in the UK (NMR, 2013). This variation in

calving age may be attributed to differences in age at first breeding as a result of poor growth during the rearing period, or it may be primarily related to heifer fertility, or it may simply be due to a farm management decision to calve heifers later than 24 months.

GROWTH DURING THE REARING PERIOD

Gestation length is fixed; therefore AFC is a function of the age at the commencement of first breeding, combined with the reproductive efficiency of the animal. The decision on when to start breeding is primarily a management one, based on the age of the heifer, but is also influenced by

Table 3. Milk production over the first 5 years of life³

	Age at first calving				P-value
	<23 months	23-25 months	26-30 months	>30 months	
Starting no. heifers	60	129	155	44	
305d milk yield, L1 (kg)	8494±206	8811±167	9103±166	8914±335	NS
305d milk yield, L2 (kg)	9340±210	9908±190	10546±183	9633±537	NS
Total milk yield over 5 years (kg)	21072±1400 ^a	22477±912 ^a	20605±863 ^a	15777±1237 ^b	0.021

Values are mean ± SEM; within rows a>b using mixed model analysis; NS = not significant.

growth during the rearing period. Growth should be sufficient so that heifers reach sexual maturity and have 55% to 60% mature body weight at the desired time of breeding, and this should have increased to 85% to 90% by first calving. Variability in growth rates, often due to suboptimal nutrition and/or disease within groups of animals can lead to a large spread in the age at which heifers are bred for the first time. Growth rate varied enormously across 19 dairy farms in southern England, ranging between individual calves from 0.2kg to 1.3kg per day during the first six months of life⁶. This range in growth had a significant impact at the time of first breeding, with many animals deemed too small to be bred, and were not served for the first time until on average 17 to 20 months of age. Younger calving heifers (<26 months) had the highest growth rate up to six months of between 0.82 and 0.85kg/d³.

NUTRITION

Young animals have the ability to convert feed into growth most efficiently during the first two months of life. Therefore to achieve target breeding age and weight in a cost effective manner, growth should be maximised during the milk feeding period (Table 4). Growth rates will however vary according to the energy and protein contents of the milk and the volume and frequency with which it is supplied. A calf weighing 45kg requires 1.75 Mcal/d of ME for maintenance

under thermoneutral conditions⁷. Whole milk contains about 5.4 Mcal of ME/kg of dry matter (DM), which means that a calf requires about 325g of milk solids (2.6L fresh milk, assuming 12.5% solids content) for maintenance alone⁸. Most milk replacers are lower in fat content than whole milk so they have less ME per unit of DM (typically 4.0 to 4.7 Mcal ME/kg DM); thus a calf will require more milk replacer DM just for maintenance. Traditional calf

rearing systems offering restricted volumes of milk during the pre-weaning period, typically feeding liquid milk at 10% of body weight and supplying 400 to 500g milk solids/day, may produce healthy calves but it will restrict growth rates at the time of the highest potential feed conversion rate. Calves provided with higher volumes of milk early in life can double their nutrient intake – ad libitum calves will consume up to 14L per

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day - compared with those fed amounts equivalent to approximately 10% of body weight, and these calves have the potential to gain more weight (approximately 1kg/d)^{9,10}. Feeding higher volumes of milk for higher growth rates requires using a milk replacer with a high protein and low fat content, since maximal average daily gain and starter intake is achieved when feeding a milk replacer with 17% to 20% fat, and 27% protein¹¹. Feeding enough whole milk or milk replacer to support rapid growth rates during the pre-weaning period will help enable heifers to achieve breeding size earlier, and potentially reduce age at first calving and the costs associated with raising replacement heifers.

Table 4. Growth targets during the rearing period

Age (months)	Target growth rate, kg/day
0-4	Up to 0.9
4-12	0.7
12-16	0.8-0.9
16-24	0.7-0.75

SETTING TARGETS AND MONITORING GROWTH

Most producers start first breeding at 15 months of age, but maiden heifers require on average 1.4 services per conception and have a first service conception rate of only 67%⁴. Therefore to achieve first calving at 24 months, first breeding must start at 13 to 14 months of age to ensure heifers are actually in calf by 15 months. Heifers can be served at 13 to 14 months providing early growth is good. Targets must be set – about 55 to 60% mature body weight at first breeding and this should have increased to 90% by first calving (85% after calving). The mature body weight of Holstein-Friesian cows can vary considerably according to selection policy, so the mature body weight

of cows in the herd must be measured. For example, if the mature body weight of the herd is 600kg, the target body weight at first breeding at 13 to 14 months is 330 to 360kg. To achieve this body weight, a 40kg calf at birth will need to gain 290 to 320kg over about 410 days – which requires an average daily gain of at least 0.75kg every day of the rearing period until first breeding.

The only way to ensure heifers achieve the target set, and to reduce the variation within groups, is to regularly measure and monitor growth rates:

Set growth targets for the farm based on the mature body weight of cows in the herd (lactation 3+) - aim for 55 to 60% mature body weight at first breeding

Measure calves at birth, and again when heifers are handled, e.g. for vaccination, worming or insemination
Use weigh scales in a race or crush, or use a weigh band (girth tape)

Use the same measure consistently so that growth can be benchmarked between years

SUMMARY

Heifer performance, in terms of fertility, milk production and survivability is fundamental for farm profitability. There is strong evidence that it is more economical to rear heifers to calve at younger ages, since heifers calving for the first time at 23 to 25 months of age have better fertility, milk production and survival to third calving. But individual farms must set a target first calving age to suit their system and goals. Whether this is 24 months or 26 months – a goal needs to be set, and heifers must be monitored throughout the rearing period to ensure they are on track for reaching the target. Improved monitoring of growth at regular intervals could help ensure that all

Reader Questions and Answers

1. ON AVERAGE, WHAT PERCENTAGE OF LIVEBORN HEIFERS FAIL TO REACH FIRST CALVING?

- a) 5%
- b) 10%
- c) 15%
- d) 20%

2. WHAT GROWTH RATE DURING THE MILK FEEDING PERIOD SHOULD BE TARGETED?

- a) Less than 0.7 kg per day
- b) Up to 0.9 kg per day
- c) Greater than 0.9 kg per day
- d) Doesn't matter as long as they drink their milk

3. WHAT IS THE OPTIMAL BODY WEIGHT AT FIRST BREEDING?

- a) Doesn't matter as long as they look big enough 350kg
- b) 55 to 60% mature body weight
- c) 85 to 90% mature body weight

4. WHICH OF THE FOLLOWING IS NOT ASSOCIATED WITH AGE AT FIRST CALVING?

- a) Fertility during lactation 1 and 2
- b) Survival through to third calving
- c) 305 day milk yield in lactation 1
- d) Milk production over the first five years of life

5. THE IDEAL AGE AT FIRST CALVING FOR SUBSEQUENT PERFORMANCE IS

- a) <23 months
- b) 23 to 25 months
- c) 26 to 30 months
- d) >30 months

ANSWERS: 1, C, 2, B, 3, C, 4, C, 5, B.