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PROVINCE OF KWAZULU-NATAL

DAIRYING IN KWAZULU-NATAL

Rearing Dairy Replacement Heifers

T J Dugmore
Cedara Agricultural Development Institute

A great deal of research work has been carried out in Australia, Europe and North America to determine the effect of the level of feeding and of age at first calving on subsequent production performance. Overfattening of heifers has been shown to inhibit milk production severely, while the milk production of undersized heifers is severely restricted by their incomplete development. Heifers mated to calve early (24 to 27 months) and fed to maintain growth rates of 0,6 to 0,7 kg/day for Holstein-Friesland and 0,4 to 0,5 kg/day for Jerseys, usually produce higher total yields during their productive lives than do heifers mated to calve later.

The faster an animal grows, the more efficient it is in converting feed into livemass, because a smaller proportion of its feed is used for maintenance, and thus a greater proportion is available for growth. Although this suggests that heifers should grow as quickly as possible to attain the target livemass, there is an age below which they should not calve down. Rearing experiments have shown that heifers which calve very early have given disappointing milk yields, and suffered extra calving problems, in spite of having achieved adequate livemass.

It is therefore recommended that no Holstein-Friesland heifer should calve under 23 months of age, but as soon after as possible. Delaying age at first calving by a month resulted in an average yield increase of 73 litres of fat-corrected milk (FCM) for a 300 day first lactation in the Cedara Holstein-Friesland herd. This effect has been shown to fall away after 29 months of age (Figure 1), therefore calving at ages greater than 29 months carries no benefit due to age, and cannot be recommended.

Figure 1. Effect of age at first calving on first lactation production

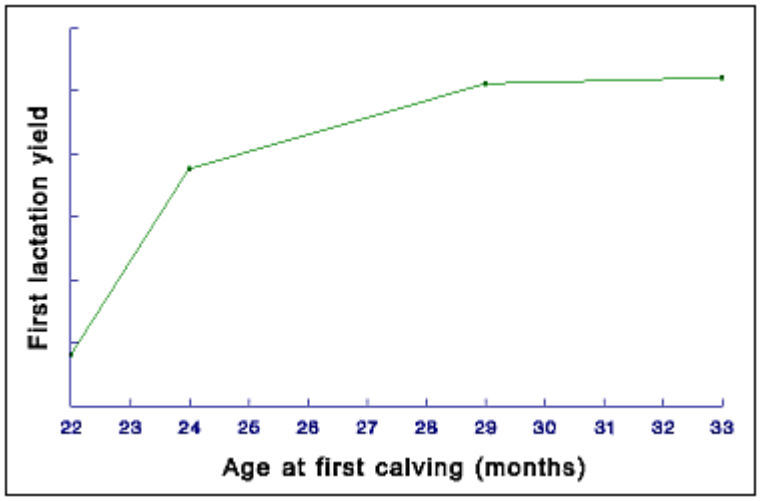


Table 1. Increased milk yields per kilogram increase in livemass at first calving, measured over 3 lactations (after Kerr, Bird & Buchanan, 1985)

Lactation No.	Litres of milk advantage (per lactation) for every kg increase in livemass at first calving		
	per kg	per 50 kg	Cumulative total
1	8,7	435	435
2	7,6	380	815
3	6,6	330	1 145

The size and condition of a heifer at calving influences her subsequent milk yield. Undersized heifers usually give low yields, particularly when high forage intakes are required. The effect of size at first calving is shown in Table 1.

An analysis of Cedara's first lactation records has shown that every increment of 50 kg bodymass before calving (pre-partum) produces 306 litres more FCM over a 300 day lactation, or 6,1 litres of FCM per additional kilogram livemass.

Larger responses, of 10 to 12 litres of milk per kg extra post-partum livemass, measured during first lactation, have been recorded in commercial dairy herds in KwaZulu-Natal (Figure 2). The correlation coefficient (r^2) of these data is greater than 70, indicating that livemass accounts for more than 70% of the variation encountered in first lactation yields.

Figure 2. First lactation production vs livemass for commercial herds in Natal (R I Jones)

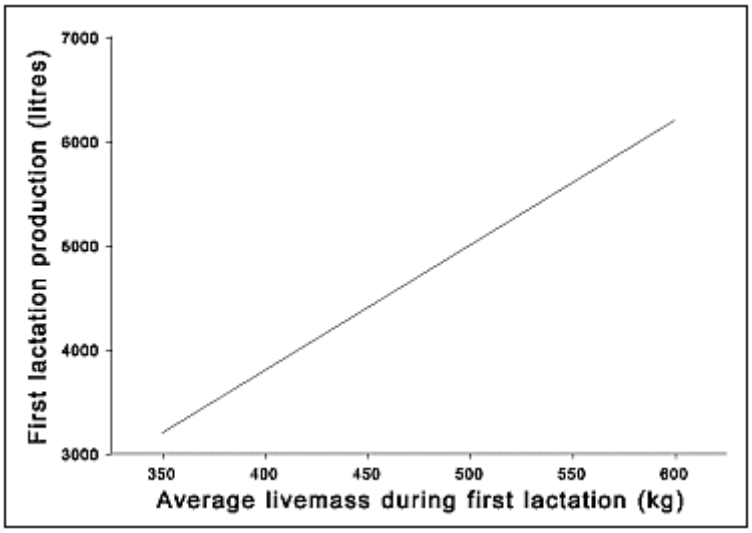


Table 2. Effect of growth rates (ADG) of Holstein-Friesland heifers, from 14 weeks to mating, on lifetime milk production (after Little & Kay, 1979)

Treatment	ADG 14 to 39 weeks of age	Mating		Production per lactation (kg FCM)				
		mass (kg)	age (weeks)	1st	2nd	3rd	4th	Total yield
A	1,08	302	42,9	1959	2918	3545	3210	11 632
B	0,98	443	78,4	2450	3216	3310	-	8 976
C	0,61	353	78,1	3863	4994	4813	-	13 370

The heavier an animal at calving (as long as she is not overfat), the higher her milk yield for that lactation. There are two reasons for the increase in milk production per lactation with increased livemass. First, the animals have greater body reserves, which can be utilized to produce more milk during the first three months of lactation, when energy intake does not equal energy output in the milk produced, *i.e.* the cows are milking "off their backs". Second, the heavier the animal at calving, the closer she is to her ultimate mature livemass. She therefore requires less energy for growth during her first lactation, to reach her mature weight. This allows more energy for milk production. Heifers that were well-grown at the time of calving have a production advantage not only during the first lactation, but that persists beyond the second and even into the third lactation, when compared with heifers that were smaller and lighter at first calving.

While additional livemass, and consequently increased body reserves, at calving improve both first lactation and lifetime milk production, excessive mass gains (more than 0,8 kg/day for large breeds and more than 0,45 kg/day for small breeds) prior to puberty have proved to be detrimental to milk production. This is particularly important for the heifer, during her first year of life. The effect of growth rates, from 14 weeks of age to mating, on milk production are shown in Table 2.

The data in Table 2 illustrate that, under similar growth rates (Treatment A & B), earlier calving produces greater lifetime yields, even though the first lactation yield may be much lower than that of the later calving animal. Excessive growth rates prior to mating are detrimental to future milk production, both first lactation and lifetime production (Treatments A & B compared with C). Conversely, calving at a very light mass causes diminished first and second lactation productions owing to incomplete development at calving. Undersized heifers experience even more calving problems than do overfat animals.

Diminished yields associated with fast growth are caused by excessive fat deposition in the developing udder tissue, at the expense of milk-secreting tissue. The most critical time, for secretory tissue development, is prior to mating, at puberty or even earlier. The mammary glands of cows which were reared as heifers never to exceed a livemass gain of 0,74 kg/day, weighed 39% more and contained 68% more secretory tissue than the glands of rapidly reared heifers, grown to gain 1,0 kg/day until 11 months of age.

In Table 3, the analyses of the mammary glands of pregnant heifers, reared at different rates of livemass gain, shows that high rates of livemass gain in heifers, prior to puberty, may enhance adipose tissue development in the mammary gland and limit subsequent development of milk secretory tissue during pregnancy. On the other hand low rates of gain during pregnancy may reduce cell division in the mammary gland and impair milk secretory tissue development. In practical terms what this means to the farmer is that impaired tissue development depresses milk yield. Figure 3 shows that high rates of gain, pre-puberty, impair milk production relative to the cows genetic potential. Higher rates of gain during pregnancy (as opposed to pre-puberty) result in enhanced milk production.

Table 3. Analyses of mammary glands of Holstein-Friesland heifers reared at different rates of liveweight gain and slaughtered at 250 days of pregnancy (after Harrison, Reynolds & Little, 1983)

	Treatment		
	LL*	**LH#**	**HL**
Gland mass (kg)	6,4	9,0	6,8
	4,0	5,4	3,2
Parenchyma mass (kg)	63,7	61,0	49,6
(%)	1,53	1,82	1,39
Gland mass as % of livemass	0,58	0,58	1,03
	0,68	0,84	0,58

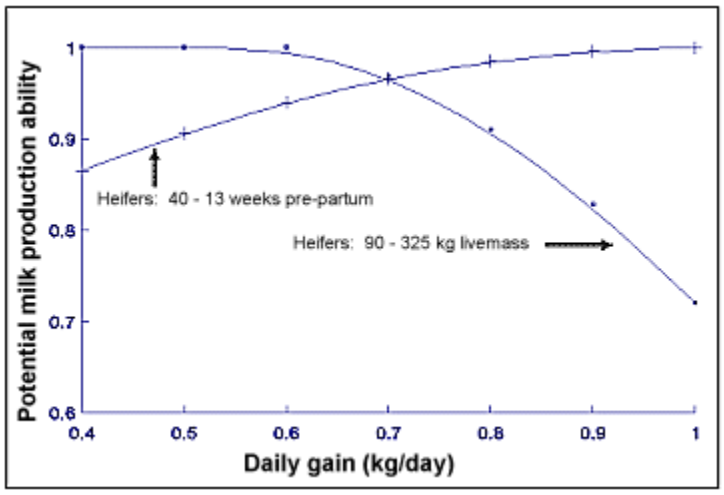
ADG to 12 months (kg/day) ADG during pregnancy (kg/day)			

* LL = low rate of gain for the first year followed by low rate of gain during pregnancy

LH = low rate of gain for the first year followed by high rate of gain during pregnancy LH = low rate of gain for the first year followed by high rate of gain during pregnancy LH = low rate of gain for the first year followed by high rate of gain during pregnancy

HL = high rate of gain for the first year followed by low rate of gain during pregnancy

Figure 3. Relationship between milk production ability and daily gain during two stages of growth (Sorensen, 1989)



It is therefore recommended that heifers be grown reasonably slowly in their first year. Pre-puberal growth rates in excess of 0,75 kg/day for Friesians and 0,45 for Jerseys have been shown to cause incomplete udder development.

A balance between too high a mass and too low a mass is therefore required to optimise first and subsequent lactation productions, especially since modern cows have limited herd-lives (approx. 3 to 4 lactations). The concept of target weights was established to provide safe calving weights, as well as to optimise production potential. These target masses are given in Table 4 and must not be considered as averages, but as figures which should be reached by the majority of the animals in the herd. Mating usually occurs at 60 to 70 % of expected mature mass with calving at 90% of expected mature mass.

Condition at calving is a factor which has been shown to influence milk yields significantly after calving. Condition at calving is measured by a systemof condition scoring, where a score between 1 (emaciated) and 5 (grossly fat) is allocated.

Figure 4. Heifer growth chart for Holstein-Frieslands and Jerseys

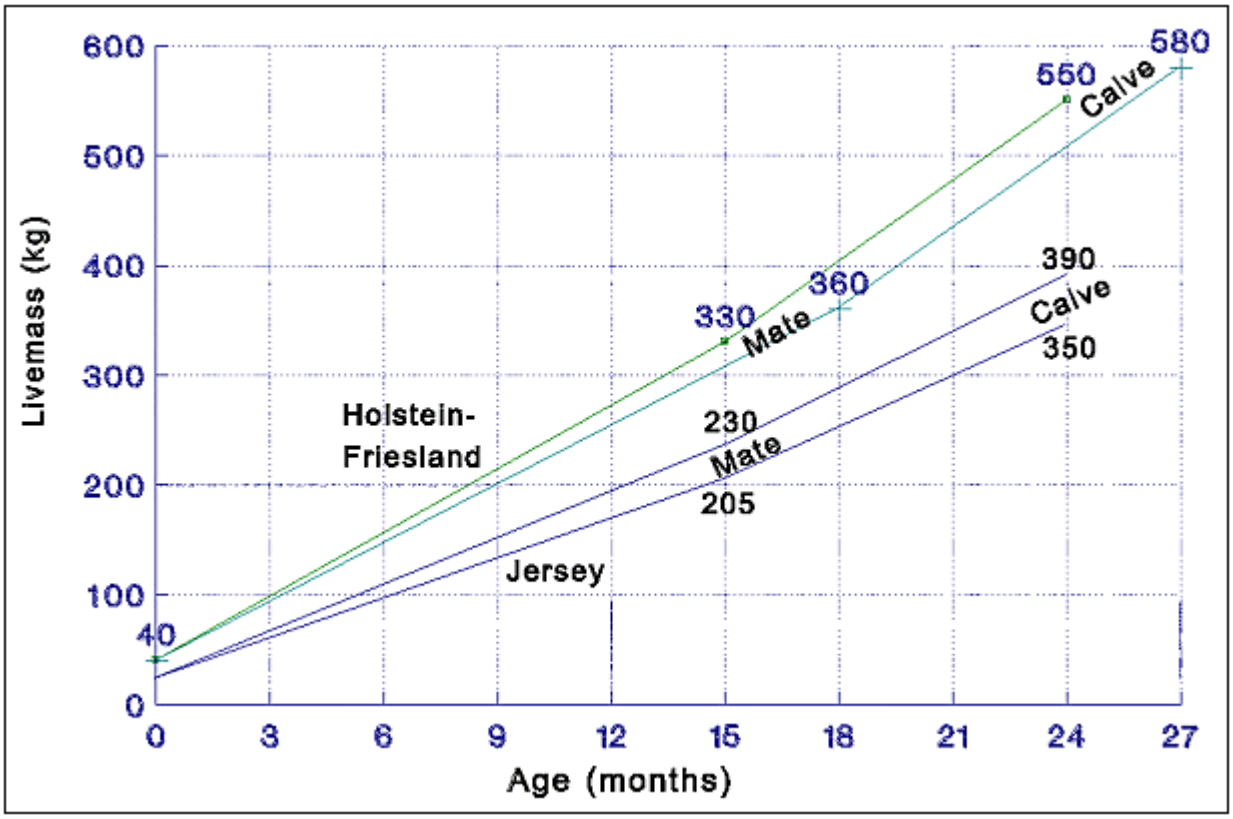


Table 4. Target masses for mating and calving

Breed	Birth mass (kg)	Mating mass (kg)	Growth rate (kg/day)	Calving mass (kg)	Growth rate (kg/day)
		15 mth mating		*24 mth calving*	
Holstein-Friesland	40	310 - 360	0,60 - 0,70	510 - 560	0,70 - 0,80
Ayrshire	32	250 - 280	0,50 - 0,55	440 - 480	0,65 - 0,70
Guernsey	30	230 - 250	0,45 - 0,50	390 - 430	0,60 - 0,65
Jersey	25	205 - 230	0,40 - 0,45	350 - 390	0,55 - 0,60
		18 mth mating		*27 mth calving*	

Holstein-Friesland	40	350 - 380	0,56 - 0,62	550 - 580	0,70 - 0,80

Research has shown that optimum condition scores are between 2,5 and 3,5 at calving. Condition scores of 4 or 2 have been shown to affect milk production adversely because animals are overfat or underfed respectively.

As mature masses vary for each individual cow, it is not possible to establish an exact target mass prior to first calving. Condition scoring can be used to ensure that individual animals do not become overfat nor calve down in too poor a condition for optimum milk yields, *i.e.* if they are growing at the desired rate but laying down excessive body fat, feed and growth rate must be reduced or *vice versa*.

In conclusion, it must be emphasized that a combination of target masses, condition score and growth rate is vital to good heifer rearing, if the heifer is to achieve her full potential. For this purpose, the use of a cattle-scale is essential, because the eye and the weighband are deceiving, mainly because of individual animal variation.

During the rearing period, one should offer heifers good quality hay, silage or pasture, supplemented with up to 2 kg of an appropriate meal per day, as required to maintain adequate growth and development. On certain pastures, *e.g.* ryegrass, only minerals supplements should be necessary, whereas on others, *e.g.* Kikuyu, mineral supplements are essential and energy supplements may be required. One should weigh the animals regularly, to ensure that they are gaining correctly and then, if necessary, adjust the feed relative to the required growth.

Management is the key to a successful operation and the use of either a peg board or magnets on a metal board with the graph drawn using the figures in Table 4, illustrated in Figure 4, and the heifer weights plotted on it, would show at a glance the state of affairs in the heifer rearing programme.

Finally, the pregnant heifer should not be treated as such, but as a dry-cow for the eight weeks prior to calving.

FURTHER READING

HARRISON, R.D., REYNOLDS, I.A. & LITTLE, W.,1983. A quantitative analysis of mammary glands of dairy heifers reared at different rates of liveweight gain. *J. Dairy Res*., 50: 405-412.

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