New Zealand Society of Animal Production online archive

This paper is from the New Zealand Society for Animal Production online archive. NZSAP holds a regular annual conference in June or July each year for the presentation of technical and applied topics in animal production. NZSAP plays an important role as a forum fostering research in all areas of animal production including production systems, nutrition, meat science, animal welfare, wool science, animal breeding and genetics.

An invitation is extended to all those involved in the field of animal production to apply for membership of the New Zealand Society of Animal Production at our website www.nzsap.org.nz

View All Proceedings   Next Conference   Join NZSAP

More dairy heifers are achieving liveweight targets

RC Handcock[a]*, TJ Lopdell[b] and LR McNaughton[b]

[a]*Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand. [b]Livestock Improvement Corporation, Private Bag 3016, Hamilton 3240, New Zealand.*

Corresponding author. Email: R.C.Handcock@massey.ac.nz

Abstract

Dairy heifers should reach industry liveweight targets that are set to ensure heifers achieve good reproductive performance and milk production. The aim of this study was to determine if more dairy heifers born between the 2011-12 and 2014-15 dairy seasons (current) in New Zealand are achieving liveweight targets since a study on heifers born between the 2006-07 and 2010-11 dairy seasons (historic). In all age groups the mean live weight of current heifers was heavier than that of historic heifers. There were also a greater percentage of the current heifers at or above their target live weight compared with the historic heifers ($P<0.001$), suggesting that the rearing of dairy heifers has improved. The greatest improvement was seen at 15 months of age (mating) when 25% of historic heifers were at or above target compared with 56% of current heifers. Despite the improvement, 44% of current heifers were below target at mating and 65% were below target pre-calving (22 months of age). At 22 months of age, current heifers were on average nearly 42 kg below target live weight. By failing to achieve targets near calving, farmers are not capturing potential milk production benefits.

Keywords: dairy heifers; liveweight targets

Introduction

Industry target liveweights (LWT) for dairy heifers are 30% of mature LWT at six months of age, 60% at mating and 90% pre-calving. Previous research reported that dairy heifers were failing to reach these targets, with 61% of heifers being more than 5% below target at mating and this increased to 73% by 22 months (McNaughton & Lopdell 2012). In the analysis of McNaughton and Lopdell (2012), heifers during their first autumn/winter (nine - 12 months of age) had very low growth rates and were not able to regain target trajectory. The number of heifer LWTs recorded in Livestock Improvement Corporation's MINDA Weights™ herd-recording software has increased dramatically since 2012, (414,272 records in the 2011-12 season vs 1,695,291 records in the 2014-15 season).

The aim of this study was to determine if the proportion of dairy heifers reaching target LWTs in New Zealand has improved since McNaughton & Lopdell's (2012) study on heifers born between the 2006-07 and 2010-11 dairy seasons.

Materials and methods

Data

Live weights, liveweight breeding values (LWT BV), birth dates and Friesian, Jersey and Ayrshire breed sixteenths for spring-born dairy heifers that were less than 730 days of age and born between the 2011-12 and 2014-15 dairy seasons were extracted from the Livestock Improvement Corporation database (Animal Evaluation BV run 06/03/2015). Records that had unusually light or heavy live weights for their ages were removed using the same criteria as McNaughton and Lopdell (2012) and (2013). Additionally, any heifer that was older than 600 days of age but less than 250 kg was also removed from the

dataset as well as any heifer who had breed sixteenths that were not equal to 16.

This left a dataset of 2,629,866 observations on 655,964 animals (current). The heifer's age at each weighing event was calculated using a standard birth date for the heifer that was 730 days before the planned start of calving (PSC) date of her herd, reflecting the need for all animals to be at 60% of mature LWT at the planned start of mating (PSM), regardless of their actual birth date. Target LWTs at each weighing event were then calculated using this standard age. The target LWTs were calculated using a modified version of the growth prediction equation of Bryant et al. (2004) that is embedded in MINDA Weights™ herd-recording software and a base cow live weight of 500 kg.

Instead of comparing the current heifers to the results of McNaughton and Lopdell (2012), the heifers used were re-evaluated with the most recent LWT BVs (Animal Evaluation BV run 06/03/2015) to calculate the expected mature LWT and target LWTs. This was done to provide a direct comparison between the current and historic heifers as the LWT BVs changed significantly on 16/02/2015. The data cleaning and age calculation described above was applied to the historic heifers, apart from the breed criteria.

Subsets of data were created for each standard age month with animals that had a LWT recorded within 15 days of that age included in the subset.

Statistical analysis

Data were analysed using R 3.1.2 (R Core Team 2014). Differences in the percentage of target LWT achieved by historic and current heifers were tested using one-way ANOVA. Differences in the percentage of target LWT achieved among breeds were tested using one-way ANOVA followed by pairwise comparison. The proportion

of heifers that were above, at, or below target LWT were compared using Chi-squared test followed by a two-sample test for equality of proportions.
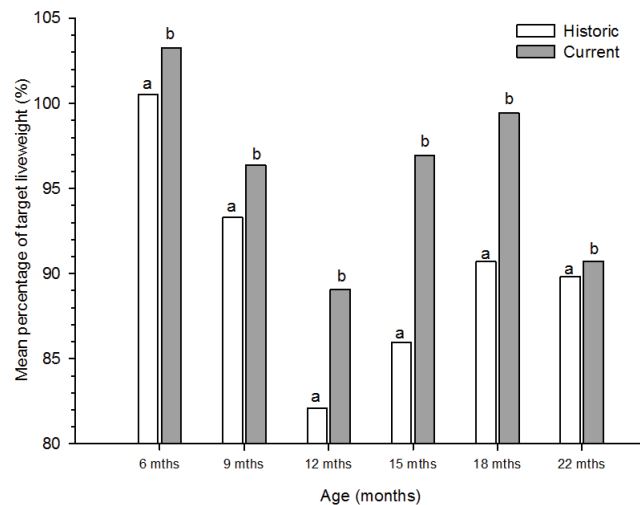
Results

The target and actual mean live weights, and number of records for current and historic heifers are summarised in Table 1. There were more live weight records for current heifers than for historic heifers (Table 1). The mean LWT BV was -1.7 kg for historic heifers and 0.8 kg for current heifers. At all ages the mean LWT of current heifers was heavier than that of historic heifers (Table 1). From six to seven months of age, the mean LWT of heifers from both groups were above target. From seven to eight months of age, current heifers remained at target, whereas the mean LWT of historic heifers fell below target and remained below target until 22 months of age. The mean LWT of current heifers was below target from eight until 15 months of age. At 16 and 17 months of age, the mean LWT of current heifers was above target, and then from 18 months of age the mean LWT of current heifers was below target and remained below until 22 months of age. There were two ages (six and seven months of age) when the mean LWT of the historic heifers were above target and four ages (six to seven and 16-17 months of age) when the mean LWT of the current heifers were above target (indicated in bold in Table 1).

The percentage of target LWT achieved followed the same pattern for both groups (Figure 1). From six to 12 months of age the percentage of target LWT achieved declined, from 12 to 18 months of age it increased and from 18 to 22 months of age it declined. In all age groups the

Table 1 The target live weight, actual mean live weights and the number of records of historic (2006-07 to 2010-11 born) and current (2011-12 to 2014-15 born) dairy heifers at different ages. The mean live weights in bold were above target.

Age	Target (kg)	Mean Live weight (kg)		Number of records	
		Historic	Current	Historic	Current
6 mths	139.5	**140.2**	**144.0**	11,906	199,709
7 mths	159.1	**160.4**	**162.6**	12,373	185,020
8 mths	179.1	171.1	179.0	12,221	130,479
9 mths	200.8	187.3	193.5	18,391	137,115
10 mths	219.3	196.1	202.6	10,056	108,033
11 mths	238.2	199.4	214.8	9,856	86,184
12 mths	255.7	210.0	227.8	7,605	83,661
13 mths	274.7	233.0	248.9	7,294	109,377
14 mths	289.8	244.6	268.6	17,464	148,126
15 mths	304.4	261.6	295.1	11,449	69,862
16 mths	321.2	306.0	**329.2**	10,970	70,288
17 mths	338.9	332.4	**349.7**	4,280	70,012
18 mths	372.4	337.8	370.4	13,343	80,683
19 mths	396.7	362.6	385.5	9,014	72,180
20 mths	419.0	374.1	401.3	10,038	37,493
21 mths	438.9	403.7	413.7	17,168	53,864
22 mths	450.9	404.9	409.1	9,035	27,567

Figure 1 The mean percentage of target live weight achieved by historic (2006-07 to 2010-11 born) and current (2011-12 to 2014-15 born) dairy heifers at 6, 9, 12, 15, 18 and 22 months of age.
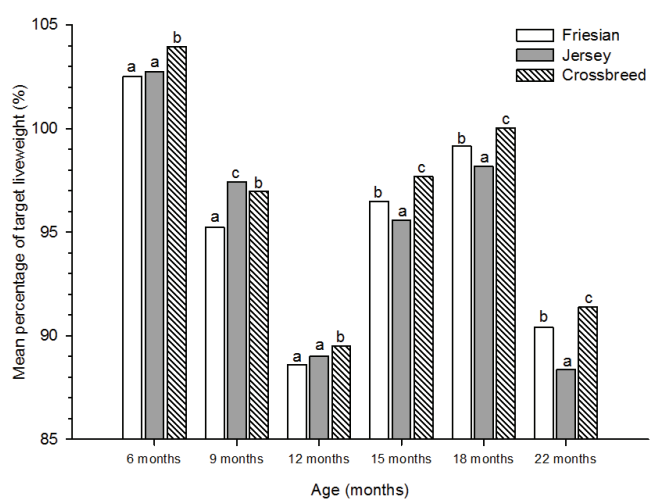

[a,b]values within each age group without letters in common are significantly different ($P<0.001$)

current heifers attained a greater percentage of target LWT compared with the historic heifers ($P<0.001$).

A greater proportion of the current heifers were at or above their target LWT compared with historic heifers at all ages (Table 2). At 12 months of age, 15% of historic heifers were at or above target, compared with current heifers at 34% ($P<0.001$). At 15 months of age (PSM), the percentage of heifers at or above target was 25% and 56% for historic and current, respectively ($P<0.001$). This pattern continued for heifers at 18 months of age, with 38% of historic heifers at or above target compared with 67% of current heifers at or above target ($P<0.001$). At 22 months of age, 28% of

Figure 2 The mean percentage of target live weight achieved by current (2011-12 and 2014-15 born) dairy heifers at 6, 9, 12, 15, 18 and 22 months of age separated by Friesian, Jersey and crossbreed.

[a,b,c]values within each age group without letters in common are significantly different ($P<0.001$)

Table 2 The proportion of historic (2006-07 to 2010-11 born) and current (2011-12 to 2014-15 born) heifers that were above target (greater than 5% above), at target (between 5% above and 5% below) or below target (greater than 5% below target) at different ages

Parameter	Age (months)					
	6	9	12	15	18	22
Proportion >20% above target (%)						
Historic heifers	14.2	4.6[a]	0.2[a]	0.4[a]	0.5[a]	0.7[b]
Current heifers	14.0	5.5[b]	1.3[b]	3.1[b]	2.3[b]	0.3[a]
Proportion 5 - 20% above target (%)						
Historic heifers	27.6[a]	19.2[a]	4.2[a]	6.5[a]	11.0[a]	5.8[a]
Current heifers	30.8[b]	22.1[b]	10.7[b]	22.1[b]	26.3[b]	8.4[b]
Proportion at target (%)						
Historic heifers	23.0[a]	23.1[a]	10.8[a]	18.3[a]	26.2[a]	21.3[a]
Current heifers	25.5[b]	26.3[b]	21.5[b]	31.2[b]	38.7[b]	25.8[b]
Proportion 5 - 20% below target (%)						
Historic heifers	23.8	34.6[b]	39.1[a]	44.3[b]	48.1[b]	52.2[b]
Current heifers	23.4	32.9[a]	41.4[b]	35.6[a]	30.1[a]	49.5[a]
Proportion >20% below target (%)						
Historic heifers	11.4[b]	18.5[b]	45.8[b]	30.4[b]	14.2[b]	20.1[b]
Current heifers	6.3[a]	13.1[a]	25.1[a]	8.1[a]	2.7[a]	16.0[a]

[a,b]values within column, within proportion parameter without letters in common differ at the P<0.001 level.

historic heifers were at or above target compared with 35% for current heifers (P<0.001).

The mean percentage of target LWT achieved by each breed is summarised in Figure 2. Crossbreed heifers achieved a greater percentage of LWT target than did Jersey and Friesian heifers at all ages apart from at nine months of age, when Jersey heifers achieved a greater percentage than crossbreed and Friesian heifers (P<0.001). From nine to 22 months of age, all breeds failed to meet LWT targets apart from at 18 months of age when crossbreed heifers were at target. At six and 12 months of age, Jerseys and Friesians were not significantly different (P>0.05), however, from 15-22 months of age, Friesians achieved a greater percentage of target LWT than did Jerseys (P<0.001). The mean target LWT at PSM (15 months of age) for Friesians, Jerseys and crossbreeds were 321 kg, 272 kg and 300 kg respectively. At 22 months of age these targets were 483 kg for Friesians, 398 kg for Jerseys and 445 kg for crossbreeds.

Discussion

The mean LWTs and the percentage of heifers above target have increased since McNaughton and Lopdell's (2012) study, suggesting that heifer rearing has improved.

Two of the most important periods in heifer rearing in terms of reproductive performance and milk production are PSM and pre-calving. Puberty in heifers occurs at approximately 45 to 50% of mature LWT (Garcia-Muniz 1998; Hafez & Hafez 2000). To ensure that heifers have attained puberty before PSM, the target LWT is 60% of mature LWT (Burke et al. 2007). More heifers that were bred to their third oestrus were pregnant (78%) compared with heifers that were bred to their first oestrus (57%), confirming that fertility improves over the first few oestrous cycles (Byerley et al. 1987). Therefore, it is advantageous to have all heifers pubertal before the PSM. Heifers that

were more than 20% below their target LWT at PSM may be at risk of being pre-pubertal. Even though at PSM, the current heifers were on average only 9 kg below target, over 40% of them were more than 5% below target and 8% were more than 20% below target, and so at risk of being pre-pubertal. This means that 92% of current heifers were likely to have attained puberty by mating, compared with 70% of historic heifers. Both of these figures are greater than the 60% of heifers that were reported pubertal at the start of a heifer synchrony programme study (McDougall et al. 2013).

Several studies have shown that heifers that were heavier before calving had greater first-lactation milk production than did lighter heifers (Macdonald et al. 2005; McNaughton & Lopdell 2013; van der Waaij et al. 1997). The value of 1 kg of additional LWT before calving was estimated as 0.45 kg MS (van der Waaij et al. 1997). The value of a one percent increase in target LWT attained was 23.2 L of milk or 2 kg MS (McNaughton & Lopdell 2013). In the current study, 22-month-old heifers were 9% below target. Using the average milksolids response of McNaughton and Lopdell (2013) and van der Waaij et al. (1997) which equates to a loss of between 18.0 and 20.7 kg MS per heifer in their first lactation. There was also little improvement between historic and current heifers in the mean LWT and percentage of heifers at and above target at 22 months. This period also had the least percentage of heifers above target (8.7%) and more than 60% were below target. Growth rates of Friesian and Jersey heifers from puberty to calving had significant positive effects on first-lactation milk production (Macdonald et al. 2005). It is, therefore, important to maintain adequate growth rates after mating to calving. By failing to achieve LWT targets near calving, farmers are not capturing potential milk-production benefits.

The first-lactation reproductive benefits of achieving LWT targets during rearing are difficult to estimate. One study reported that heifers which had a calving recorded, attained a greater percentage of target LWT at 15 to 17 months of age compared with heifers that did not have a calving (McNaughton & Lopdell 2013). The heifers that had a second calving recorded, also attained a greater percentage of target LWT at 15 to 17 months of age compared with heifers that had only one calving recorded (McNaughton & Lopdell 2013). These results suggest that there is a positive relationship between attaining target LWT near PSM and the probability of calving, but do not quantify the economic benefits. The economic benefits of achieving LWT targets during rearing can be estimated using the DairyNZ heifer rearing "gap calculator" that is available to farmers and consultants (DairyNZ 2014). Using the 22-month-old target and mean LWTs in this study, the historic heifers had a 10% gap between target and actual whilst the current heifers had a 9% gap. The likely economic benefits for reproduction (increased six-week in-calf rate and decreased empty rate in the first lactation) were $40.00/heifer for historic and $36.00/heifer for current heifers, if the gap was reduced to zero.

Throughout the majority of the rearing period, crossbreed heifers achieved a greater percentage of LWT target compared with Friesian and Jersey heifers. McNaughton and Lopdell (2013) reported that Jerseys achieved a greater percentage of target LWT compared with crossbreeds, which achieved a greater percentage than Friesians. The differences between the present study and McNaughton and Lopdell (2013) may be due to significant changes in LWT BVs and the separation of age groups in the current study. By separating the data into different age groups, it is possible to detect in which periods heifers are meeting targets and periods when significant improvement is required. Based on the current study, Jersey heifers were able to attain growth rates that allowed them to achieve a percentage of target LWT that was comparable to Friesians and crossbreeds in the first 12 months of rearing, and were unable to in the later stages.

It is important to look at the individuals in a herd/mob when making decisions instead of using the mean LWT. At six months of age, the mean LWT of both current and historic heifers was above the target. However, there were 35.3% of historic and 29.7% of current heifers that were still below target LWT.

There were differences between the historic heifers reported here and those in McNaughton and Lopdell (2012), even though it was the same dataset. The number of heifers in each age group and the actual LWT achieved were different in the two studies. These differences were due to the method used to calculate the age of the heifer. McNaughton and Lopdell (2012) reported the age as the actual age of the heifer. For the present study the age was recalculated based on all heifers being 15 months of age at the PSM, effectively treating every heifer as being born on the first day of the calving period. The age of the historic

heifers in the current study were therefore, around 15-30 days greater than in the previous study of McNaughton and Lopdell (2012). As a result of this, the allocation of heifers to groups by month of age resulted in some heifers being allocated to different age groups in the present study, and consequently the mean LWT and the number of LWTs recorded were different.

In all age groups, a greater percentage of the heifers in the current study were at or above their target LWT, compared with the historic heifers, suggesting that the rearing of dairy heifers has improved. This could be due to increased interest in dairy heifer performance, higher milk payout in the 2013/14 season, extension efforts of industry bodies; such as the DairyNZ Heifer Grazing Project and the increased use of MINDA weights™. Further investigations into the relationships between LWT and future milk production and reproductive performance are currently being completed.

Despite the apparent improvement, 44% of current heifers were below target at mating and 65% were below target pre-calving. It has previously been demonstrated that heifers that were heavier at calving had greater milk production compared with lighter heifers. Greater milk production could be achieved if more heifers attained LWT targets.

Acknowledgements

References
Bryant JR, Holmes CW, Lopez-Villalobos N, McNaughton LR, Brookes IM, Verkerk GA, Pryce JE 2004. Use of breeding values for live weight to calculate individual targets for dairy heifers. Proceedings of the New Zealand Society of Animal Production 64: 118-121.

Burke C, Blackwell M, Little S 2007. The InCalf book for New Zealand dairy farmers. Hamilton, DairyNZ. 204 p.

Byerley DJ, Staigmiller RB, Berardinelli JG, Short RE 1987. Pregnancy rates of beef heifers bred either on puberal or third estrus. Journal of Animal Science 65: 645-650.

DairyNZ 2014 Heifer rearing tool. DairyNZ, Hamilton, New Zealand. 14p. http://www.dairynz.co.nz/media/669765/heifer_rearing_tool_v2.pdf [26 January 2016].

Garcia-Muniz JG, Holmes CW, Garrick DJ, Lopez-Villalobos N, Wickham BW, Wilson GF, Brookes IM, Purchas RW 1998. Growth curves and productivity of Holstein-Friesian cows bred for heavy or light mature weight. Proceedings of the New Zealand Society of Animal Production 58: 68-72.

Hafez ESE, Hafez B 2000. Reproductive Cycles. Chapter 4. In: Reproduction in Farm Animals. 7 ed. Lippincott Williams & Williams, Philadelphia, USA. Pg. 55-67.

Macdonald KA, Penno JW, Bryant AM, Roche JR 2005. Effect of feeding level pre- and post-puberty and body weight at first calving on growth, milk production, and fertility in fertility in grazing dairy cows. Journal of Dairy Science 88: 3363-3375.

McDougall S, Rhodes FM, Compton CWR 2013. Evaluation of three synchrony programs for pasture-based dairy heifers. Theriogenology 79: 882-889.

McNaughton LR, Lopdell TJ 2012. Brief communication: Are dairy heifers achieving liveweight targets? Proceedings of the New Zealand Society of Animal Production 72: 120-122.

McNaughton LR, Lopdell TJ 2013. Effect of heifer live weight on calving pattern and milk production. Proceedings of the New Zealand Society of Animal Production 73: 103-107.

R Core Development Team 2014. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.

van der Waaij EH, Galesloot PJB, Garrick DJ. 1997. Some relationships between weights of growing heifers and their subsequent lactation performance. New Zealand Journal of Agricultural Research 40: 87-92.