# LARGER SIZE, OR HIGHER BODY CONDITION, FOR INCREASED FIRST LACTATION MILK PRODUCTION IN DAIRY HEIFERS

*J.A. STEWART** and *L.W. TAYLOR**

## SUMMARY

For heifers in similar body condition at first calving, increased skeletal size (119.8 v 115.4 cm height at withers, 48.2 v 44.2 cm hip width) was not associated with increased milk production once account was taken of difference in calving date;

In a second experiment, for similar skeletal size at calving, higher body condition (5.8 v 5.1 *score)* was associated with increased live weight (416 v 381 kg) and resulted in more milk (1882 v 1721 l), milk fat (88.0 v 82.2 kg) and milk protein (64.2 v 59.4 kg) to 20 weeks of lactation.

## INTRODUCTION

Milk production in the first lactation of dairy cattle is positively related to live weight at calving, although excessive rates of liveweight gain in pre-pubertal heifers may limit the productive capacity of the mammary gland (Valentine *et al. 1987).* For heifers reared on pasture in Australia, excessive rates of liveweight gain before puberty would be unusual, since the majority would generally face an extended interval of only moderate feed intake during the critical period.

However, live weight is dependent on body condition and skeletal size. Although body condition can be changed relatively quickly by short-term regulation of the feed supply, skeletal size takes longer to change and nutrition of heifers would need to be regulated from earlier in the rearing phase, If there is a difference in the relative importance of body condition *or* skeletal size for milk production, this would have important implications for rearing replacement stock.

For mature cows a positive relation has been established between body condition at calving and subsequent milk production (Grainger *et al. 1982).* The relation has not been determined for heifers, nor does there appear to have been any attempt to determine if there is a direct effect of skeletal size on subsequent production.

This paper reports two experiments which sought to determine the independent effects of body skeletal size or body condition on milk production in dairy heifers.

## MATERIALS AND METHODS

### *Experiment 1*

Nineteen monozygotic twin-sets of mixed dairy breeding were split between two treatment groups (Big and Small) when weaned at about two and a half months of age. Thereafter the groups were run separately on perennial ryegrass/white clover pastures and their feed allowances regulated to produce divergent growth, From about 14 to 18 months of age a bull was run with each group with the intention that the heifers would calve at about two years of age. Three bulls were used on a weekly rotation between groups. From 3 months before calving pasture allowance was regulated to reduce within-set difference in body

* *Dairy Research Institute, Ellinbank, RMB 2460, Warragul, Vic. 3820.*

condition at calving, by allocating animals to one of three grazing groups to gain, maintain or lose body condition.

At calving, twin-sets were selected from the original group on the basis that, within sets, there was a difference in skeletal size, little or no difference in body condition, and difference in calving date was less than three weeks. After calving in July/August, all animals grazed perennial ryegrass/white clover pastures as part of a larger herd which included mature cows. Pastures allowed full feeding until December, after which quantity and quality declined gradually and, from late January, were supplemented with silage,

### *Experiment 2*

Twenty four unrelated Friesian dairy heifers were paired, three months before calving, on the basis of skeletal size, live weight, condition score and expected calving date. Pasture allowance was regulated to produce a within-pair difference in body condition at calving at about two years of age, by allocating animals to one of three grazing groups to gain, maintain or lose body condition. After calving in July, all animals grazed together as a herd, separate from mature cows. They received a liberal allowance of high quality pasture until about mid November, after which declining quality and, by mid summer, quantity of available pasture would have limited intake.

### *Measurements*

Live weight was recorded weekly. Body condition was scored by the method of Earle (1976) on a fortnightly basis from three months before calving to two months after calving and thereafter monthly until the end of lactation. For Experiment 1, height at withers and hip width were recorded at approximately monthly intervals from weaning. For Experiment 2, height at withers was recorded three times at weekly intervals and averaged, three months before calving and again at calving.

Milk yield was recorded twice daily and a composite p.m. and a.m. sample taken once weekly to determine fat and protein content. Data were analysed by analysis of variance with blocking for twin- sets (Experiment 1) or pairs (Experiment 2).

## RESULTS

### *Experiment 1*

Of the original nineteen twin-sets, only eight met the selection criteria. Small heifers calved, on average, 13.4 days (+/- 2.9 s.e.m.) later than their Big mates. Big heifers had higher milk production to 30 weeks (Table 1) but the difference at 5 weeks was not significant ($P>0.05$).

### *Experiment 2*

Heifers calved at the same mean date. Those at higher body condition score produced more milk, milk fat and milk protein, lost more body condition, and lost, rather than gained, live weight (Table 2).

Table 1 Body measurements and milk production for heifers calving at different skeletal size (Experiment 1)

| | Size | | l.s.d. | Size | | l.s.d. |
|---|---|---|---|---|---|---|
| | Big | Small | 0.05 | Big | Small | 0.05 |
| | Height at withers (cm) | | | Hip width (cm) | | |
| Weaning | 85.6 | 84.5 | 2.3 | 24.2 | 24.0 | 0.9 |
| Mating | 113.1 | 105.6 | 3.0 | 39.4 | 35.1 | 1.9 |
| Calving | 119.8 | 115.4 | 2.4 | 48.2 | 44.2 | 1.0 |
| | Condition score | | | Live weight (kg) | | |
| Mating | na | na | - | 307 | 267 | 18 |
| Calving | 5.2 | 5.1 | 0.2 | 346 | 327 | 14 |
| 30 wk. lact. | 4.6 | 4.7 | 0.3 | 375 | 361 | 20 |
| Yields : | First 5 weeks | | | 30 week lactation | | |
| Milk (l) | 463 | 449 | 92 | 2719 | 2447 | 227 |
| Fat (kg) | 21.0 | 18.6 | 2.9 | 122 | 110 | 7.2 |
| Protein (kg) | 15.8 | 14.8 | 3.2 | 90 | 83 | 6.4 |

Table 2 Body measurements and milk production for heifers calving at different body condition (Experiment 2)

| | Body condition score | | l.s.d. |
|---|---|---|---|
| | High | Low | 0.05 |
| Calving : | | | |
| Condition score | 5.8 | 5.1 | 0.2 |
| Height at withers (cm) | 116 | 116 | 1.2 |
| Live weight (kg) | 416 | 381 | 17.3 |
| 0-5 weeks post-calving : | | | |
| Milk yield (l) | 515 | 446 | 44 |
| Fat yield (kg) | 25.4 | 21.4 | 1.6 |
| Protein yield (kg) | 18.2 | 15.7 | 1.3 |
| Condition score change | -0.14 | 0 | 0.11 |
| Liveweight change | -27 | -18 | 11.4 |
| 0-20 weeks post-calving : | | | |
| Milk yield (l) | 1882 | 1721 | 107 |
| Fat yield (kg) | 88.0 | 82.2 | 5.8 |
| Protein yield (kg) | 64.2 | 59.4 | 3.1 |
| Condition score change | -0.6 | -0.1 | 0.3 |
| Liveweight change | -9.4 | 26.5 | 16.4 |

## DISCUSSION

The effect of skeletal size on production in Experiment 1 was unfortunately confounded with time of calving. Delayed calving has been associated with lowered lactation production under seasonal pasture feeding conditions in New Zealand (MacMillan 1979), where milk fat production was reduced by about 1 kg milk fat per day of calving delay for two herds, although for a third herd an

eleven day delay in calving reduced milk fat production by only 4 kg. In our experiment there was a similar association in that a difference in calving date of 13.4 days was associated with a difference in 30 week lactation milk fat of 12 kg. Also, in our experiment, the apparent effect of skeletal size on milk fat yield was later in lactation, which indicates that the deteriorating feed conditions later in the year adversely affected the heifers which were earlier in lactation. After taking into account these effects of delayed calving, it seems that the direct effect of skeletal size was slight, Since Thomas and Mickan (1987) also found no effect of skeletal size of heifers at calving on subsequent production, it appears that skeletal size may not be important in directly influencing milk production in the first lactation,

By contrast, in the second experiment the effect of body condition score at calving was clear; an extra 8.3 kg milk fat, per unit increase in condition score, over 20 weeks of lactation. This is similar to that recorded by Grainger et *al.* (1982) for mature cows: an extra 4.0, 11.0 and 7.4 kg milk fat, per unit increase in condition score, over 20 weeks of lactation *in* three experimental groups, The relation between live weight and condition score at calving, at about 50 kg per *score,* is also similar to the 46 kg per score for Friesians reported by the same authors.

In preparation for the experiment on skeletal size, the outstanding effect of a low growth rate was demonstrated at mating. Whilst all heifers in the Big group conceived at an early stage, six of the Small gorup failed to get in calf (Chi-square = 5.0, $P<0.05$) and most of the remainder had conception delayed. These penalties emphasise the need to ensure adequate nutrition for dairy heifers, Target live weights at mating for Jerseys (210 kg) and Friesians (319 kg) have been suggested by Thomas and Mickan (1987). In our experiement mixed breeding of the twin-sets precluded direct comparison, but the mean live weight at mating of those heifers which failed to conceive (240 kg) suggests that the target weights should be regarded as minimum, rather than desirable.

It is concluded that, whilst improved body condition at first calving has a direct and positive effect on milk production, increased skeletal size may have little direct effect on milk production, provided pre-mating growth is sufficient to assure conception at the desired time.

## ACKNOWLEDGEMENTS

We would like to thank Miss B. Cooke, for technical input, and the Australian Dairy Research Council, for financial assistance.

## REFERENCES

EARLE, D.F. (1976). J. Agric. Vic. 74: 228.

GRAINGER, C., WILHELMS, G.D. and MCGOWAN, A.A. (1982). Aust. J. Exp. Agric. Anim. Husb. 22: 9.

MACMILLAN, K.L. (1979). Proc. N.Z. Soc. Anim. Prod. 39: 169.

THOMAS, G.W. and MICKAN, F.J. (1987). Aust. J. Exp. Agric. 27:481.

VALENTINE, S.C., DOBOS, R.C., LEWIS, P.A., BARTSCH, B.D. and WICKES, R.B. (1987). Aust. J. Exp. Agric. 27: 195.