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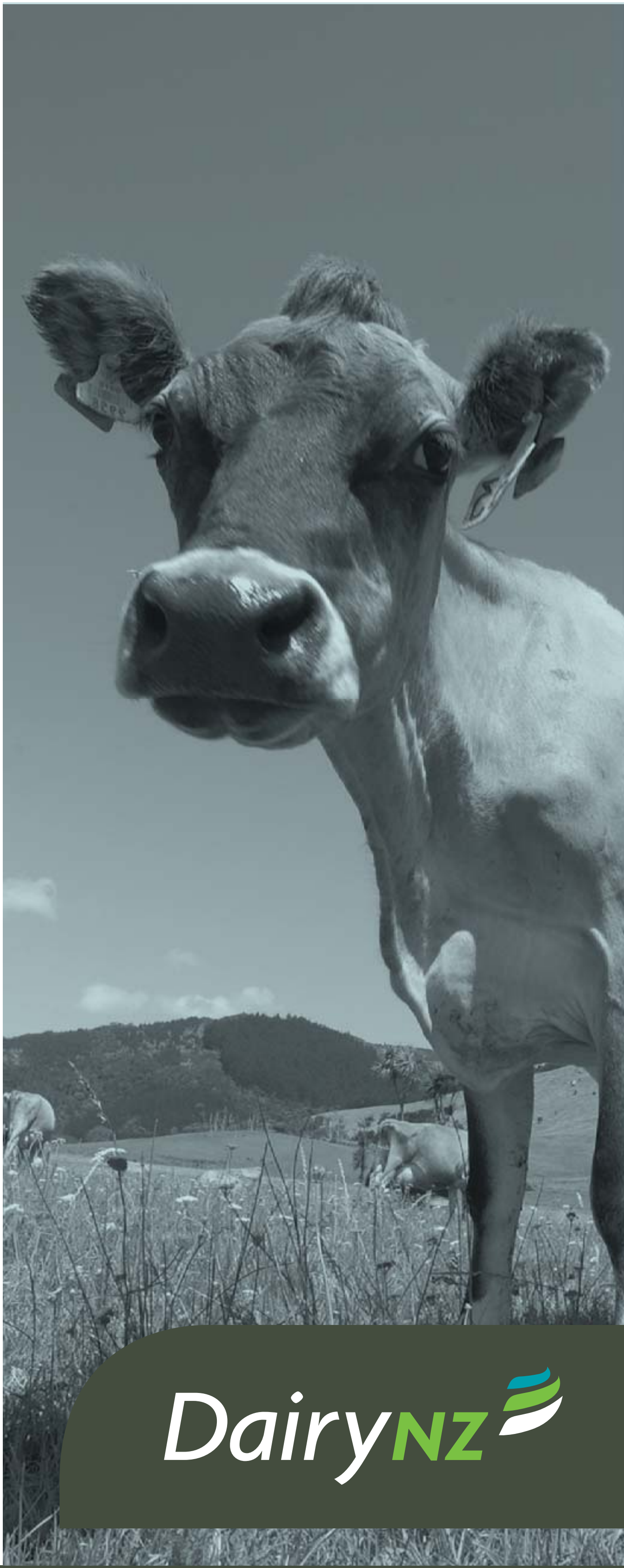

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Body condition score of 5.0 at calving – more than just a feeling!

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Summary

- Body Condition Score (BCS) is the only practical measure of the medium to long-term nutritional state of a dairy cow
- The three targets to remember are:
  - BCS 5.0 to 5.5 at calving,
  - greater than BCS 4.0 at mating, and
  - losing no more than 1.0 BCS unit in early lactation.
- These targets result in most milk production, healthiest cows, lowest animal health costs, and best fertility results
- The number of cows in a herd that are too skinny, and how they are treated, is more important than the average herd BCS
- Nutrition during early lactation has little effect on BCS. Therefore, the only way to achieve these three targets is to ensure that mature cows calve at BCS 5.0 and young cows (1st and 2nd calvers) calve at 5.5
- Failure to monitor BCS is the first barrier to achieving these targets.

The body condition score (BCS) at which a cow calves, the amount of condition she loses after calving, and the condition at planned start of mating (PSM) are recognised as being important for animal health, milk production, and reproduction.

There are also welfare considerations, with farmers increasingly being scrutinised by their urban neighbours, who, in general, regard thin cows (below BCS 3.0) as a sign of mismanagement.

A programme jointly funded by DairyNZ and the MAF Sustainable Farming Fund was initiated to collate all the available information on BCS relevant to New Zealand dairy farmers[1].

In this article, some of the important factors affected by BCS will be outlined.

Note: This article was first published in the Winter 2009 edition of DairyNewz (now Inside Dairy).

Milk production

It has been well established that milk yield is affected by the BCS in which a cow calves and by the amount of condition she loses after calving.

New Zealand data[2] indicate that milksolids (MS) yield increases as calving BCS increases (Table 1). However, the increase in MS with increasing calving BCS gets smaller as the cow gets fatter. Increasing calving BCS from 3.0 to 4.0 and 4.0 to 5.0, increases MS production by 17 kg/cow and 12 kg/cow, respectively, irrespective of cow breed. In comparison, the difference between a cow calving at 5.0 or 6.0 is only 6 kg MS.

Cows naturally lose BCS in early lactation to support the increased milk production. A cow that loses 0.5 BCS units post-calving produces 2.2 kg MS more than cows that only lose 0.25 BCS units, and a cow that loses 1.0 BCS unit produces 2.75 kg MS more than a cow losing 0.5 BCS units. However, MS production declines if cows lose more than 1.5 BCS units[1,2].

To maximise milk production, cows should calve at BCS 5.0 for mixed aged cows, BCS 5.5 for first and second calvers and not lose more than 1.5 BCS units post-calving.

Table 1. The effect of calving BCS on the marginal increase in MS production over a full lactation

	3.0 to 3.5	3.5 to 4.0	4.0 to 4.5	4.5 to 5.0	5.0 to 5.5	5.5 to 6.0
Increase in milk fat (kg)	5.2	4.5	3.7	2.9	2.2	1.4
Increase in milk protein (kg)	4.0	3.4	2.8	2.2	1.7	1.1
Increase in MS (kg)	9.2	7.9	6.5	5.2	3.8	2.5
Value ($)* - $5/kg MS	46.18	39.46	32.73	26.00	19.27	12.55
Value ($)* - $6/kg MS	55.42	47.35	39.27	31.20	23.13	15.05
Value ($)* - $7/kg MS	64.66	55.24	45.82	36.40	26.98	17.56

*assumes $/kg protein = 2 x $/kg fat

Reproduction

New Zealand data[3,4] indicate that cows calving at BCS 4.0 compared with BCS 5.0 are 7% less likely to be cycling at the PSM. Cows that have not started cycling by the PSM have a 16% lower 6-week in-calf rate, and a 6% greater empty rate[5]. Anoestrous treatment of non-cyclers will advance the timing of pregnancy, but will not necessarily improve the 6-week in-calf rate and final empty rate[6]. Non-cyclers are, therefore, a 'subfertile' group and BCS at calving is a significant risk factor for non-cycling.

Thin cows at calving don't lose as much body condition as fatter cows, but still tend to be thinner at PSM[3,4] (e.g. cows calving at BCS 4.0 tend to be BCS 3.5 at PSM, while cows calving at 5.0 tend to be BCS 4.0 at PSM). Because of this, cows calving at BCS 4.0 will have a 2-4% lower 6-week in-calf rate and a 1-2% greater empty rate than if those cows had calved at 5.0.

Cows with BCS 5.0-5.5 at calving and BCS 4.0-4.5 at mating are more likely to get pregnant than cows outside these targets. Therefore, calving at BCS 5.0-5.5 and ensuring that cows lose no more than 1.0 BCS unit post-calving will maximise their chances of getting pregnant.

Cow health

Calving BCS and the amount of weight a cow loses between calving and PSM will likely influence cow health. Recent data from DairyNZ imply that thin cows in early lactation (BCS 3.5 or less) are more likely to have a uterine infection six weeks after calving. These findings are consistent with previous research in Israel[7]. In addition, first and second calvers have an increased risk of mastitis in early lactation when thin at calving[1].

Very fat cows (>BCS 6) at calving are at risk of milk fever, difficult calvings and, as a result, still-born calves[1]. In New Zealand, however, these problems are not normally a result of excessive BCS.

Thinner cows in early lactation are more likely to have a uterine infection, while fatter cows are more likely to have a metabolic disorder at calving. A calving BCS of 5.0-5.5 ensures cows are as healthy as possible in early lactation.

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Sex ratio of calves

A recent discovery at DairyNZ[8] is that the fatter a cow is at calving (i.e. BCS 5.0 vs 4.0) then the more likely she is to have a heifer calf the following year. Most people believe that there is a 50:50 chance of a cow giving birth to a bull or a heifer. However, birth sex ratio is normally skewed slightly towards bulls (52% of calves are bulls[8]). These data, therefore, highlight that herds calving at BCS 4.0 will have 4% fewer replacement heifers than cows that calve at 5.0.

A cow that calves at BCS 5.0-5.5 is more likely to have a heifer calf the following year than one that calves too thin.

Body Condition Score targets

All these results point to a target BCS of 5.0 at calving for mature cows (5.5 for first and second calvers), 4.0 at PSM, and a BCS loss of no more than 1.0 BCS unit after calving. These targets result in cows producing the most milk, being most healthy, cycling as early as possible, and having the greatest chance of getting in calf early in the breeding season.

The level of feeding or type of feed that cows receive in early lactation has been demonstrated to have very little effect on BCS[9]. Therefore, the most effective way to achieve all these targets is by calving cows at BCS 5.0-5.5.

Most cows that calve at BCS 5.0-5.5 will not lose more than 1.0 BCS unit after calving and will be greater than BCS 4.0 at mating. Cows that lose more than 1.0 BCS unit after calving will produce more milk when offered supplement, and will not partition supplementary feed towards BCS replenishment.

BCS 3

BCS 4

BCS 5

BCS 6

Monitoring and acting on BCS information

Assessing BCS does not need to involve all cows in the herd. A random sample of 70 cows is sufficient to ascertain both the average herd BCS and the proportion of cows that are too thin or too fat.

The four crucial times of the year to measure BCS are end of mating, late lactation, two weeks pre-calving, and two weeks before mating starts.

These are strategic decision-making times for implementing options for managing herd condition. Useful information about this is available on pages 59-69 of the *InCalf Book for New Zealand Dairy Farmers.*

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Achieving Body Condition Score Targets – what's in it for you?

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Summary

- An average body condition score (BCS) of 5.0 for mixed age cows and 5.5 for first and second calvers is still the target to maximise profitability and sustainability of the farm system
- Body condition score 5.0 for mixed age cows and 5.5 for first and second calvers achieves a good balance between maximising milk production and reproduction potential and animal health
- There are many effective ways of achieving these targets, including using once-a-day milking in late lactation, providing supplements to cows in late lactation and when dry, and by drying cows off during the autumn depending on their BCS
- Combinations of these have been evaluated and operating profit/ha can be increased by up to $270/ha, compared with a herd average calving BCS of 4.25
- In addition, achieving the calving BCS targets has many other benefits for the sustainability of the farm system, such as the ability to cull more on production or run a lower replacement rate and having a buffer for really wet springs.

For almost three decades, industry experts have recommended a body condition score of 5.0 for older mixed age cows and 5.5 for first and second calvers at calving. This figure is a compromise between maximising a cow's milk production and reproduction potential, while not compromising her health at calving by having her too fat[1]. Although body condition score (BCS) of 5.0 is generally accepted by most as the appropriate target, calving BCS on many well managed farms has tended to decrease, with cows calving between 4.0 and 4.5 in recent years. Should the recommendations change?

The value proposition

Cows calving at less than BCS 5.0 (and younger cows less than 5.5) will produce less milksolids, take longer to cycle, and have lower conception rates early in the breeding period (See *Technical Series* article – Body Condition Score 5 at calving – more than just a feeling on pg 2 by Roche et al). Obviously, this negatively affects farm revenue and has the potential to reduce profit. However, historical financial analyses have not been able to properly account for all benefits and costs, making the value proposition of achieving the calving BCS targets difficult to calculate. Advances in computer modelling have allowed the different factors important in this question to be accounted for, allowing the true value of calving BCS to be determined.

Different approaches being taken by farmers

There are many different ways used to get cows to a calving BCS of 5.0. "Early dry-off decision rules" were developed when the price of feed supplements relative to the price of milk made supplementation uneconomic. These decision rules involve assessing cow condition during February, March and April and cows are dried off each month if under certain progressive BCS thresholds (*DairyNZ Facts and Figures for New Zealand Dairy Farmers*, pg 38).

These thresholds enable cows to achieve the desired calving BCS if offered sufficient pasture (approximately 10 kg DM/cow/day). However, incorporation of maize silage into some farm systems, the importation of less expensive supplements (e.g. PKE), the development of brassica-based wintering systems in the South Island, and higher milk prices have led to longer lactations and the use of these feeds to gain BCS either during late lactation or the dry period. In addition, use of once-a-day milking (OAD) after Christmas is used successfully on many farms to improve lifestyle and allow cows to recover BCS during lactation.

Which option or combination of options to help achieve BCS 5.0 at calving is most profitable?

Farmax Dairy Pro (**farmax.co.nz**), a computerised model of a dairy farm, has been used to help understand the relative impact of these different management strategies on farm profitability. The results presented are for one complete season but include the effects of different management in the autumn on the following spring. A typical low input (System 2) North Island farm on which cows are dried off mid-May and calved at an average BCS of 4.25 (Base) was compared with farms that achieved a BCS of 5.0 at calving using the following management strategies:

- **Dry-off rules** – Only difference to base is the use of the "early dry-off decision rules", with cows deemed to be thin at the time of measurement being dried off. Slightly more total supplement used to get dry cow intakes to 10 kg DM/day.
- **Dry-off -1 month** – Drying the whole herd off a month earlier than the base to have enough feed to get to target BCS before winter. More supplements needed to get to target BCS despite drying off one month earlier.
- **Dry-off -2 weeks + supp & no feed pad** – Drying the whole herd off two weeks earlier (early May) and feeding supplements to dry cows to gain condition before winter
- **Intensify & feed pad** – Additional supplements fed in late lactation and to dry cows during winter on a feed pad to gain condition, milking for an extra ten days and drying off late May
- **OAD & dry-off rules** – Whole herd OAD milking from 1 January and applying the dry-off decision rules
- **OAD + supp & no feed pad** – Whole herd OAD milking from 1 January plus additional supplements fed to the milkers, milking for an extra ten days (dry-off late May)

Key features of the different systems are presented in Table 1

Table 1. Key features of farms where calving BCS was 4.25 (Base) compared with systems designed to achieve a calving BCS of 5.0 (5.5 for young cows) with a $6.00/kgMS milkprice and 31 cents/kgDM imported feed cost

	Base	Dry-off rules	Dry-off – 1 month	Dry-off – 2 weeks + supp & No feed pad	Intensify & Feed pad	OAD & dry-off rules	OAD + supp & No feed pad
MS/ha - to factory	939	949	934	952	1050	950	990
MS/ha June – Dec[2]	669	694	692	691	696	698	699
MS/ha Jan – May[2]	285	268	255	273	366	264	305
Lactation length (days)	275	246	243	258	285	269	285
APC at calving (kg DM/ha)	2150	2150	2150	2150	2150	2150	2150
BCS at calving	4.25	5.0	5.0	5.0	5.0	5.0	5.0
Herd BCS 1 May	4.0	4.2	4.3	4.0	4.1	4.9	5.0
Feed costs per cow ($)	114	167	153	172	258	133	197
Operating expenses ($/kgMS)	4.63	4.74	4.77	4.74	4.73	4.52	4.53
Stock sales ($/kgMS)	0.35	0.35	0.36	0.34	0.31	0.36	0.34
Reproductive benefits ($/ha)		91	91	91	91	91	91
Operating profit/ha ($/ha)[1]	1615	1618	1569	1615	1754	1835	1885

[1] Operating profit/ha ($/ha) = (MS/ha x milk price) + (MS/ha x stock sales ($/kgMS)) + reproductive benefits ($/ha) – (operating expenses ($/kgMS) x MS/ha)

[2] Difference between MS/ha produced and production to factory explained by milk fed to calves and rounding errors.

(cont'd p8)

(cont'd from p7)

Trade-off between condition and days in milk

Several of the options (dry-off rules, dry-off -1 month, dry-off -2 weeks + supp) analysed, involved drying off all or part of the herd earlier than the base scenario (18 May), reducing lactation length. In these situations, there was little difference in average milk production per cow or per ha, as the cows on the base farm produced more milk in autumn and the farms that achieved BCS 5.0 at calving produced more at the start of lactation.

Although the cows in better condition cycled earlier and had a better reproduction outcome, more feed was required. It is more energy efficient to use autumn feed to put milk in the vat than use it to build body condition that is then mobilised for milk production in spring. The extra feed required to gain the additional BCS unit was of a similar economic value to the value of improved reproductive performance. Hence, there was no difference in operating profit from achieving the BCS at 5.0 by drying cows off earlier, compared with the base scenario of milking longer and calving cows at BCS 4.25. However, there are other factors to consider:

1. The production lost in autumn from drying off early had a negative impact on the farm's cashflow.
2. Cows that calve thin are thinner in early lactation. A herd that calves at BCS 4.25 will have an average BCS in a good spring before mating of around 3.5. This means that a proportion of cows will be thinner than farmers' obligations under the Dairy Cattle Code of Welfare and may be at an increased risk of mastitis and other diseases
3. Cows that calve thin will cycle and get pregnant later, increasing the need for CIDRs this year and inductions the following year. While the economics of this has been taken into account, there are now restrictions on inductions, the calving pattern is likely to be more spread out and the financial losses greater than the $40 per BCS used in this study
4. Calving at BCS 4.25 is very risky should the spring be very wet, as there is no spare cow condition to buffer feed shortages and animal welfare may be an issue
5. Improved reproductive performance due to calving at BCS 5 results in an ability to cull more cows on production or genetic merit, thereby improving the value of the herd.

Autumn supplements to milking cows

In situations where pasture growth in late summer/ autumn limits lactation length and feeding levels, supplements such as PKE and maize silage can be fed to late lactation cows profitably if they are purchased for less than 5% of milk price (i.e. less than 35 c/kg DM at $6.90 milk price) and lactation length is increased. However, this has only a small effect on BCS gain (around 0.2 BCS units for 300 kg DM of supplement per cow). Furthermore, as with the early dry-off decision rules, better condition cows in early lactation, and with better reproduction, would result in a more sustainable system when use of CIDRs or induction are significantly curtailed. If wet conditions are common in the autumn limiting the ability to feed out, then the expense of constructing and maintaining a feed pad can be justified with supplements purchased for less than 5% of milk price.

Supplements to dry cows for BCS gain

Feeding supplements to dry cows (maize silage, PKE) to gain condition up to BCS 5.0 is one of the most profitable ways to use supplements if it is practical - supplement wastage and feed out costs must be minimised. If cows have to be dried off earlier, to allow supplement to be fed to dry cows because weather limits the ability to feed out later in the season, then profit won't be increased. However, use of CIDRs and induction in subsequent years will be reduced.

If a feed pad is necessary to make supplement feeding to dry cows practical, the expenses associated with construction and maintenance cannot be justified solely by the profitability of feeding supplements to dry cows. However, if a feed pad is necessary to feed supplements to milking cows and used to reduce pugging, it may be profitable to install a feed pad.

Part-season once a day milking

Two of the options (OAD & dry-off rules and OAD + supp) used OAD milking for the whole herd from 1 January onwards. Both of these options showed the greatest operating profits. In the OAD options, milk production was suppressed in mid/late lactation and the herd gained condition over this period. By late lactation the herd was close to calving condition and could be milked on longer than other options that achieved target BCS without additional feeding over the winter. Total production was maintained or improved while also gaining the reproduction benefits of attaining target BCS.

This was most evident when the two options that applied the dry-off decision rules were compared. The OAD & dry-off rules increased average lactation length by 23 days as fewer cows were dried off at each trigger point because they were in better condition. As a result, total production was maintained despite lower average daily per cow production during the second half of the season for the OAD & dry-off rules option.

Furthermore, energy was conserved through reduced walking so that BCS targets were achieved with little additional supplement. There were further advantages in operating expenses, such as casual labour, electricity and repairs and maintenance, which were reduced by part-season OAD.

Table 2. Effect of milk price and supplement price on the operating profit ($/ha) of two potential management strategies to ensure a herd average BCS of 5 at calving compared to the base scenario. Figures in bold are under the base assumptions used.

	OAD & dry-off rules vs. Base			Intensify vs. Base		
	Supplement price			Supplement price		
	40 c/kg DM	31 c/kg DM	22 /kg DM	40 c/kg DM	31 c/kg DM	22 c/kg DM
Milk price $5.00/kgMS	+203	+209	+215	-82	+29	+141
Milk price $6.00/kgMS	+214	+220	+226	+28	+139	+250
Milk price $7.00/kgMS	+225	+231	+237	+138	+249	+360

Sensitivity

The sensitivity of two of the most profitable management scenarios (OAD & dry-off rules and Intensify & feed pad) to changes in milk price and supplement cost were tested. These were compared with the base scenario shown in Table 2.

The part-season OAD utilising the dry-off rules was the most profitable low input option (Table 1). Total production and the amount of imported feed were similar to the base scenario therefore the advantage is similar across a range of milk prices and feed costs. The increased profitability was the result of the economic benefit of improved reproductive performance along with the lower cost of milking the herd OAD for part of the season.

The option to install a feed pad and feed 1.33 tDM/ha of supplement more than the base scenario was the most profitable twice a day (TAD) milking option. Extra production of 111 kg MS/ha was attained with additional costs, feed, feeding out and costs relating to the feedpad investment. Profit was highly dependent on the ratio of feed to milk price. The option to intensify only becomes more profitable than the optimal low input scenario when feed costs are low and milk price high.

What about my farm?

The results presented will change according to some situations on farm:

- Where a feed pad has already been constructed the economic costs associated with it will largely be incurred regardless of how much it is used. In this case the "Intensify & feed pad" option involving late lactation feeding to extend lactation and additional supplementary feed to dry cows will be more profitable than the OAD options
- Where feed supply in the second half of the season is relatively good, the OAD options will not be as attractive as there is not the same trade-off between autumn production and attaining BCS targets. When pasture availability is good the relative decline in production due to OAD will be greater. Farms with relatively low stocking rates, consistently wet summers or very good winter growth will fall into this category
- On extremely wet farms, the option to build a feedpad could be economically viable due to the ability to reduce pugging damage and reduce supplement wastage. Under these circumstances the farm would fall into the same category as farms that already have a feedpad and therefore the OAD options will not be as attractive as the "Intensify & feed pad" option.

Friendly warnings

- These are computer modelled data and require validation in a farm system
- The model assumes crude protein is not limiting in the diet
- All of the scenarios assume that management options are not limited by high somatic cell counts (SCC). OAD options are not suitable for herds with a high SCC as SCC will approximately double when going OAD and will stay approximately 50-100,000 higher than they would have being twice daily milked
- Some cows/breeds are more suited to OAD milking than others
- The advantages of OAD can only be realised when longer lactations are achieved i.e. the cows do not need to be dried off for other reasons such as SCC or a lack of feed.

(cont'd p10)

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Various options

This study has identified that there are several profitable options available to help attain an average herd BCS of 5.0 at calving. Which option is chosen on a particular farm will depend on what is practical on that farm and what strategies best line up with the farmer's interests and goals.

In summary:

- Trading off autumn production for BCS has similar profitability compared with extending lactation length
  - Although milking on and calving cows at a low BCS may show similar profitability this option risks maintaining a compact calving spread and contravening animal welfare standards
- Autumn supplements to lactating cows can be profitable if they are purchased for less than 5% of milk price (i.e. less than 35 c/kg DM at $6.90 milk price) and lactation length is increased.
- Autumn supplements to lactating cows will contribute only a small amount to increasing herd BCS
- Supplement feeding to dry cows above maintenance is a profitable way to get to BCS 5.0
- OAD milking in mid-late lactation can be a profitable strategy as it largely eliminates the trade-off between lactation length and attaining BCS targets.

Is an average herd body condition score at calving of 5.0 still the target?

This study has identified that with changing economic conditions there are now several profitable alternatives to trading off autumn production to reach target BCS on a low input North Island farm. Management options to reach target BCS such as part-season OAD, supplement feeding to dry cows and late lactation supplements can be used to reach target BCS at calving and increase profit. Furthermore, calving at BCS of 5.0 improves the sustainability of the system through alleviating welfare concerns, reducing the need for reproductive intervention and inductions, reducing the risks associated with a wet spring and increasing the ability to cull on production rather than reproduction.

So it is an emphatic Yes, an average herd body condition score at calving of 5.0 is still the target.

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Replacement heifers – rearing the next generation

Kevin Macdonald; DairyNZ Senior Scientist Farm Systems

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Summary

- Mature live weight (Lwt) should be 500+ LWT BV:
  - 425 kg for Jersey cows
  - 475 kg for Kiwi-cross cows
  - 525 kg for NZ Holstein-Friesian cows
  - 550 kg for North-American/Dutch Holstein-Friesian cows
- Live weight targets are:
  - 20% of mature Lwt at 3 months (weaning)
  - 50% of mature Lwt at 11-12 months (puberty)
  - 60% of mature Lwt at 14-15 months (breeding)
  - 90% of mature Lwt at 22 months (pre-calving)
- If live weight gain is too fast before puberty, the milk production potential of the cow will be reduced.
- Live weight gain before breeding should be:
  - 0.55 kg/d for Jersey cows
  - 0.60 kg/d for Kiwi-cross cows
  - 0.65 kg/d for NZ Holstein-Friesian cows
  - 0.65 kg/d for North-American/Dutch Holstein-Friesian cows
- Live weight gain after breeding should be increased to:
  - 0.60 kg/d for Jersey cows
  - 0.70 kg/d for Kiwi-cross cows
  - 0.75 kg/d for NZ Holstein-Friesian cows
  - 0.80 kg/d for North-American/Dutch Holstein-Friesian cows
- Irrespective of breed, each kg of Lwt at 22 months (up to the target Lwt for the breed) is worth 0.14 kg fat and 0.10 kg of protein or $1.63 at the current milk price ($6.90 /kgMS).

Rearing replacement heifers is a considerable cost to the farm business and needs to be done properly so that maximum value can be extracted from the investment. A major experiment undertaken in New Zealand during the 1990s defined the impact of heifer growth rate and live weight (Lwt) on milk production, mature Lwt, and herd fertility[1]. These results help define the ideal Lwt at calving, the best way to achieve that Lwt, and the consequences of failing to achieve it.

What is the ideal live weight at first calving?

Mature Lwt should be slightly more than twice the Lwt of the cow at puberty[2,3]. Live weight at puberty is relatively consistent across feeding regimes within breeds[4,5,6]. New Zealand data indicate that Jersey, NZ Holstein-Friesian (HF) and North American/Dutch (NA) HF reach puberty at 180-200, 250-255 and 270-275 kg Lwt, respectively, and from this it is estimated that Kiwi-cross cows will reach puberty at around 215 kg Lwt. These data allow us to estimate what mature Lwt should be for each breed (Table 1).

Does live weight at first calving affect milk production?

Many studies have reported milk production benefits from increased first-calving Lwt in grazing heifers[7,8,9,10], but other studies identified no effect of animal size at first calving[11,12,13]. In a large New Zealand study[1], increased Lwt at first calving as a result of pre-pubertal nutrition reduced milk production, whereas, increased Lwt as a result of post-pubertal nutrition increased milk production. This effect of timing of Lwt gain relative to puberty may help explain some of the inconsistency previously reported. It also suggests that the effect of heifer size on subsequent milk production is not as simple as merely first-calving Lwt, but also involves the 'pathway' by which that final Lwt was achieved. It is, therefore, important to target Lwt gain at key times.

(cont'd p12)

(cont'd from p11)

Targeting live weight gain

In general, there is a negative effect of rapid pre-pubertal Lwt gain on subsequent milk production, regardless of the age at first calving[14,15,16,17,18]. New Zealand research results[1] confirmed this effect under pasture-based systems, indicating a 6 to 12% reduction in annual milksolids production in New Zealand HF and Jersey heifers achieving pre-pubertal growth rates of 0.80 and 0.65 kg/day, respectively, versus heifers growing at 0.40 and 0.35 kg/day, respectively, provided the heifers with low pre-pubertal growth rates had compensatory growth after puberty and still achieved 22 month Lwt targets.

The collective data indicate that if Lwt gain is too rapid pre-puberty, life time milk production will be less. Therefore, slow pre-pubertal Lwt gain is recommended. However, it is still necessary to grow heifers sufficiently quickly such that they achieve puberty by 11-12 months of age and can be bred before 15 months of age to fit into a seasonal calving system, with heifers calving at 24 months of age. The growth rates required to achieve the dual goals of limited pre-pubertal growth rate and puberty before 12 months of age are presented in Table 1.

What is the cost of failing to achieve the target Lwt at 22 months?

If growth rate targets are not achieved before puberty, the onset of reproductive activity will be delayed. Failure to reach puberty before 12 months, therefore, increases the risk that heifers will not conceive early and may require treatment to start cycling. This will delay their subsequent calving and increase the likelihood that they will be culled in their first season.

Assuming pre-pubertal Lwt gain is sufficient to achieve puberty at 11-12 months, but not so high as to reduce milk production, failure to achieve 22 month Lwt targets will result in reduced milk production during the first lactation, when light heifers partition more of the energy consumed to Lwt gain.

New Zealand research results suggest that each kg Lwt below the 22 month target reduces production by 0.14 kg fat and 0.10 kg protein, irrespective of breed. At milk prices of $6.90/kg milksolids, this is equivalent to $1.63/kg Lwt before the 22 month target. A kg Lwt gain requires calves to eat approximately 45 MJ metabolisable energy (approx. 4 kg DM). The value of each kg of Lwt, up to the target for the breed, at different milksolids prices is presented in Table 2.

Recently published by DairyNZ – Science Conference Publications

DairyNZ researchers publish their findings in high calibre national and international journals, so they remain at the leading edge of dairy industry research.

Clark C., D. A. Clark, D. Waugh, C. G. Roach, C. B. Glassey, S. Woodward, E. Minnee, and D. Woodfield. 2010. Alternative systems to increase grazeable forage production in the Waikato. Pages 49-54 in Proceedings of the New Zealand Grassland Association, Lincoln University, Christchurch, New Zealand.

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Glassey C., C. Roach, M. Strahan, and N. Mclean. 2010. Dry matter yield, pasture quality and profit on two Waikato dairy farms after pasture renewal. Pages 91-96 in Proceedings of the New Zealand Grassland Association, Lincoln University, Christchurch, New Zealand.

Jago J., and J.L. Burke. 2010. An evaluation of two pastoral dairy production systems using automatic milking technology. Pages 109-116 in Proceedings of the New Zealand Grassland Association, Lincoln University, Christchurch, New Zealand.

Lee J., D. Donaghy, P. Sathish, and J. R. Roche. 2010. Perennial ryegrass regrowth after defoliation - physiological and molecular changes. Pages 127-133 in Proceedings of the New Zealand Grassland Association, Lincoln University, Christchurch, New Zealand.

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Minnee E., T. Knight, L. Sutherland, B. Vlamming, L. Fletcher, and D. A. Clark. 2010. Herbage production from perennial ryegrass and tall fescue pastures under irrigation in Canterbury and Waikato Regions of New Zealand. Pages 185-189 in Proceedings of the New Zealand Grassland Association, Lincoln University, Christchurch, New Zealand.

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Table 1. Growth rates (kg/day) during the different periods of the heifer's growth cycle that facilitate the dual goals of limited pre-pubertal growth rates, but achieving the milestones required for a seasonal breeding system. The % of mature Lwt at the end of each growth stage is also presented.

Breed (mature Lwt)	% mature Lwt	Jersey (425kg)	Kiwi-cross (475kg)	NZHF (525kg)	NAHF (550kg)
Growth rate to weaning	20	0.65	0.70	0.80	0.85
Growth rate to breeding	60	0.55	0.60	0.65	0.65
Growth rate post-breeding	90	0.60	0.70	0.75	0.80

Table 2. Value of each kg of Lwt up to the breed 22 month target Lwt at different milksolids prices.

	Milksolids price			
	$4.50	**$5.50**	**$6.50**	**$7.50**
Value of 1 kg Lwt up to target, $	1.07	1.30	1.54	1.78

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Planning for healthy young stock

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The replacement stock for the dairy farm capture a significant amount of investment and potential for future profitability yet their priority in management is often extremely low. Early in their lives this may result from staff workload, especially at calving time. For many farmers the responsibility is then shipped elsewhere and to someone else while home-reared calves and heifers often have to make do with what resources are left after the milking herd.

Achieving good growth through sufficient feeding and parasite control is one thing, but other aspects of health management and the related biosecurity of calves are two key areas where a little effort can result in big advantages when the animals finally join the milking herd. It is easy to forget that many diseases diagnosed, and the accompanying morbidity in adult cows, start with infection of the very young. Two major diseases worthy of attention in young animals are

- *BVD (bovine viral diarrhoea) which limits production, causes reproductive losses and may lead to death and*
- *Johne's Disease, revealed as chronic wasting in older cows.*

Both these diseases can be transmitted vertically i.e. between generations, so management starts with the planning of breeding, only to breed, especially replacements, only from cows in good health.

The BVD virus can cross the placenta to the foetus so an infected dam will produce an infected calf. The health status of all cows should be considered in herds where BVD has been found or suspected. An added complication is that any cow or heifer with a new infection during the first 150 days of pregnancy will produce a calf with an immune system tolerant of the virus.

It will be persistently infected, ill thrifty and secrete virus; so it is a significant source of infection to other naive animals. Infected heifers that survive long enough to calve have been shown to have lower rates of growth, produce only half the expected milk in the first lactation, suffer multiple other infections and have a shorter lifespan[1].

The virus is transmitted via many body fluids, so horizontal transmission to naive herd mates is a risk especially when animals from different sources are co-mingled, as happens when calves and heifers are pooled from different farms in commercial rearing enterprises.

Management of BVD requires good biosecurity practice and a robust herd health record system. Bulk milk can be screened for presence of the virus or antigens to indicate relative risk in a herd, whilst individual animal tests are valuable in identifying carriers. For problem herds, vaccines are available.

BVD has become endemic in many cattle populations but it can be managed successfully. In Scandinavia and Scotland total eradication campaigns are underway with some success. For the individual New Zealand farm, having a closed herd policy, screening the milk vat annually, only accepting animals tested free of the virus on to the farm (including bulls) and home-rearing all replacement stock are essential components of a control strategy to remain BVD free. The run-off, where contact with other animals can never be excluded, may be the weak link in the chain.

Similar principles apply with Johne's Disease. It is a bacterial infection by an organism that is very common in the environment and affects many other species including sheep, deer, and rabbits. Most new infections occur in the first 6 months of life and calves are particularly at risk in their first 30 days. Infected animals excrete the bacteria (*Mycobacterium avium paratuberculosis* or MAP) in faeces in increasing amounts over years as the infection develops. Even then, the disease usually remains subclinical in dairy cows with only occasional animals showing the classical wasting, persistent scouring and loss of body condition. Only in these older and clinically affected animals are the bacteria likely to be found in milk or colostrum.

Hygiene with young calves is paramount in Johne's Disease control programmes especially avoiding faecal contamination from older cows. Separation of the calf from the cow soon after birth is important provided it can be guaranteed that adequate colostrum is being fed.

Immediate post calving management needs care. Each calf has to receive sufficient colostrum from a healthy dam. This is the best use of colostrum. Where dam health has not been properly considered then cross feeding of colostrum from another or mixture of dams potentially carries a significant risk. Pasturisation of pooled colostrum can be a useful tool in a control programme.

Good practice also includes

- not mixing groups of young animals from separate locations until a quarantine period has been observed
- maintaining a closed herd as the best insurance to prevent disease entry
- a herd health plan. This is essential for every dairy farmer. Many apply such schemes but only to the milking herd. When making the plans for next season, engage the veterinarian to include all youngstock as well.

DairyNZ supports BVD research in collaboration with Eltham District Veterinary Services. Johne's Disease research is supported by DairyNZ through the Johnes Disease Research Consortium.

BVD

- Bovine viral diarrhoea virus may affect up to 60% dairy cows and 90% herds
- Estimated annual cost of BVD infection to the NZ dairy industry is more than NZ$23M, or NZ$11,334/herd[2]
- Effects include diarrhoea, impaired reproductive performance, reduced immune function, mucosal disease
- Control includes removing infected animals, vaccination, closed herd (see **controlbvd.org.nz**)

Johne's Disease

- Johne's Disease is a bacterial infection. Clinical disease has been reported from 20% of dairy herds over a three-year period probably with up to 60% of animals infected[3]
- Estimated annual cost of Johne's Disease to the NZ agricultural sector is more than NZ$40M[4]
- Effects increase with age, including diarrhoea, reduced milk yield and wasting (usually from around 4 years of age)
- Animals are infected for life: there is no known cure
- Control includes good hygiene especially for young calves, removing infected animals and maintaining a closed herd.

Good agricultural practices for animal health must include

- Manage the herd to resist disease
- Prevent entry of disease onto the farm
- Isolate sick animals
- Have an effective herd health management programme in place
- Practice good hygiene and pest control
- Use all chemicals and veterinary medicines as prescribed
- Train people appropriately.

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Focus on international research

The following is a brief summary of some key science papers recently published

Norman and others (2010) Use of sexed semen and its effect on conception rate, calf sex, dystocia and stillbirth of Holsteins in the United States. Journal of Dairy Science 93:3880-3890.

Sexed semen has been used successfully for more than 10 years, resulting in 85 to 90% heifer calves. Conception rate, however, was 20 to 30% lower than for non-sexed semen, even in heifers (39 vs 56%). Difficult calvings were fewer when sexed semen was used, probably because of the greater proportion of heifers. Twinning percentage was not different when sexed or conventional semen was used.

DairyNZ comment: Sexed semen is a reliable technology that will become more available. The greatest consideration for New Zealand farmers will be dealing with the lower conception rate from sexed semen. Improvements in technology will likely see this difference in conception shrink with time.

Schutz and others (2011) Dairy cattle prefer shade over sprinklers: Effects on behavior and physiology. Journal of Dairy Science 94: 273-283.

The effect of water sprinklers or shade on heat stress were evaluated in a New Zealand study. Cows that chose to use sprinklers were cooler and were less annoyed by insects. Despite these advantages, cows preferred shade over sprinklers and ambient conditions (no cooling) and this preference increased with ambient temperatures and wind-speed, but decreased with humidity. Results highlight the benefit of shade and sprinklers in heat stress abatement and the need for air movement under the shade provided for effectiveness in reducing heat stress.

DairyNZ comment: Shade or sprinklers can be used effectively to reduce heat stress in dairy cattle but air movement must be considered as part of the heat stress abatement policy, particularly in humid areas.

Duarte and others (2011) The effect of bovine milk lactoferrin on human breast cancer cell lines. Journal of Dairy Science 94: 66-76.

The effects of a protein in cows' milk (lactoferrin) on human breast cancer cells were studied. Lactoferrin decreased cancer cell viability by 50% and increased cancer cell death (apoptosis) about two-fold. Proliferation (growth) rates of the cancer cell lines decreased by 40 to 60%. Results suggest that lactoferrin interferes with some of the most important steps involved in cancer development.

DairyNZ comment: Contrary to common nutritional messages, consumption of dairy products can have some very positive effects on human health. More of these beneficial effects are being identified and reported. The industry must continue to educate the consumer on the place for dairy products in a balanced diet.

Pinedo and others (2011) A retrospective study on the association between different lengths of the dry period and subclinical mastitis, milk yield, reproductive performance, and culling in Chilean dairy cows. Journal of Dairy Science 94: 106-115.

This study examined the effect of dry period length in 12,000 cows from 239 herds. Dry period lengths varied from 0 to 250 days. Very short (<30 days) or very long (>143 days) dry periods resulted in reduced milk production. Dry periods greater than 77 days were associated with a higher SCC in early lactation and poorer reproduction. Cows with dry periods less than 30 days or greater than 143 days had an increased risk of culling. Optimal dry period length in this study was 53 to 76 days.

DairyNZ comment: Average dry period length in New Zealand is greater than 100 days, suggesting that a proportion of the herd are at a slightly increased risk of higher SCC and poor reproduction. These findings require validation using New Zealand data.