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Influence of dairy cow genotype on milksolids, body condition and reproduction response to concentrate supplementation

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ABSTRACT

Responses to supplementary feeding overseas (OS) and New Zealand (NZ) Holstein-Friesian (HF) cows were investigated over two years using 57 cows receiving a high pasture allowance and 0, 3 or 6 kg concentrate DM/cow/day. Cows of similar Breeding Worth (\$BW) grazed as a single herd and were individually fed a grain-based supplement. Important production genotype x diet interactions of a scaling nature were detected. Across all supplementation levels, OS cows gave a greater ($P < 0.05$) linear production response than NZ cows (74 vs 37 g MS/kg concentrate DM; 1.22 vs 0.67 kg milk/kg concentrate DM consumed, respectively), but gave a similar response in live weight and condition score gain during lactation per kg of concentrate DM consumed. However, because OS HF appeared to have a larger relative feed deficit than NZ HF when fed *ad libitum* on pasture, OS HF maintained a lower body condition score throughout lactation and produced less milksolids (as a % of live weight). Current supplementary feeding decision rules which recommend reducing supplementary feed use when abundant pasture is available remain appropriate for high \$BW NZ HF cows. However, reasonable responses to high-energy supplements will continue to be obtained from high \$BW OS HF cows, even when pasture supply appears adequate to meet cow requirements. Use of indicators of relative feed deficit such as milksolids as a % of live weight and body condition score, may be a better guide to predicting the production response to supplementation, rather than decision rules based on genotype.

Keywords: Holstein-Friesian; genotype; supplements.

INTRODUCTION

Current guidelines recommend that it is generally uneconomic to use supplements when the supply of good quality pasture is sufficient to meet herd demand (Penno, 1998; Macdonald, 1999; Holmes *et al.*, 2002). This is because much of the supplement simply substitutes for pasture, and milksolids (MS) response is consequently low.

However, previous comparisons of New Zealand (NZ HF) cows and overseas Holstein-Friesian (OS HF) cows of North American and Dutch origin have reported OS HF to have low body condition, poor fertility, and lower pasture intake (as a % of live weight) than NZ HF, even when pasture is available *ad libitum* (Kolver *et al.*, 2002). While these results question the suitability of cows with these characteristics for seasonal pastoral systems, the current genetic composition of the national herd and prevalence of OS HF sires means that farmers will need to make management changes in the coming years to maintain a compact calving, cows in suitable body condition, and a low involuntary cull rate. The results of Kolver *et al.* (2002) suggest that compared with NZ HF, OS HF cows experience a larger feed deficit relative to their requirements when pasture availability is high. As a consequence, production responses to supplementary feed may be larger than previously expected for NZ HF.

The current two-year study was designed to update decision rules for supplementary feeding. In particular it tested the hypothesis that NZ HF would give low MS responses, and OS HF high MS responses, when a high-energy supplement was fed to cows

grazing at a high pasture allowance (approximately 50 kg DM/cow in spring and 70 kg DM/cow in summer) and producing at high levels (462 kg MS/cow on pasture alone). This study also tested the amount of high-energy supplementary feed required to increase body condition of OS HF, and the subsequent effect on fertility.

MATERIALS AND METHODS

Design

Primiparous and multiparous OS and NZ HF grazed pasture and were fed 0, 3, or 6 kg DM/cow/day of a pelleted concentrate supplement (60% maize grain, 31% barley grain, 7% molasses, and 2% broil on a DM basis) at the Dexcel Lye Dairy during the 2002/2003 and 2003/2004 seasons. Cows were re-randomised at the beginning of the second season. The six treatments in this 2x3x2 factorial experiment used 54 cows in 2002/2003 and 59 cows in 2003/2004 and were: NZ0 (n = 9 2002/2003; n = 10 2003/2004); NZ3 (n = 9 2002/2003; n = 10 2003/2004); NZ6 (n = 9 2002/2003; n = 10 2003/2004); OS0 (n = 8 2002/2003; n = 9 2003/2004); OS3 (n = 10 2002/2003; n = 10 2003/2004); and OS6 (n = 9 2002/2003; n = 10 2003/2004). Average age distribution within treatments was 19% first-lactation, 14% second-lactation, and 67% mixed age (third- to sixth-lactation) cows.

Each season, treatments were balanced for Breeding Worth (\$BW: NZ0 113 ± 35.3; NZ3 115 ± 24.1; NZ6 116 ± 22.7; OS0 97 ± 38.3; OS3 99 ± 33.4; OS6 103 ± 32.3; mean ± SD). Mean \$BW of NZ HF was 115 ± 27.4, which was comparable to that of OS

HF (100 ± 34.7). Within genotype, treatments were balanced for sire and live weight. All treatments had a similar mean calving date (NZ0 23 July ± 21.6 days; NZ3 27 July ± 22.6 days; NZ6 21 July ± 21.1 days; OS0 30 July ± 23.4 days; OS3 4 August ± 25.4 days; OS6 29 July ± 24.3 days; mean \pm SD), with mean calving date of NZ HF being 24 July ± 21.7 days and OS HF being 31 July ± 24.4 days.

Cow selection

Cows used in this study were sourced from the Holstein-Friesian Comparison study (Kolver *et al.*, 2002). Each treatment represented 5-9 sires, which were common within genotype.

The OS genotype had $> 87.5\%$ OS ancestry. The majority of OS HF cows were imported as embryos in 1996 from the United States of America and the Netherlands by Holland Genetics Ltd for the Livestock Improvement Corporation (LIC), NZ as part of the LIC Sire-Proving Scheme. As such, the OS genetics used in the present experiment represent OS genetics that have been widely used in NZ. All sires had NZ proofs. In addition, the brothers of the heifers used in this experiment have been part of the LIC's Sire-Proving Scheme. After birth, OS calves were sold to commercial farmers and were subsequently purchased by Dexcel Limited as 6-12 month heifers or prior to their first parturition. The younger OS cows were bred in NZ using OS sires available in NZ.

The NZ genetics used in the present experiment were selected from Dexcel herds based on \$BW and proportion of NZ ancestry ($< 12.5\%$ OS genes). The same sires were represented across treatments, within genotype, with the following number of sires in each treatment group: 7 NZ0; 6 NZ3; 6 NZ6; 6 OS0; 8 OS3; 9 OS6.

Feeding and management

Cows with electronic identification were individually fed supplement at each milking in the rotary dairy. A flat rate of 3 or 6 kg DM/cow/day (3.5 or 7 kg fresh matter/cow/day) was fed each day of lactation, with individual residues being measured and sampled each milking. The rationale for a continuous flat rate was that this would ensure that the same dose response treatment difference in feeding could be imposed for every day of lactation. Thus, this experiment was a lactation-long comparison of three pasture-based diets, rather than a farm systems experiment. The 6 kg DM/cow/day level of supplementation was chosen as it was expected that this was realistically the highest rate that could be fed without incurring protein or fibre deficiencies in the diet. The principle being tested was the cows' response to an energy dense supplement. The choice of supplement was based on its ability to provide energy in a dense form, and which was reasonably common and less expensive than other concentrate products. No protein was included in the concentrate as it was anticipated that high quality pastures would provide

sufficient dietary protein. Supplemented cows were offered 2 kg DM/cow/day for 15 days prior to calving, with the level rising to 3 kg DM/day immediately after calving for the 3 kg DM/day treatments, and to 6 kg DM/day gradually over the first week for the 6 kg DM/day treatments.

Cows were grazed as one herd for the duration of the experiment. This decision was made to ensure a common, generous, grazing residual was achieved for all herds, and so that cows could be used as replicates. Cows were grazed on 20 ha of land (20, 1 ha paddocks), but this was not a closed system. Because cows were managed to leave pasture residuals that were higher than industry best practice, pasture quality was maintained by following with a non-treatment herd or topping during the spring. The objective was to test supplementation in a high pasture allowance environment. Cows were offered 50 kg DM/cow/day, rotating through paddocks every 15-18 days in spring and 20 days in summer and autumn. Post-grazing residuals were used to determine pasture allocation; post-grazing residuals of greater than 1800 kg DM/ha were targeted during spring and autumn and greater than 2200 kg DM/ha during summer. A total of 321 kg grass silage DM/cow was offered to both herds during spring (47 days), summer (21 days) and autumn (40 days) at an average rate of 4.14 kg DM/cow/day to maintain pasture residual targets. The decision to dry off was based on condition score, time from calving, daily milk production, with a final imposed drying off on 16 May (Macdonald *et al.*, 2005). Grazing cows received 12 g supplementary magnesium/cow/day in the water trough pre- and post-calving, and an additional 12 g magnesium/cow/day as a drench post-calving until November. Cows received a calcium supplement (Calol) on the day of calving.

Measurements

Milk yield was recorded daily and milk composition determined weekly from a 35-ml subsample. Live weight was recorded weekly and body condition score every second week. A representative 500 g sample of pre-grazed pasture and offered and refused concentrate was collected on one day each week. Samples were oven-dried at 100 °C for determination of DM.

Statistical analysis

All data were analysed using the residual maximum likelihood (REML) procedure of Genstat (Version 3.2). The 2x3x2 factorial design was analysed using a model that included genotype, linear and quadratic contrasts of diet, season, and linear and quadratic interactions as fixed effects, with sire and cow as random effects.

An additional analysis was made of milk, MS, live weight, and body condition response to concentrate, as defined by the increase in milk, MS, live weight and condition score during lactation, and body condition score at drying off per kg concentrate DM actually

consumed during the lactation. Analysis included genotype, linear and quadratic contrasts of kg concentrate DM actually consumed for each cow as fixed effects, season, and linear and quadratic interactions as fixed effects, with sire and cow as random effects. Quadratic effects were not significant, and except for analysis of change in body condition during lactation, were not used in the final analysis.

Pregnancy rate and empty rate were analysed using generalised linear models with binomial error distribution and logit link including genotype, diet, season, and the interactions as fixed effects. Postpartum anoestrous interval (PPAI) was estimated for cows with censored data using the Censor procedure in Genstat. This was then analysed using REML. Significant effects for all analyses were declared at $P < 0.05$ and trends at $P < 0.15$.

TABLE 1: Mean annual milk production, live weight, body condition, and substitution rate of New Zealand (NZ) and overseas (OS) Holstein-Friesian cows grazing pasture and fed 0, 3, or 6 kg concentrate DM/cow/day of lactation.

Treatment	NZ0	NZ3	NZ6	OS0	OS3	OS6	SED	P value ¹				
								Genotype	Diet _L	Diet _Q	GxD _L	GxD _Q
Concentrate												
(kg DM/cow/day)	0	2.97	5.61	0	2.94	5.65	0.066					
(kg DM/cow)	0	828	1620	0	806	1578	43.1					
Annual production												
Days in milk	296	290	297	288	283	289	9.5	0.180	0.904	0.265	0.967	0.907
Milk yield (kg/cow)	5568	6365	6632	6112	7114	7827	383.1	<0.001	<0.001	0.075	0.087	0.751
Milk fat (%)	4.77	4.48	4.28	4.17	3.95	3.74	0.154	<0.001	<0.001	0.466	0.690	0.737
Milk protein (%)	3.56	3.64	3.69	3.48	3.43	3.57	0.060	0.008	<0.001	0.068	0.518	0.047
Milksolids (MS, kg/cow)	462	512	519	463	520	567	32.0	0.328	<0.001	0.355	0.107	0.527
MS efficiency (% LW)	94	104	101	83	95	99	4.30	0.022	<0.001	0.039	0.088	0.619
MS efficiency (% LW ^{0.75})	445	489	481	404	458	484	21.2	0.189	<0.001	0.082	0.084	0.594
Milk efficiency (kg/kg LW)	11.4	12.9	12.9	11.1	12.9	13.5	0.59	0.666	<0.001	0.053	0.209	0.796
Milk efficiency (kg/kg LW ^{0.75})	53.4	60.8	61.4	53.7	62.5	66.1	2.74	0.121	<0.001	0.065	0.188	0.795
Live weight												
Mean during lactation (kg/cow)	480	493	504	577	572	581	27.3	0.001	0.044	0.744	0.234	0.590
Change during lactation (kg/cow)	-15	25	53	-44	-16	8	26.5	0.094	<0.001	0.771	0.622	0.854
Season end (kg/cow)	508	534	552	587	594	621	24.3	0.001	<0.001	0.673	0.675	0.430
Body condition												
Mean during lactation	4.33	4.45	4.91	3.91	3.84	4.27	0.236	0.002	<0.001	0.101	0.464	0.815
Change during lactation	-0.27	0.03	1.61	-1.96	-1.69	0.23	0.874	0.009	<0.001	0.117	0.777	0.863
Season end	4.57	5.19	6.15	3.88	3.84	4.87	0.33	<0.001	<0.001	0.045	0.176	0.349
Milksolids response												
g MS/kg concentrate DM		60	35		71	66						
Substitution rate												
kg pasture DM/kg concentrate DM		0.63	0.75		0.67	0.67						

¹L = Linear contrast; Q = quadratic contrast

RESULTS

Both genotypes consumed 98% of the 3 kg concentrate DM/day offered, and 94% of the 6 kg concentrate DM/day offered, resulting in an average of 817 and 1599 kg concentrate DM/cow, respectively, consumed during lactation (Table 1).

All treatments had similar DIM (291 days). On all diets, OS HF produced more milk with a lower milk fat and protein content, had a higher live weight, tended to gain less live weight during lactation, maintained lower body condition during lactation, gained less condition during lactation, and dried off at a higher live weight but lower body condition compared with NZ HF. OS HF had the same MS production as NZ HF and produced less MS as a proportion of live weight than NZ HF, although this difference in efficiency between genotypes was smaller when expressed in terms of metabolic weight, and was not different when expressed as kg milk/kg LW. Compared to NZ HF, OS HF had a similar PPAI (37.2 days), lower 42-day pregnancy rate (31 vs 55%), and higher 11-week empty rate (42 vs 14%) (Table 2).

Supplementation with increasing levels of concentrate produced a linear increase in MS, live weight, condition score, live-weight gain, and condition score gain during lactation, and a linear decrease in milk fat content. MS efficiency (% LW) and condition score at drying off increased quadratically with supplementation, and there was a trend for a quadratic increase in milk yield, milk efficiency (% LW and %LW^{0.75}), MS efficiency (%LW^{0.75}), milk protein, average body condition during lactation, and change in body condition during lactation. Supplementation did not significantly change PPAI, 42-day pregnancy rate, or 11-week empty rate.

A genotype x diet^{Quadratic} interaction was detected for milk protein content, and a trend detected for a genotype x diet^{Linear} interaction for milk yield, MS, and MS efficiency (%LW and %LW^{0.75}) (Table 1).

A separate analysis revealed a genotype x diet^{Linear} interaction for the response rate of milk and MS production, and body condition at the end of the season, to each kg of concentrate DM actually

consumed per day. This showed that OS HF produced twice the milk and MS response, and approximately half the end-of-season body condition for every kg of concentrate DM consumed compared with NZ HF (Table 3). This analysis also showed there was no genotype x diet^{Linear} interaction for the response rate of live-weight gain during lactation or end-of-season live weight to each kg of concentrate DM consumed (Table 3) and indicated a trend (P = 0.127) for a genotype x diet^{Quadratic} interaction for change in condition score during lactation in response to each kg of concentrate DM consumed (data not shown).

DISCUSSION

This study identified important genotype x diet interactions between OS HF and NZ HF cows of similar \$BW, that were achieving high levels of MS production on a range of pasture-based diets. Although genotypes ranked the same for production characteristics on diets ranging from all pasture to pasture plus 6 kg DM/cow/day (1599 kg concentrate DM/cow), the scale of response of genotypes to supplementation was different; OS HF produced twice the milk and MS response, and approximately half the end-of-season body condition response for each kg of concentrate DM consumed compared with NZ HF, when grazed generously and producing 462 kg MS/cow on pasture alone. Other important genotype x diet interactions were detected for the efficiency of MS production, and milk protein content.

This is important because these results suggest even though cows of different genotype or characteristics may have the same \$BW, they perform differently in different pasture-based diets or farm systems. While the ranking of NZ HF and OS HF for production and response to supplement did not change across the diets tested in this study, the differences between NZ HF and OS HF did change. The implication is that while \$BW can be used to rank cows across different diets or systems, there are benefits to selecting cows with desirable characteristics for different farming systems.

TABLE 2: Mean reproductive performance of New Zealand (NZ) and overseas (OS) Holstein-Friesian cows grazing pasture and fed 0, 3, or 6 kg concentrate DM/cow/day of lactation.

Treatment	NZ0	NZ3	NZ6	OS0	OS3	OS6	SED	P value		
								Genotype	Diet	GxD
Reproduction										
Estimated PPAI ¹ (days)	39.0	43.0	35.5	35.0	35.6	35.3	3.079	0.256	0.507	0.478
42-day pregnancy rate (%)	57.9	44.9	63.1	20.2	44.4	26.4	11.30	<0.010	0.945	0.156
11-week empty rate (%)	15.8	22.0	5.2	46.5	33.1	47.1	10.0	<0.001	0.958	0.214

¹Postpartum anovulatory interval estimated by weekly blood progesterone analysis

TABLE 3: Milk, milksolids, live-weight change and end-of-season live weight and body condition response of New Zealand (NZ) and overseas (OS) Holstein-Friesian cows per kg of concentrate consumed during lactation. Concentrate intake ranged from 0 to 6 kg DM/cow/day.

	NZ	OS	SED	GxD _L P value ¹
Milk (kg/kg concentrate DM)	0.67	1.22	0.241	0.023
Milksolids (g/kg concentrate DM)	37	74	17.8	0.038
Live-weight change during lactation (g change/kg concentrate DM)	44.2	34.1	11.62	0.559
Season end live weight (g/kg concentrate DM)	28.4	22.2	7.37	0.562
Season end body condition ² (units/kg concentrate DM)	0.0010	0.0006	0.00026	0.077

¹L = Linear contrast

²1-10 scale

This result also has implications for how supplements are fed. Current decision rules maintain that a low MS response would be expected in a situation where pasture allowance, pasture quality, and MS production are high (Penno, 1998; Macdonald 1999; Holmes *et al.*, 2002). This is because the substitution rate of supplement for pasture is expected to be high.

This was the situation in the current study where NZ HF gave a low annual milk and MS response to a high quality energy supplement (0.67 kg milk and 37 g MS/kg concentrate DM), suggesting that for high \$BW NZ HF the current decision rules remain applicable. The OS HF, however had a comparatively high response, producing 1.22 kg milk and 74 g MS/kg concentrate DM and exhibiting a lower pasture substitution rate for supplementation rates up to 6 kg concentrate DM/cow/day.

This suggests that for cows with characteristics like OS HF, supplementary feeding decision rules require amendment. Compared with NZ HF, OS HF cows in this study had a greater relative feed deficit, even when fed pasture *ad libitum* and producing 463 kg MS/cow on pasture alone. Indicators of this greater relative feed deficit include the lower average body condition score during lactation and at drying off, smaller gains in condition score and live weight during the season, and the lower MS production expressed as a % of live weight of OS HF compared with NZ HF at all levels of supplementation. The lower estimated substitution rate of OS HF at high levels of supplementation also points to a greater relative feed deficit, as OS HF continued to use the higher levels of supplement to increase total DM intake, whereas the NZ HF substituted more pasture for every kg of concentrate DM. In short, there were different relative feed deficits between the two genotypes when fed at high pasture allowances, and as a result OS HF continued to respond to high levels of concentrate with increased DM intake and higher MS production, whereas the NZ HF simply consumed the concentrate with only small increases in total DM intake.

The reason for the greater relative feed deficit is partly attributable to the low ability of OS HF cows to

achieve high levels of pasture intake (as a % of LW; Kolver *et al.*, 2002). At the highest concentrate level in the current experiment, it was calculated that approximately half of the greater MS response of OS HF could be attributed to the lower substitution rate and consequently greater increase in total DM intake. The other half of the MS response could be attributed to greater partitioning of nutrients towards MS production.

It is proposed that supplementary feeding decisions could be made based on universal indicators of relative feed deficit such as kg MS (as a % of live weight) and body condition score. For example, in the current study providing extra supplementary feed to cows producing MS at 100% of live weight (e.g. NZ3) gave small MS responses, whereas providing extra supplementary feed to cows producing MS at 80% of live weight (e.g. OS0) gave large responses. This approach would capture relative feed deficits that occurred as a result of cow level as well as system level drivers of relative feed deficit.

However, consideration of genotype would still need to be made. This study and others (e.g. Kolver *et al.*, 2002) have shown that NZ HF can produce up to approximately 95% of live weight as MS when fed *ad libitum* pasture, whereas 85% of live weight as MS appears the maximum for OS HF. This means that both NZ HF and OS HF may respond similarly to extra feed when producing at a common level of MS production (as a % of live weight). However, OS HF would require high energy supplementary feed to achieve MS responses above approximately 85% of live weight, whereas NZ HF only require supplements for MS production above 95% of live weight. Because 95% is close to the maximum MS production (105% of liveweight) reported on pasture-based diets, NZ HF will give small responses to supplements, and OS HF larger responses, when offered high allowances of pasture.

Using the MS response rates in Table 3 to feeding 0-6 kg concentrate DM/day, the marginal break-even price of consumed supplement for OS HF based on the additional milk income was 26, 30, or 33 cents/kg DM (at \$3.50, \$4.00, or \$4.50/kg MS payout). Other costs such as feed wastage, and capital costs of

feeding equipment and additional shares would need to be considered in a full economic analysis. In contrast, the marginal break-even price of consumed supplement for NZ HF in this study was 13, 15, or 17 cents/kg DM (at \$3.50, \$4.00, and \$4.50/kg payout). However for NZ HF, this break-even price depends on the level of supplement fed. Treatment response rates in Table 2 show that the break-even price of feeding up to 3 kg concentrate DM/cow/day to be 21, 24, or 28 cents/kg DM consumed, but when feeding at higher levels up to 6 kg concentrate DM/cow/day, feed would have to be purchased much more cheaply (12, 14, 16 cents/kg DM consumed) at \$3.50, \$4.00, and \$4.50/kg payout, respectively.

Within genotype, body condition gain during lactation quadratically increased with increasing concentrate level. The shape of the body condition score response was similar for both NZ and OS HF, although there was an indication of a trend for a genotype x diet^{Quadratic} interaction. This suggested that the condition score response to increasing concentrate level from 3 to 6 kg DM/cow/day was greater for OS HF than for NZ HF. This was also evident in the smaller difference in dry-off condition score between the two genotypes at the higher level of concentrate feeding, compared with lower levels of supplementation. However because of the difference in relative feed deficit when NZ HF and OS HF were fed pasture *ad libitum*, OS HF fed 6 kg concentrate DM/day ended lactation 1.28 condition score units lighter than NZ HF. The difference in genotype response can be seen by comparing OS6 and NZ0 treatments, which both ended lactation in a similar body condition.

The genetic difference between NZ and OS HF cows was also evident in the significantly poorer reproductive performance of the OS HF. Despite being fed well, as evidenced by the high levels of production achieved, the empty rate of OS HF was very high (42 versus 14%), and the 42-day pregnancy rate very low (31 versus 55%). This was consistent with a lower body condition score during mating, and an inability of high-energy supplements to produce a meaningful increase in body condition of OS HF at mating. NZ HF responded to concentrate feeding by increasing body condition, however the apparent lack of a reproductive response may have been because of insufficient cow numbers per treatment, or because NZ HF were beyond the point of response, i.e. NZ0 were being fed well and in good body condition for good reproductive performance.

These genotype differences are consistent with reports from previous NZ studies at the national herd level (Peterson, 1991; Mwansa & Peterson, 1998; Harris and Kolver 2001) and from research farm studies (Kolver *et al.*, 2002; Kolver *et al.*, 2004; Macdonald *et al.*, 2005). Similar studies in Ireland feeding up to 1710 kg concentrate DM/cow have also reported the greater milk response of grazing OS HF to concentrate during lactation and the inability of supplementation to improve the poor reproductive performance of OS HF

(Buckley *et al.*, 2000; Kennedy *et al.*, 2003; Horan *et al.*, 2004a; Horan *et al.*, 2004b).

Previously, Kolver *et al.* (2002) reported genotype x diet interactions for a number of important productive and reproductive responses when OS and NZ HF were compared on all-pasture or total mixed ration (TMR) diets. The range of pasture-based diets tested in the current study fall between the extremes of dietary allowance tested by Kolver *et al.* (2002). Similar studies to the current study have not reported a re-ranking of cow genotypes when farmed in different pasture-based systems (Buckley *et al.*, 2000; Kennedy *et al.*, 2003; Horan *et al.*, 2004a; Horan *et al.*, 2004b), but these studies have identified that the relative differences in performance between genotypes does change with farming system or diet. This type of genotype x environment interaction is also consistent with the results from the Dexcel Strain Trial (Macdonald *et al.*, 2005).

This study was specifically designed to provide guidelines on supplementary feeding decisions for cows fed well on pasture. However for a farm systems evaluation of the suitability of cows for a range of pasture-based production systems, and the impact on economic farm surplus, results from the Dexcel Strain Trial (Kolver *et al.*, 2004; Macdonald *et al.*, 2005) should be viewed. These show that NZ HF produce more profit than OS HF across a wide range of seasonal dairy systems.

CONCLUSION

Overseas HF cows gave double the milk and MS response, and a broadly similar body condition response per kg of concentrate DM consumed compared with NZ HF when grazing at a high pasture allowance. Currently accepted decision rules which recommend reducing supplement when pasture supply meets cow requirements remain applicable for high \$BW NZ HF. This study suggests that reasonable responses to high-energy supplements will continue to be obtained from high \$BW OS HF, even when pasture supply appears adequate to meet cow requirements. Supplementation did not appear to improve the poor reproductive performance of OS HF. Use of indicators of relative feed deficit such as MS as a % of live weight, and body condition score, may be a better guide to predicting the production response to supplementation, than decision rules based on genotype.

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