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Management and reproductive performance in herds that differed in their induction policies

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ABSTRACT

A large scale retrospective study was undertaken in 2005 on the impact of the policies for induction of early calving (either undertaken during study period, stopped in previous 2 seasons, or continuing to induce) and other factors on herd reproductive performance. Data was gathered from whole-herd pregnancy testing data and farm visit records, and electronic records from the LIC database. Data analysed included records from 3 consecutive seasons from 82 herds, and included 34,729 cows, 72,593 calvings, 237,884 individual herd test records and summary pregnancy test results for each herd for 3 seasons.

Factors that significantly influenced herd reproductive performance were herd induction policy, season, herd predominant breed, 4 week submission rate, average milk protein percent at herd test within 60 days following the start of the breeding programme, and length of breeding programme (all P< 0.01). Induction usage was found to be declining over time, implemented at a later stage of the calving programme and unlikely to meet Code of Practice requirements, and under-reported to the LIC database. This large-scale epidemiologic study provides important information for herd owners, their advisors, and other scientists on herd reproductive performance.

Keywords: Herd reproductive performance; calving induction.

INTRODUCTION

Herd reproductive performance has an important impact on its economic performance (Holmes et al., 2002, pg. 159). Herd owners and their advisors use measures of herd reproductive performance to compare individual herd's performance to previously-agreed or industry-wide established targets. However, no published data from industry-wide surveys in New Zealand is available on associations between herd reproduction and economic performance, and results from simulation studies or partial budgets are used to predict responses to changes in reproductive management or to emphasise the importance of this component of dairy farm systems. Moreover, there is no agreement on which reproductive performance measures are most important and what the targets should be.

Herd reproductive performance benchmarks for use in New Zealand dairy herds have been suggested by few authors. Targets for primary outcomes directly affecting economic performance are in-calf rates at 6 weeks and the end of the breeding programme (9 to 12 weeks) of 80% and 93% (Holmes et al., 2002, pg. 168) or 4 week, 8 week and final (after 100 days) in-calf rates of 62%, 86% and 93% (Hayes, 1998); 14 days from start to median calving date (Holmes et al., 2002, pg. 169) or 4 and 8 week calving rates of 67% and 95% (Hayes, 1998); and length of breeding restricted to 10 weeks (Holmes et al., 2002, pg. 168). Secondary outcome targets include submission rates (SR) at 3 and 6 weeks of 90% and 100% (Holmes et al., 2002, pg. 168) and 90% and 92% (Hayes, 1998); and first service conception rates of 60% (Hayes, 1998). Holmes et al (2002, pg. 166) do not emphasise the final pregnancy rate as a measure of reproductive performance, and instead conclude that the success of the breeding programme can be assessed by the percentage of the herd "which become pregnant in the early stages of the breeding programme."

Following concerns over the welfare of cows induced to calve early and the calves they deliver (Williamson, 1993) and a perceived risk of imposition of non tariff trade barriers (Bodeker, 1998), Fonterra dairy company proposed in 2001 that the numbers of inductions be less than 5% of total dairy cow numbers by 2005, and less than 2% by 2010 in a programme for sustainable farming named "Market-Focused – An Environmental Management System for New Zealand Dairy Farmers". In March 2004, routine induction of calving was removed from product label claims for long-acting dexamethasone products registered under the Agricultural Compounds and Veterinary Medicines (ACVM) Act because of its adverse effects on the health and welfare of treated cows and calves, which led to the development of a Code of Practice for the Induction of Calving in Dairy Cattle under the ACVM Act (New Zealand Veterinary Association, 2005). Compliance with the code would mean that routine induction would be justifiable as a management tool only in specific herds where major reproductive failure had occurred due to the effects of unforeseeable circumstances such as severe weather or bull failure.

Because of the perceived economic benefits of induction to herd owners, there is interest in assessing the impact of reducing or ceasing induction on herd reproductive performance and profitability. Stevens (2000) showed that high levels of farm profitability could be obtained without inductions through good farm management. That study did not however quantify the change in performance for herds that changed from an induction to a non-induction policy. The main objective of this study was to describe management and reproductive performance in dairy herds according to their induction usage, and specifically in herds that changed to a nil-induction policy over the 2002-2004 seasons. A secondary objective was to define herd-level factors that affect herd reproductive performance.

MATERIALS AND METHODS

Herds (n =138) were selected for this study in October 2004 on the basis that they were clients of the Animal Health Centre, Morrinsville (AHC), calved all cows in spring (i.e. July to October), and had complete and reliable data recorded from whole-herd pregnancy tests in the seasons of 2002-2003 and 2003-2004 on the practice database. Eighty-two clients who were still operating the same farming enterprises in the 2004-2005 season agreed to participate in the study, and completed a questionnaire on farm effective area, supplementary feeding practices and reproductive management for the current and 2 previous seasons. Enrolled herd owners were asked to undertake whole-herd pregnancy diagnoses less than 14 weeks after the planned start of the seasonal breeding programme, so that the 8 week in-calf percentage, and the final not in-calf percentage could be accurately defined. For herds with breeding programmes > 13 weeks, this required at least 2 pregnancy test visits. Other data used for analysis included numbers and reasons for removal of cows during and after the breeding programme, AHC records (number and date) of any induction treatments, and Livestock Improvement Corporation (LIC, Hamilton, N.Z) core database records on individual cows in study herds for 3 seasons from 2002 extracted on the 6th May 2005. This database extract contained data on 34,279 individual cows, 73,037 cow-lactations, 72,593 calvings, and 237, 884 individual herd test records.

Enrolled herds were classified according to their induction usage over the 3 study seasons: 2002-2003, 2003-2004 and 2004-2005. This classification was based on induction records from the practice database. “Nil” induction herds (n = 14) had not used routine inductions over the 3 seasons (1 induction per herd per season was permitted if it was for therapeutic reasons). “Reducing” induction herds (n = 11) had used routine inductions in the 2002-2003 season, and either ceased their use in the 2003-2004 (4/11 herds) or in the 2004-2005 (7/11 herds) season. “Continuing” induction (n = 57) herds were herds that typically induced cows in each season (only 14 herd lactations of 171 from these 57 herds over 3 lactations had no veterinary-recorded induction event). Herds were also classified by their predominant cow breed as either Friesian, Jersey (when that breed was >11/16ths of LIC-recorded genetics) or “Other” (predominantly Jersey-Friesian crossbreed). Comparisons with correction for multiple tests by the Holm method were undertaken between herd induction classes for averages of continuous variables and proportions of categorical variables. Analysis of the days from the planned start of calving to actual calving date, and from planned start of mating to first mating date for individual cows, was undertaken by the Kaplan-Meier method and log-rank tests. To account for the correlated responses within herds, variables associated ($P < 0.25$) with the outcomes from bivariate analyses were modelled using multivariable generalised estimating equations for count and continuous data, and robust Cox proportional hazards models for time from planned start of calving to calving date and planned start of breeding programme to first mating date. Adjusted mean responses were predicted from models which included induction usage class and season as main effects to give values on a percentage scale. Statistical analysis was carried out in the computer software “R (R Development Core Team, 2005) and statistical significance was set at $P \leq 0.1$.

RESULTS

A summary of descriptive statistics for study herds is shown in Table 1. There was no difference in ownership structure between herds in different induction usage classes, but “reducing” herds had a larger average effective farm (89 ha) area than the “nil” farms (71.2 ha), but were similar in area to the “continuing” farms (95 ha). Overall average herd size was larger in “reducing” herds than the “nil” herds, but were not different to “continuing” herds. “Reducing” herds were more likely to be comprised of predominantly Friesian cows (72%) than “nil” or “continuing” herds, in which 45% and 49% respectively, were predominantly Friesian.

TABLE 1: Description of average characteristics in 82 Waikato herds in 3 classes of induction policy over 3 seasons

		Induction Use Class		
		Nil	Reducing	Continuing
Ownership	Manager	0%	18%	11%
	Owner	79%	64%	67%
	Share-milker	21%	18%	22%
Effective area (ha)		71.2[a]	89.0[b]	95.2[b]
Herd Size		205[a]	258[b]	277[bc]
Stocking Rate		2.9	3.0	3.1
Predominant breed	Friesian	45%[a]	72%[b]	49%[a]
	Jersey	29%	9%	17%
	Other	26%	19%	34%

Values with superscripts differing within row differed significantly ($P \leq 0.1$)

In "reducing" herds the average 8 week herd in-calf % declined from 81% to 77% and the average crude final herd empty % increased from 9.1% to 10.8% from the season when inductions were last used to the first year inductions were not used, but these differences were not statistically significant (P = 0.15 and 0.52, respectively).

Descriptive statistics for calving programmes for all cows including heifers are shown in Table 2. The number of days from planned start of calving (PSC) to median calving date for herds with heifers removed from analysis (to provide estimate of in-calf rate in early mating in previous lactation) was 18, 19 and 20 days for "nil", "reducing" and "continuing" herds, respectively (tests for differences: P < 0.08 for "nil" vs. "reducing", P = 0.01 for "nil" vs. "continuing" herds). "Reducing" herds had a longer average length of calving than the "nil" herds or the "continuing" herds (95, 85 and 84 days respectively, P = 0.03). The pattern of induction use changed over the period of the study. The median number of days prior to the start of mating for the first induction treatment decreased from 54 days to 45 days and the median percentage of cows treated within those herds reduced from 7% to 6% between 2002 and 2004. Veterinary-recorded inductions totalled 4185 cows over all herds and 3 seasons, but LIC database recorded inductions for the same period totalled 2436 or 58% of the former total. The total length of mating (including natural mating) differed significantly between herd induction classes and season (Table 3). "Nil" induction herds had the shortest average length of mating with 82 days, which was significantly shorter (P < 0.02) than "reducing" (91 days) or "continuing" (94 days) herds. There was also a significant (P < 0.01) reduction in length of mating across all herd induction categories from 2002 to 2003 (-5 days) and to 2004 (-9 days total). The adjusted average 8 week-in calf percentages were significantly higher (p < 0.01) in non-inducing herds (83%) compared to both "reducing" (78%) and "continuing" (79%) herds. The 8 week in-calf % declined from 81% in the 2002 season to 77% in the 2004 season (P < 0.01) across all induction category herds. The final not pregnant ("empty") percentage did not differ between induction usage category herds (P > 0.5) but increased from 2002 to 2004 (9.7% to 11.1% ; P = 0.01).

TABLE 2: Description of calving programme in 82 Waikato dairy herds in 3 classes of induction policy over 3 seasons

Grouping	Induction class	Planned start of calving date	Days from start to median calving date	Duration calving (d)	% Herd calved <40 d of PSM*	% Herd induced (vet record)	% Herd induced (LIC record)
2002 season	Nil	18/07	17	84	16%	0%	0%
	Reducing	18/07	18	99	18%	5%	4%
	Continuing	17/07	18	83	18%	8%	5%
2003 season	Nil	18/07	16	84	15%	0%	0%
	Reducing	17/07	16	91	16%	5%	3%
	Continuing	17/07	18	82	16%	7%	3%
2004 season	Nil	17/07	15	83	12%	0%	0%
	Reducing	17/07	17	91	16%	0%	0%
	Continuing	16/07	18	84	16%	6%	4%
Overall seasons	Nil	18/07	16	84	14%	0%	0%
	Reducing	17/07	17	94	16%	3%	2%
	Continuing	17/07	18	83	17%	7%	4%
Overall seasons and herds	Minimum	29/06	12	47	0%	0%	0%
	1st Qu.	14/07	15	76	11%	0%	0%
	Median	17/07	17	83	16%	4%	1%
	Mean	17/07	18	85	16%	5%	3%
	3rd Qu.	21/07	19	92	20%	8%	6%
	Maximum	01/08	35	146	56%	28%	17%
	Missing	0	0	0	0	6	0

* Planned start of mating programmes

TABLE 3: Description of breeding programme and reproductive performance in 82 Waikato herds in 3 classes of induction policy over 3 seasons

Season	Induction Category	Planned Start Mating	Duration AB* (d)	Total duration mating (d)	21 day SR** (%)	28 day SR** (%)	8 wk ICR*** (%)	Final empty(%)
2002 season	Nil	9/10	37	84	77%	82%	82%	10%
	Reducing	9/10	36	95	75%	79%	80%	6%
	Continuing	10/10	34	99	74%	79%	80%	7%
2003 season	Nil	9/10	37	81	79%	83%	84%	9%
	Reducing	9/10	37	89	70%	75%	78%	9%
	Continuing	8/10	34	94	74%	79%	78%	9%
2004 season	Nil	10/10	37	81	79%	83%	82%	9%
	Reducing	11/10	36	90	77%	80%	76%	9%
	Continuing	8/10	34	88	75%	80%	76%	9%
Overall seasons	Nil	9/10	37	82	78%	83%	83%	10%
	Reducing	10/10	36	91	74%	78%	78%	8%
	Continuing	9/10	34	94	74%	80%	78%	8%
Overall herds and seasons	Minimum	14/09	16	60	34%	53%	41%	0%
	1st Qu.	5/10	28	83	70%	76%	75%	6%
	Median	8/10	34	91	77%	82%	80%	8%
	Mean	8/10	35	91.35	76%	81%	79%	8%
	3rd Qu.	13/10	40	98.75	84%	88%	84%	11%
	Maximum	25/10	95	143	94%	95%	96%	25%
	Missing	0	0	0	2	2	31	0

* Artificial breeding ** Submission rate *** In-calf rate

Herds with a majority of Friesian cows had a significantly lower 8 week in calf % (74.8%) than either Jersey (78.1%, P = 0.07) or "other" breeds (77.9%, P < 0.01), and higher empty % (11.0%) than Jersey (8.4%, P < 0.01) or "other" breeds (8.0%, P < 0.01). The percentage of the herd submitted for a first service by 21 and 28 days of mating significantly (P < 0.01) affected herd 8 week in-calf %. The adjusted average 8 week in-calf % for the average (76%) 21 day SR was 79%, and herds at the top quartile for 21 day SR (84%) had 81% of the herd in-calf by 8 weeks of mating. Herds at the top quartile of protein % after adjusting for the effect of breed had a 2 % higher 8 week in-calf % 82% vs. 80% (P < 0.01) and a 1% lower final empty % than average protein % herds (9% vs. 8%, P < 0.01). Extending natural mating by 21 days past the average (91 days) was associated with a 2% lower final empty % (P < 0.01).

DISCUSSION

Farms in this study were typical of those in the region in terms of herd size, area, stocking rate, breed and ownership structure over the study years (Anon, 2003, Anon, 2004), giving confidence that the conclusions of this study are applicable to other herds in the region. However, herds in other regions in New Zealand differ in herd characteristics, and caution should be taken in generalising findings from this study in one region to the national industry. The small average increases in the final herd empty percentage and decline in 8 week in-calf percentage found in this study in herds that changed to "nil" inductions were unexpected. Possible reasons for this include that there are other important factors affecting herd reproductive performance that were not accounted for in this study; or that because on average inductions had previously accounted for a small % of the herd and were carried out late in the calving programme, there was therefore little benefit to herd reproduction, and hence ceasing inductions had little negative impact.

Data from this study also show that inductions are under-reported by farmers to the LIC database and have been used later in each successive recent season. Induction of cows late in the calving period when they calve within 40 days of the start of the mating period is least likely to provide economic benefit (Stevens, 2000), and would be unlikely to meet the current Code of Practice for induction of calving (New Zealand Veterinary Association, 2005). Suggested targets for primary measures of reproductive performance from previously cited authors have been achieved by herds in the top 25% of performing herds, and thus are appropriate; but targets for 21 day SR were not even met by most top quartile herds, and may not be achievable by top-quartile performing herds.

Several factors previously-shown to be associated with herd-level reproductive performance were identified and quantified in this study. The findings that submission rate and herd test average milk protein % after the start of the breeding programme were both significantly and positively associated with primary reproductive outcomes is important. Both may be calculated on a daily basis during the artificial breeding programme and give an indicator for farmers early in the mating period whether they are likely to be achieving reproductive performance goals, and may allow early remedial action to be taken. The first relationship is not surprising, but we provide an estimate of its importance in primary outcome terms at the herd level. Relationships between individual cow milk production measures over the mating period have been reported (Buckley et al., 2003, Morton, 2004), and our findings for individual herd test records aggregated to a herd level support those previously found in New Zealand (Xu and Burton, 2003). However, milk protein % is associated with Holstein-Friesian (HF) genetics (Kolver et al., 2000, Harris and Kolver, 2001), and analysis of more detailed genetic information such as herd percentage HF genetics instead of predominant herd breed as used in this study is needed to adjust for this confounding effect. The high proportion of Holstein-Friesian genetics combined with industry concerns about genetic affects on reproduction (Harris and Kolver, 2001), emphasise the importance of a better understanding of the role of nutrition and genetics in the New Zealand dairy industry and pose a challenge to reducing the use of inductions.

Our results show that well-documented (e.g. SR, breed and herd milk protein %) factors associated with reproductive performance are still important and should be addressed in efforts to improve herd reproductive performance, and further that alarmist concerns over major negative impacts on reproduction from ceasing induction usage are not supported by our data. This field study has also provided data on herd reproductive performance measures and relationships between it and herd-level factors in terms that farmers and their advisors use, and that may also be useful to farm system modellers to formulate scenarios that are representative of industry practice.

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