REPRODUCTIVE EFFICIENCY IN DAIRY CATTLE

CALVING DURING AUTUMN OR SPRING

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Reproductive Efficiency in Dairy Cattle Calving during Autumn or Spring

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Firstly I dedicate this thesis to God, because through Him I have achieved and got everything I have.

To my beloved Paty. Thank you for your love, help and support; all these things made possible my coming to New Zealand, my persistence in this commitment and the final achievement of this goal.

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ABSTRACT

Reproductive performance of cows is a key element in the productivity and efficiency of a dairy system. Therefore, the aim of this study was to evaluate and compare the reproductive performance of cows calving in different seasons (autumn or spring) in three dairy farm systems: 100 % spring calving (S), 100 % autumn calving (A) and 50 % / 50 % spring and autumn calving (AS). Data recorded at No. 1 Dairy Farm (Massey University) during 1996-1999 was used for the present study. Also, milk samples collected during 1998-1999 from the S and A farmlets were used to determine some metabolites (urea, progesterone and β-hydroxybutyrate) in order to assess possible causes of differences in reproductive function. During the three-year period, the AS farmlet showed a more concentrated calving pattern than the A and S farmlets. The planned start of calving to median calving date was 15, 17 and 19 days for the AS, A and S farmlets, respectively. In line with its calving pattern, S farmlet had a higher proportion of induced calvings (10 %) ($P < 0.01$) than A (3 %) and AS farmlets (5 %) and a lower proportion of cows showing heats before planned start of mating (PSM) ($P < 0.01$) (59 % *vs* 69 and 70 % for the A and AS cows, respectively). Also S cows displayed a higher incidence of metabolic disorders (9 %) than cows in the other farmlets (4 and 3 % for the A and AS farmlets, respectively). Despite a similar submission rate at 28 days for all farmlets (92, 94 and 90 % for the A, S and AS farmlets, respectively), cows in the S farmlet tended to show a lower conception rate to first service (CR1st) (47 %) than cows in the A (54 %) and AS (53 %) farmlets. Therefore, cows in the S farmlet tended to have a longer PSM to conception interval (35 days) ($P < 0.1$) than cows in the A (30 days) and AS (31 days) farmlets. Regardless of farmlet, anoestrus cows were less likely to be submitted for artificial insemination (odds ratio (OR) = 0.43) and to conceive (OR = 0.64) than their cycling herdmates. Similarly, cows calving later in the season, had reduced probabilities of being submitted for artificial insemination (AI) and conceiving than cows calving earlier. The probability of conception either at first service or during the whole mating period was lower for cows experiencing a metabolic disorder (OR = 0.27 and 0.64 for conception to first service and during the whole mating period, respectively) than cows with no events recorded. Similarly, cows having two or more lameness episodes were less likely to conceive (OR = 0.61) than cows with no episodes.

During 1998-1999, the effects of milk urea concentration (MU) and energy balance, assessed by changes in body condition (BC) and concentrations of β-hydroxybutyrate in milk (B-OH), upon fertility (CR1st) of cows in the A and S farmlets were explored. Despite having a higher MU ($P < 0.05$) (8.5 *vs* 6.6 mmol/L for the A and

S cows, respectively), A cows tended to have a higher CR1st (60 %) than S cows (49 %). However, within each farmlet, as MU increased the probability of conception to first service tended to decrease. Through progesterone concentrations (P4) determinations and pregnancy tests, cows in both farmlets were classified into three groups: pregnant (P), non-pregnant with low P4 on day 21 post-AI (EL) and non-pregnant with high P4 on day 21 post-AI (EH). P cows in both herds tended to have lower MU at AI (MU0), higher BC at AI (bcsm) and higher P4 on day 12 post-AI (P12) than EH and EL cows. On the other hand, EH cows tended to have higher MU0 and lower P12 than P and EL cows. In the A farmlet, P cows had similar B-OH to EL cows but higher than EH cows ($P < 0.1$). Regardless of farmlet, the probability of a cow becoming pregnant at first service was decreased by 0.105 for each unit increase in the natural logarithm of MU0. Also, the probability of a cow conceiving to first service when it had one health disorder event was only 35 % of that of a cow with no health disorders recorded. On the other hand, the probability of a cow becoming pregnant was increased by a factor of 5.29 for each unit increase in bcsm, by nearly 3 % for each ng/ml increase in P12, and by 55 % for each increase in the square root of the interval from PSM to first service (PSMFS).

It was concluded that, under the study circumstances, calving during autumn was not associated with an impaired reproductive performance as generally reported in other studies. Calving pattern, health status as well as the duration of the mating period appeared to be the most important factors affecting reproduction of cows in the present study. Also, despite the negative effect of high MU upon fertility, its effects are unlikely to be expressed, unless other concurrent factors such as low bcsm, short PSMFS interval and high incidence of health disorders occur.

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LIST OF ABBREVIATIONS

A = 100 % autumn-calving farmlet

ADF = acid detergent fibre

AI = artificial insemination

AS = 50 % autumn- / 50 % spring-calving farmlet

BCS = body condition score

Bcsc = BCS at calving

Bcsd = difference between bcsm and bcsc

Bcsm = BCS at mating

B-OH = β-hydroxybutyrate

CC = calving to conception interval

CD = calving date

CFS = calving to first service interval

CI = calving interval

CIDR = controlled intravaginal drug release device

CL = confidence limits

CP = crude protein

CR1st = conception rate to first service

DCAD = dietary cation-anion difference

DM = dry matter

EB = energy balance

EH = non-pregnant cows with high progesterone concentration on day 21 post-breeding

EL = non-pregnant cows with low progesterone concentration on day 21 post-breeding

FSC = first service to conception interval

LH = luteinizing hormone

LoF = level of feeding

m.fat = milk fat

ME = metabolisable energy

MU = milk urea concentration

MU0 = milk urea concentration at breeding

MU12 = milk urea concentration on day 12 post-breeding

n = number

NDF = neutral detergent fibre

NEB = negative energy balance

ng = nanogram

NIRS = near infrared reflectance spectrometry

NR = not reported

NS = not significant

OMD = organic matter digestibility

OR = odds ratio

P = pregnant cows

P12 = progesterone concentration on day 12 post-breeding

P4 = progesterone concentration

PSC = planned start of calving

PSM = planned start of mating

PSMC = planned start of mating to conception interval

PSMFS = planned start of mating to first service interval

PUN = plasma urea nitrogen concentration

RDP = rumen degradable protein

RFM = retained foetal membranes

S = 100 % spring-calving farmlet

SCHOs = soluble carbohydrates

SE = standard error

Sig. = significance

SR = submission rate

SR-21 = submission rate at 21 days

SR-28 = submission rate at 28 days

StdCD = standardised calving date (difference between actual calving date an a specific date fixed a 100 days before PSC)

StR = stocking rate

SUN = serum urea nitrogen concentration

Wgtc = weight at calving

Wgtd = difference between wgtm and wgtc

Wgtm = weight at mating

r^2 = coefficient of determination

χ^2 = chi-square

⇧ = probability < 0.1

* = probability < 0.05

** = probability < 0.01

*** = probability < 0.001

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