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Effect of timing of insemination of dairy cows with liquid semen relative to the observation of oestrus

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ABSTRACT

Many studies have confirmed that the best conception rates are obtained when cows are inseminated from mid to late oestrus. The conclusions of Trimberger, (1948) has led to the universally accepted AM - PM schedule for inseminating cows. The guideline suggests that cows found in oestrus during the AM period be inseminated at the following PM and the cows in oestrus at the PM be inseminated the following AM. Variations of this rule have been tested with single and multiple AI during oestrus periods and once daily AI after the AM milking with no adverse effect on conception rates. The objective of this study was to determine the effect of time of insemination on Non Return Rates (NRR's) in a sample of seasonal breeding New Zealand dairy cows submitted for insemination once a day after following the AM - PM guideline. Two hundred farms participated in this trial with over 12,000 animals representing Friesian, Jersey and Cross breeds were included in this dataset. The farmers were asked to keep accurate records on when cows were first detected in oestrus during the first two weeks of mating. There was no significant difference in 18 to 24 day non return rates for all cows observed in heat at the two time periods and inseminated the following AM (71.8%, PM and 71.6% AM respectively, $p = 0.18$). There was no effect of bulls or age of cows. A nominal effect of breed of cow was observed. In conclusion, there was no effect on NRR when cows were inseminated at the one time period after AM milking whether they were first observed in heat the previous PM or the AM just prior to insemination.

Keywords: insemination; bovine; liquid semen.

INTRODUCTION

The final outcome on a herd's reproductive performance is a function of the efficiency of heat detection, correct timing of insemination and survival of sperm in the female reproductive tract with viable sperm present during ovulation. Based on the conclusions of Trimberger (1948) and Trimberger and Davis (1943), many studies have confirmed that the best conception rates are obtained when cows are inseminated from mid to late oestrus (Hall et al, 1959, Trimberger, 1956, Macmillan and Watson 1975a, 1975b). This work has led to the universally accepted AM - PM schedule for inseminating cows. This guideline suggests that cows found in oestrus at the AM period, be inseminated at the following PM and that cows in oestrus at the PM be inseminated the following AM. The rule has been tested with single and multiple AI during oestrus periods (Gwasdauskas et al, 1981, Wilcox and Pfau, 1958) and once daily AI after the AM milking (Macmillan and Watson 1975a and 1975b) with no adverse effect on conception rates. The objective of this study was to determine non return rates in a sample of seasonal breeding New Zealand dairy cows submitted for insemination once a day after following the AM - PM guideline. New Zealand is the only country in the world where majority of cows on seasonal dairy farms are inseminated with liquid semen (Vishwanath, 2003). This method of semen storage has been empirically optimised over many years with the main intention of decreasing dose rates in individual breeding units and, extend the

shelf life of use in the field. Over the last thirty years, dose rates have dropped to around 1 million sperm per breeding unit with an effective shelf life of three days in the field. Similarly, frozen semen technologies have progressed considerably where dose rates have dropped from around 25 million sperm per breeding unit to between 10 and 15 million sperm (Vishwanath and Shannon, 2000). With the advent of these new semen storage procedures, information on insemination relative to oestrus detection was considered timely.

MATERIALS AND METHODS

Trial design

The following criteria were set for the trial in order to ensure adequate data return. Two hundred seasonal dairy farmers from all regions in New Zealand were recruited based on their history of record keeping. The farmers were primarily Premier Sires clients using the LIC technician service. The farms had a herd size ranging from 180 to 350 cows with a minimum mating period of at least 5 weeks (35 days AB). The farmers were supplied with survey forms to record when the cows were observed in oestrus at two time periods, the period before or after evening milking (PM) and the period before morning milking (AM). The technicians would normally visit the farms once a day after their morning milking and inseminate the selected cows with Premier Sires semen (liquid or frozen semen). The inseminated cows as identified by their ear tag numbers were entered into a Mating Detail Certificate and this

information was entered into the national database. This insemination data was subsequently aligned with the unique herd code to provide information on individual animals. The farmers were asked to record the heat information for fourteen days from the planned start of mating date.

Records of the animals inseminated in the first two weeks were picked up from the Mating Detail Certificates along with other information held in the national database which included age of cow, breed, date of insemination and whether or not the cow had returned to be inseminated (NRR). The following exclusion criteria for data applied. Cows inseminated after an anoestrus treatment were excluded from the dataset. Any short returns between days 2 and 17 after the insemination were also excluded. Only animals that returned between 18 and 24 days after their first insemination were included as valid returns. Inseminations less than 24 days from the end of the AI period were excluded to ensure accuracy of the estimated 18 – 24 day NRR. It was expected that approximately 20,000 cows would be available for this trial. The expected attrition in data was 40% and approximately 6,000 insemination events were expected to qualify for analysis for each of the time period of observation (AM or PM).

Analysis of results: The data for analysis was presented as a binary score (returned or not). A generalised linear model assuming a binomial distribution and logit link function was fitted. The linear model included the fixed effects of time of insemination, cow age, cow breed, and type of semen and random effects of herd and bull.

RESULTS

Overall, 12,550 animals qualified for the analysis. The results of estimates from the model are presented as a percentage of animals not returning to be inseminated (%NRR). The term **PM** signifies those animals identified in heat at the evening milking prior to insemination the following morning. The term **AM** signifies those animals identified in heat at the morning milking prior to insemination the same morning.

There was no significant difference in the 18 – 24 day NRR for all cows observed in heat during the two periods of observation PM or AM (Table 1).

TABLE 1: 18-24 day NRR's for all cows observed in heat during the two periods of observation. Short returns between 2 - 17 days have been removed.

Time observed in heat	Number of cows	% NRR
PM	5751	71.8
AM	6799	71.6
Total	12,550	71.7

The difference between the two times is not significant.

There was also no significant difference associated with age of cow (Table 2). There was a nominal effect of breed of cow on the overall NRR where crossbred cows (73.5%) were marginally superior to Friesian (72.3%) but significantly superior to Jersey (67.7%, $p < 0.05$). The interaction between time of observation (AM, PM) and breed of cow on %NRR was not significant (Table 3).

TABLE 2: 18-24 day NRR's for all cows by age groups observed in heat during the two periods of observation. Short returns between 2 - 17 days have been removed.

Age group	PM		AM		Total	
	Number of cows	% NRR	Number of cows	% NRR	Number of cows	% NRR
Yearlings	1228	73.7	1552	70.9	2780	72.1
2 - 3 years	1017	74.3	1205	73.1	2222	73.6
Over 3	3505	70.4	4037	71.4	7542	70.9
Total	5750	71.8	6794	71.6	12544	71.7

No group significantly different between AM and PM.

TABLE 3: 18-24 day NRR's for all cows by breed observed in heat during the two periods of observation.

Breed	AM		PM		Total	
	Number of cows	% NRR	Number of cows	% NRR	Number of cows	% NRR
Friesian	2639	72.80%	2196	71.80%	4835	72.3%
Jersey	1598	67.80%	1244	67.50%	2842	67.7%
Cross Breed	2549	72.90%	2305	74.10%	4854	73.5%
Total	6786	71.6%	5745	71.8%	12531	71.7%

No breed significantly different at each time period.

TABLE 4: 18-24 day NRR's for all cows by semen type (frozen or liquid) observed in heat during the two periods of observation.

Semen Type	AM		PM		Total	
	Number of cows	% NRR	Number of cows	% NRR	Number of cows	% NRR
Frozen	733	70.70%	565	70.10%	1298	70.4%
Liquid	5894	71.80%	5060	71.80%	10954	71.8%
Total	6627	71.70%	5625	71.60%	12252	71.65%

There was also no significant difference between each time period of observation and semen type (frozen or liquid) Table-4.

DISCUSSION

This trial confirms the results obtained by Nebel et al (1994) that Non Return Rates to a professional technician service once daily whether the cows were observed in oestrus at the PM or AM periods is not different. An earlier study in New Zealand by Macmillan and Watson (1975 a & 1975b) also came to similar conclusions. Our study involved around 200 herds with a wide variety of oestrus detection practices. Early studies by Schams et al, (1977) have described the time relationship between onset of oestrus, LH peak and ovulation. The entire period is usually around 32h with the LH peak around 6.5h after the commencement of oestrus. Ovulation occurs a further 26h after the LH peak. The recommended time for insemination is usually around 12 - 18h prior to ovulation which then coincides with 4 - 12h capacitation period for the inseminated sperm followed by a fertile life of around 30h. This coincides with ovulation. An earlier study by Vishwanath et al (1997) showed that liquid stored spermatozoa were capable of surviving in the female reproductive tract with retention of fertilizing ability for around 52h. We can therefore conclude that liquid stored semen has adequate heterogeneity in capacitation status that they are capable of surviving for longer periods in the female reproductive tract and thus, accommodating a greater variation in the period from insemination to ovulation. It is generally understood that the time between LH peak and ovulation is stable around 26h. The results of this trial suggest that inseminating once a day for all animals detected in heat in a 24h period provides satisfactory NRR's.

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