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Use of synchronisation in dairy cows to maximise submission rates

Key external stakeholders:

Dairy farmers, farm advisors, veterinary practitioners, pharmaceutical companies, AI companies, reproductive biologists.

Practical implications for stakeholders:

This study developed and compared different controlled breeding programmes for cows in seasonal calving dairy production systems with the primary goal of maximising submission rates.

- Fixed-time AI synchronisation protocols can be successfully used to achieve 100% submission rate in treated animals while maintaining similar conception rates to non-synchronised cows.
- The interval from mating start date to first insemination can be shortened by using synchronisation. Use of synchrony treatments should be targeted at anoestrous cows and late-calving cows to advance the time of re-breeding after calving. Beneficial effects on subsequent calving pattern will be maximised through early intervention.

Main results:

- Ovulation synchronisation protocols tightly synchronise timing of ovulation, which may or may not have been preceded by behavioural oestrus. These protocols facilitate insemination at a pre-determined time, and hence are also called 'fixed-time AI' protocols.
- Treatments that synchronise the timing of ovulation facilitate 100% submission rate in treated animals.
- Ovulation synchronisation protocols that provide supplemental progesterone (CIDR, PRID) result in superior reproductive performance in anoestrous cows compared with ovulation synchronisation protocols that do not include supplemental progesterone.

Opportunity / Benefit:

Dairy farmers should identify anoestrous cows before and during the breeding season, and utilize synchrony to improve the reproductive performance of these cows. Similarly, oestrous and ovulation synchronisation treatments are useful tools to shorten the interval from calving to first AI in late-calving cows.

Collaborating Institutions:

Teagasc, UCD, University of Wisconsin

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1. Project background:

Achieving a highly concentrated period of calving in the spring requires a high conception rate within a short period following the planned start of mating during the previous breeding season. Maximizing the proportion of cows that establish pregnancy within the first 6 weeks of the breeding season decreases the incidence of extended calving patterns. Cows with an extended postpartum anoestrous interval and late-calving cows in the herd can disrupt the seasonal calving pattern and result in extended calving patterns. Low submission rates decrease the proportion of animals becoming pregnant within the pre-defined 6 week period, thus negatively affecting the profitability of seasonal calving systems. Decreased profitability arises from mean calving date (**MCD**) occurring later in the year than optimal, and consequently, results in a less compact calving pattern, poor utilisation of feed, shorter lactation lengths, increased breeding costs and fewer calf sales.

Traditional oestrous synchronisation programmes using GnRH, progesterone (**P4**) and PGF2α were previously demonstrated to successfully synchronise oestrus and resulted in earlier conception in seasonal calving systems. Ovulation synchronisation protocols using timed AI (**TAI**) ensure that a cow is submitted for AI without the requirement to observe for signs of oestrus. Successful use of TAI protocols requires (i) synchronising the growth of a new follicular wave; (ii) synchronising luteal regression; and (iii) synchronising the time of ovulation. This project was undertaken to evaluate the role of oestrous and ovulation synchronisation protocols in Irish seasonal-calving systems.

2. Questions addressed by the project:

- What is the effect of different synchronisation protocols on ovarian follicular and luteal dynamics, reproductive hormone profiles and the timing of ovulation?
- To examine the potential effect on calving pattern and MCD through aggressive whole-herd intervention with protocols to synchronise oestrus or ovulation?
- What animal factors affect the responsiveness to different synchrony protocols?

3. The experimental studies:

- Study 1: Lactating autumn-calving dairy cows (n = 64) were managed as a single herd at Moorepark. Cows were stratified by parity and days in milk and randomly assigned to 1 of the 3 synchronisation treatments (CIDR_OBS, CIDR_TAI or Ovsynch) illustrated in Figure 1 (lower panel). The CIDR_OBS treatment was an oestrous-synchronisation protocol, whereas CIDR_TAI and Ovsynch were ovulation-synchronisation protocols. All cows were ≥35 DIM (mean = 58; range 35 to 82 DIM) at the initiation of synchrony treatments, resulting in synchronised oestrus/ovulation at ≥45 DIM (mean = 68; range = 45 to 92 DIM). Blood samples were collected and ovarian structures were examined by transrectal ultrasonography at frequent intervals to monitor responses to hormonal treatments, to determine time of ovulation, and to monitor corpus luteum formation after ovulation. Cows assigned to CIDR_OBS were inseminated using the am/pm rule following detection of oestrus with the aid of tail paint. All cows on the CIDR_TAI and Ovsynch treatments received TAI 18 hours after the second GnRH injection, which was administered 60 hours after PGF injection. To enhance expression of oestrous behaviour, all cows were moved to a clean stand-off woodchip pad 3 days before the presumptive day of oestrus until ovulation was confirmed.
- Study 2: A study was conducted using 1,538 cows in 8 Irish commercial spring-calving dairy herds between April and June 2008. Within each herd, cows were divided into 3 groups: early, mid, and late calving based on days in milk (DIM) at the farm mating start date (MSD). Early calving cows (n = 1,301) were 42 DIM at MSD, mid-calving cows (n = 212) were 21 to 41 DIM at MSD, and late-calving cows (n = 126) were 0 to 20 DIM at MSD. Synchronisation treatments commenced 10 days before MSD for the early calving cows, facilitating oestrus or TAI at MSD (planned breeding 1; PB1) as illustrated in Figure 1 (upper panel). All early calving cows were ≥42 DIM at AI (range in DIM of 42 to 105). Synchronisation treatments commenced on day 11 and 32 after MSD for the mid- and late-calving cows, respectively. The treatments facilitated oestrus or TAI 21 days after MSD (PB2) and 42 days after MSD (PB3) for the mid- and late-calving cows, respectively. All mid- and late-calving cows were between 42 and 62 DIM at AI. Thus, the experimental treatments were imposed on all cows

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that had calved up to and including MSD. Within each calving group, cows were stratified by parity and days in milk and randomly assigned to 1 of the 4 treatments illustrated in Figure 1 (lower panel). Cows assigned to the control (CTRL) treatment received no hormonal interventions.

- Study 3: Additional statistical analysis of the data generated in the large-scale on-farm study was used to identify animal factors associated with fertility outcomes in cows treated with protocols to synchronise oestrus and ovulation.

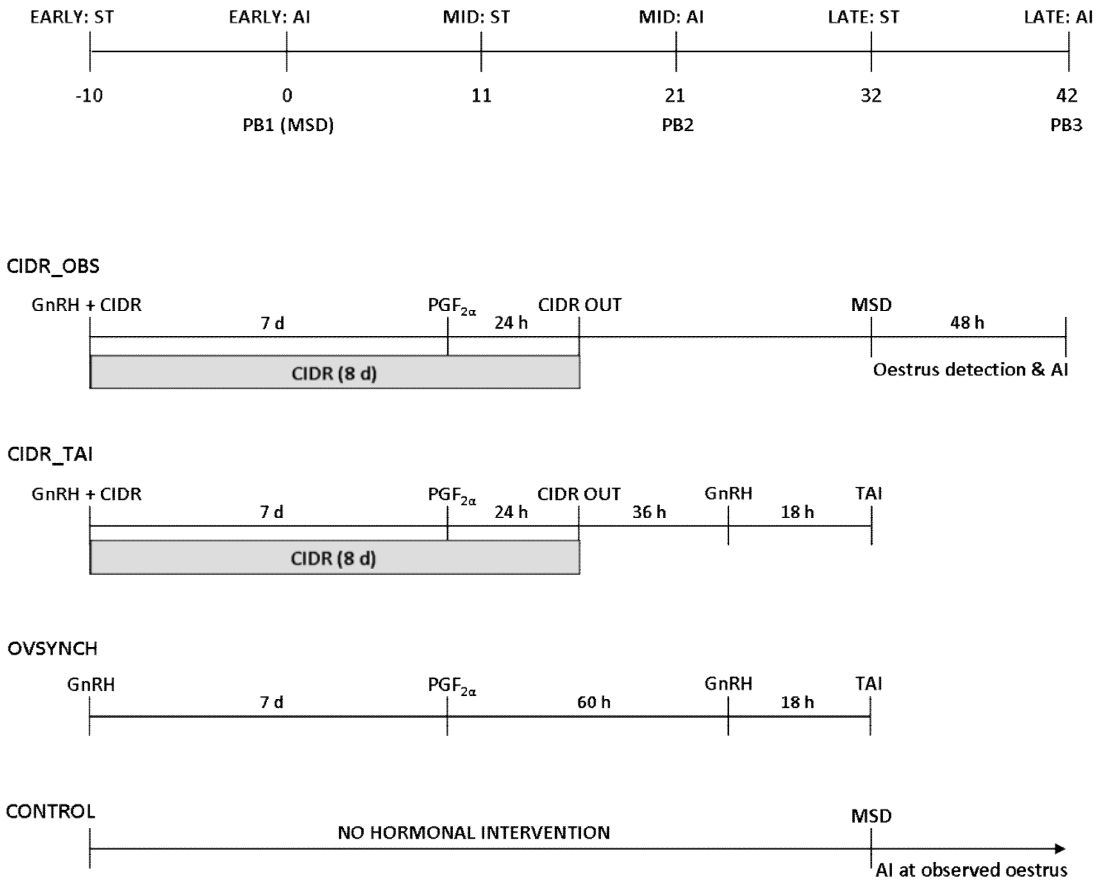

Figure 1: Schematic diagram of experimental design used to evaluate synchronisation treatments (ST) (upper panel) and treatment protocols to synchronise oestrus and ovulation (lower panel). ST = Start or synchrony treatment; AI = Artificial Insemination; PB = Planned breeding date; MSD = Mating start date.

4. Main results:

- Study 1: Circulating concentrations of P4 were greater for CIDR_OBS and CIDR_TAI compared with Ovsynch during the synchronisation treatment. Peak circulating concentrations of oestradiol were greater for CIDR_OBS compared with Ovsynch, but CIDR_TAI did not differ from either CIDR_OBS or Ovsynch. The interval from PGF injection to peak circulating oestradiol did not differ between CIDR_TAI and Ovsynch, but both of these treatments had shorter intervals from PGF injection to peak circulating oestradiol concentrations compared with CIDR_OBS. The diameter of the dominant follicle before ovulation was greater for CIDR_OBS compared with Ovsynch, but CIDR_TAI did not differ from either of the other treatments. The mean interval from PGF to ovulation was longer for CIDR_OBS (100.0 hours) compared with CIDR_TAI and Ovsynch (84.4 and 83.2 hours, respectively). All of the cows on the CIDR_TAI and Ovsynch treatments had ovulated by 92 hours after PGF, whereas 53% of the cows on the CIDR_OBS treatment had ovulated at this time. Use of CIDR_OBS resulted in increased preovulatory follicle size and greater circulating concentrations of oestradiol due to a longer period of preovulatory follicle growth. Progesterone supplementation during synchronisation and GnRH on the day before TAI affected ovulatory follicle size, and periovulatory circulating concentrations of P4 and oestradiol. No differences, however, in postovulatory P4 or luteal volume profiles were observed.
- Study 2: The likelihood of successful conception per AI was greater for CIDR_OBS (59%), CIDR_TAI (54%) and CTRL (53%) compared with Ovsynch (45%). Both CIDR_TAI and Ovsynch had an increased likelihood of earlier conception compared with the CTRL. A greater proportion of

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cows on the CIDR_TAI treatment successfully established pregnancy in the first 42 days of the breeding season compared with the CTRL (75% vs. 67% 42-day pregnancy rate, respectively). Protocols to synchronise oestrus and ovulation were effective at achieving earlier first service and conception in pasture-based seasonal calving dairy herds. However, animals that conceived following insemination at observed oestrus (CTRL and CIDR_OBS) had a decreased likelihood of embryo loss to first service compared with animals bred with TAI (CIDR_TAI and Ovsynch). Use of TAI protocols resulted in shorter intervals from calving to first service and from mating start date to conception. Progesterone supplementation as part of a TAI protocol resulted in a greater proportion of these animals successfully establishing pregnancy during the first 42 days of the breeding season.

- Study 3: Use of a CIDR-based ovulation synchronisation protocol (i.e., CIDR_TAI) increased synchronisation rates in anovular cows (i.e., a greater proportion of cows successfully responded to the synchronisation protocol). Both CIDR_OBS and CIDR_TAI animals without a corpus luteum (CL) had increased likelihood of conception at first service compared with Ovsynch animals without a CL. Low body condition score (BCS) animals treated with CIDR_OBS had increased likelihood of conceiving at first service compared with low BCS animals treated with CIDR_TAI, Ovsynch, and CTRL. Animals < 60 days in milk (DIM) treated with CIDR_OBS and CIDR_TAI had increased likelihood of conceiving at first service compared with Ovsynch. Treatment with CIDR_TAI increased synchronisation rate in cows categorised as low BCS, anovulatory, and < 60 DIM compared with both CIDR_OBS and Ovsynch, and increased submission rate compared with CIDR_OBS. Conception rate in cows within these categories, however, was greatest for CIDR_OBS, resulting in minimal differences in actual pregnancy rates between CIDR_OBS and CIDR_TAI treatments, both of which were superior to Ovsynch. Treatment differences in the response variables investigated were minimal in cows categorised as medium or high BCS, ovulatory and > 60 DIM, indicating that CIDR-based protocols could be targeted at particular cows, and all other cows could be synchronised using Ovsynch.

5. Opportunity/Benefit:

The results of this research are of immediate practical relevance to dairy farmers. Cow fertility during the breeding season and subsequent calving pattern the following spring can be improved through targeted use of oestrous and/or ovulation synchronisation protocols. Early treatment of anoestrous cows and late-calving cows will have a beneficial impact on herd calving pattern.

6. Dissemination:

Main publications:

Herlihy, M.M., Berry, D.P., Crowe, M.A., Diskin, M.G. and Butler, S.T. (2011) 'Evaluation of protocols to synchronize oestrus and ovulation in seasonal calving pasture-based dairy production systems.' *Journal of Dairy Science* 94:4488-4501.

Herlihy, M.M., Crowe, M.A., Diskin, M.G. and Butler, S.T. (2012) 'Effects of synchronization treatments on ovarian follicular dynamics, corpus luteum growth, and circulating steroid hormone concentrations in lactating dairy cows.' *Journal of Dairy Science* 95:743-754.

Conferences and Open Days:

Butler, S.T. and Herlihy, M.M. (2012) 'Use of controlled breeding programs in seasonal calving systems'. Pages 95-98 in conference proceedings 'Dairy cow fertility: reproductive performance for efficient pasture-based systems', 11th and 12th April 2012, Cork. www.agresearch.teagasc.ie/moorepark/publications/pdfs/DairyCowFertilityConference.pdf

Herlihy, M.M. and Butler, S.T. (2009) 'Increasing submission rates on dairy farms'. Pages 60-62 in Moorepark '09 Open Day 'Irish Dairying: new thinking for challenging times', 18th June 2009, Moorepark, Fermoy, Co. Cork. www.agresearch.teagasc.ie/moorepark/Publications/pdfs/Open%20Day%20Moorepark%202009.pdf

Popular publications:

Butler, S.T. Turning up the heat: alternative detection aids. Irish farmers Journal, 10/5/2008, pages 24 – 25.

Butler, S.T and Herlihy, M.M. (2008) Fancy an extra €170 profit from each cow? Today's Farm, 19:20-21.

Does cow synchronisation have a role? *Today's Farm* March - April 2012, 23(2):20-21.

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