FERTILITY: FROM CONCEPTION TO THE COW

Suzanne Naughton, veterinary technical advisor, MSD Animal Health, looks at cow fertility including conception, fertility control methods and how management changes affecting foetus and heifer can impact on subsequent fertility

Experience gained from the fodder crisis and difficult weather conditions of 2018 has highlighted the importance of maintaining nutrition and body condition score of cows as a foundation in optimising fertility. Many veterinary practitioners observed that as herd owners increased levels of feed despite the adverse environmental conditions, the knock-on effect in improved fertility was realised. Alongside nutrition, many important infectious diseases such as leptospirosis and circulation of BVD virus are well-documented as having negative effects on fertility and so vaccination must be considered as a means of protection. Synchronisation protocols will be outlined later in this article as a method to control fertility. However, firstly, we will look at how management changes affecting the foetus and young heifer can impact negatively on subsequent fertility.

THE FOETUS

Individually, and at herd level, it is important to remember the effect environment has on the developing foetus and the impact environment stresses may have on the future potential of that calf, when born, and onwards into its productive life. It has been postulated that animals conceived and developed, in a nutritionally stressed maternal environment, can experience negative effects in their development, particularly in relation to fertility. This hypothesis has been tested in beef animals by restricting nutrition of heifers to 60% of their maintenance energy requirements from shortly before conception to the end of the first trimester. Results indicated that calves born out of these foetuses had a thirty per cent lower number of good quality follicles when compared with calves born out of heifers on control diets.[1] Not alone can this have negative consequences on reproductive ability, for the rest of that animal's life, but also on future generations. This observation could be of particular relevance to the dairy industry. In order to achieve the 365-day calving interval, cows must conceive during the period of peak lactation, which often coincides with a reduced body weight as dry matter intake has not yet reached its maximum. As a result, foetuses are developing

during a period of negative energy balance and are in direct competition with nutrients for the udder. On certain farms, it could be said that if significant nutrient restriction is taking place at herd level, due to suboptimal management, the reproductive capabilities of that herd could be negatively affected through under-development of follicles in the foetus (future replacement animal).

THE GROWING HEIFER AND ADULT

Following on from the period of foetal development, the rearing period has a significant influence on the later performance of cattle including both fertility and longevity. It is widely accepted that the optimum age at first calving is approximately two years. Monitoring growth rates and ensuring good protocols of heifer management are essential in allowing heifers reach puberty at the optimum age (ideally six weeks before target breeding age). To calve at 24 months, a typical Holstein-type heifer must maintain an average growth weight of 750g/day, with lower rates delaying puberty and age at first calving (AFC).[2]

It is not surprising that heifers, which go through periods of disease, will experience adverse effects on future performance, in particular fertility. A study carried out by Heinrichs et al. investigated 18 commercial farms and how events experienced in the first four months of life impacted on performance. Difficult delivery, more days of antibiotic treatment of sick calves, poor quality forage once weaned and a higher humidity in housing all contributed to an increase in AFC. Much study has also been carried out on the impact of bovine respiratory disease (BRD). One episode of BRD, within the first few weeks of life, could delay AFC by up to six months. It goes without saying that optimising housing and management practices, as well as using vaccination protocols against BRD are essential, not just for reducing disease incidence but also in maximising the future production potential of these heifers.

Once heifers have reached breeding age, there are many other infectious diseases which can have devastating consequences on conception rate, foetal mortality and abortion. Although great strides have been made in reducing the incidence of BVD infection in Ireland with the national eradication programme, BVD virus is still circulating on certain Irish farms. As we continue to remove persistenty infected (PI) animals, we remove the source of infection. Vaccination provides an alternative means to induce immunity and reduce the negative impact of an outbreak.

Leptospirosis is another economically important bacterial infection that can result in reduced conception rates and early embryonic death, not to mention abortion and reduced milk yield. Attention to biosecurity and maintaining a closed herd are all important aids in control. Vaccination prior to exposure, typically in the spring months, is an essential step in control; it effectively confers immunity on all vaccinated animals.

SYNCHRONISATION

Finally, the use of synchronisation protocols to manipulate the oestrous cycle, via the use of synthetic hormones, can bring significant advantages in herd management and fertility. For instance, they can:

- Increase submission rates;
- Improve or, at least, not affect conception rates;
- Increase overall pregnancy rate at the end of the breeding season;
- Reduce the proportion of cows to be culled; and
- Using certain protocols, reduse heat detection, diminishing the labour component.

By using synthetic hormones three key aspects of the oestrous cycle are targeted:

- Control of follicular wave dynamics (Gonadotrophin Releasing Hormone [GnRH] eg. receptal, progesterone releasing devices);
- Stimulation of ovarian follicles (PMSG eg. Folligon);
- Regression of the Corpus Luteum (Prostaglandin [PG] eg. Estrumate) and
- Ovulation of a dominant follicle (GnRH eg. receptal).

Traditionally, artificial insemination has not been used to the same extent in beef cattle as it has in the dairy herd due to the need for accurate heat detection, handling facilities and animal interventions. The development of synchronisation programmes that minimise the need for oestrus detection and allow fixed time AI (FTAI) means that AI can successfully be incorporated into a beef-breeding programme. It also allows for compact groups of cows to be presented for scanning, as well as compact calving, facilitating easier management and future sale of offspring.

It has also been shown that dairy cows which are synchronised to ovulate and are inseminated at a fixed time will establish a pregnancy earlier compared with standard reproductive management.[4] Increased milk production (≥39.5kg/d) decreases the duration of oestrous in lactating dairy cows.[5] Using a FTAI protocol in these cows allows 100% submission rates for AI, irrespective of milk production. Research has shown that the interval from calving to first service and from mating start date to conception can be shortened using FTAI protocols in seasonal-calving, pasture-based dairy production systems.[5] The use of FTAI means herds can gain access to high genetic merit sires thereby improving the genetic merit of the herd while reducing the need for keeping a bull.

THE OESTROUS CYCLE

The oestrous cycle consists of a luteal phase and a follicular phase. During the luteal phase of the cycling heifer, consecutive waves of follicles grow but fail to ovulate as a corpus luteum (CL) is present. The corpus luteum prevents ovulation because the high levels of progesterone it secretes block the pre-ovulatory surge of luteinizing hormone (LH). Removal or luteolysis of the CL can be induced with a dose of prostaglandin (PG). Once the CL is eliminated, the dominant follicle can finish its growth and ovulate.

It is an essential requirement that a corpus luteum is present at the time of the PG injection. The time of greatest sensitivity of the CL to PG is between days six and 17 of the oestrous

Day	Beef and Dairy Heifers: PG only	Dairy Cows: GnRH+PG+GnRH (Ovsynch)	Dairy Cows: P4 + Ovsynch	Beef Cows: P4 + GnRH+PG+PMSG
0 Monday	PG	GnRH	GnRH+insert P4 device	GnRH+insert P4 device
1 Tuesday 2 Wednesday	AI at observed heat			
3 Thursday				
4 Friday				
5 Saturday				
6 Sunday				
7 Monday		PG	PG (AM)	PG Remove P4 device PMSG
8 Tuesday			Remove P4 device (AM)	
9 Wednesday		GnRH	GnRH	
10 Thursday		FTAI	FTAI	GnRH FTAI
11 Friday	PG			
12 Saturday				
13 Sunday				
14 Monday	FTAI 72 and 96 hrs after PG or AI at observed heat			
15 Tuesday 16 Wednesday				

Table 1.

cycle. If treatment takes place at 0-6 days post-oestrus, no reaction to the treatment should be expected as the young CL is not fully sensitive to the action of PG. When the dates of the previous heat are known, PG can be administered when a sensitive CL would be present (ie. from day seven post last observed oestrus). The CL can be detected with either rectal palpation or ultrasound examination. The most common practice is to inject all eligible cows, watch for heat and then re-treat those not observed in heat 11 days later.

- For success with PG, heifers need to be cycling. PG synchronisation will not work on pre-pubertal heifers.
- Target a body weight of 330kg and body condition score of 3.25 to increase the chance that they have commenced cycling prior to mating start date.

Ovsynch is a programme that can be used in dairy cattle (Table 1). The Ovsynch programme is based on the ability of an exogenous GnRH to cause ovulation of any follicle larger than 10mm and initiate a new follicular wave. The programme works best in cows that have a selected dominant follicle on their ovary at the time of the first GnRH injection. For adult beef cows, due to the high incidence of anoestrus because of nursing calves, synchronisation programmes involving Ovsynch alone will not yield satisfactory pregnancy rates. Progesterone priming is, therefore, included in the programme. A protocol involving an injection of GnRH at time of progestagen device insertion followed by PMSG administration at time of removal is required. Finally, an injection of GnRH along with FTAI three days later is recommended. Remember with Ovsynch:

- Heat detection is effectively eliminated;
- All cows treated are submitted for AI; and
- Heat detection is still required to identify repeat heats on cows that fail to conceive.

So far, calving to date this spring is behind on the same period last year which is more than likely because of the weather conditions we experienced. With the expansion of the dairy sector, close to 2.5 million cows could be presented for breeding. As discussed throughout the article, many factors can impact on fertility, right from the foetus up to the cow. We must also not forget the bull and his role in the breeding programme. The importance of fertility testing, not to mention including the bull in vaccination protocols, cannot be under-emphasised; as they are often a forgotten part of the wheel. Using synchronisation protocols are not only a beneficial tool in saving labour and time but also in advancing calving dates, increasing pregnancy rates and reaching a target calving interval of 365 days.

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