

# Artificial Insemination (AI) and Oestrus Synchronisation of Beef Cattle

## Contents

- 2 Benefits of AI
- 3 Critical success factors
- 4 Signs of heat/oestrus
- 4 Heat detection
- 5 The reproductive system
- 6 Synchronisation programmes
- 7 Oestrus synchronisation with fixed-time AI
- 10 Options for animals that don't hold to first service
- 11 Pros and cons of DIY AI

## Key Messages

- Using AI allows producers to select bulls that are suited to their herd's breeding programme without the expense of buying and keeping a bull
- Successful synchronisation requires attention to detail in managing the cattle, setting up handling facilities and planning labour
- A cow or heifer standing to be mounted is the most accurate sign of oestrus (heat)
- Successful heat detection relies on carrying out regular observation of the breeding groups
- It is crucial to correctly time insemination to achieve good conception rates
- A cow's oestrus cycle averages 21 days and starts at day 0, when she shows signs of standing heat
- Synchronisation can be used to reduce the time spent observing standing heats to indicate the timing of AI
- Once a programme has been chosen, it is important to carefully adhere to timings



Information provided by Endell Veterinary Group, Paragon Veterinary Group and RAFT Solutions/ Bishopton Cattle Breeding Services.

Compiled by Dr Mary Vickers, AHDB Beef & Lamb.

Photography: BCF Technology and Paragon Veterinary Group.

Using AI allows producers to select bulls that are suited to their herd's breeding programme without the expense of buying and keeping a bull.



AI allows different sires to be chosen for each cow or group of cows

## Introduction

Traditionally, artificial insemination (AI) has not been used in beef cattle to the extent it has in the dairy industry.

Synchronisation programmes, where a group of females is treated to come into heat and ovulate at approximately the same time, are one way of successfully incorporating AI into beef breeding programmes. Different synchronisation programmes must be used for non-cycling animals to avoid poor results. Synchronisation programmes minimise the time needed to observe heat (oestrus) and handle cattle, because all animals can be inseminated at the same time.

However, similar to breeding with a stock bull, AI and synchronisation need good overall management of the cattle to achieve good conception rates.

## Benefits of AI

There are many ways AI can benefit beef producers. The main advantage is it allows producers with suckler herds to access high genetic merit sires with desired estimated breeding values (EBVs) that suit the herd's breeding programme. This allows high rates of genetic improvement to be achieved. High genetic merit stock bulls can often be expensive to purchase, so purchasing semen instead can be a more affordable option.

Sires can also be selected for different groups of females, eg one bull for the heifers, a second to produce heifer replacements and a third to produce calves with superior carcass traits for the beef market.

Sweeper bulls are sometimes required, but AI can potentially reduce the need to keep bulls on the farm. This can be an attractive incentive because the maintenance cost for a bull can be around £45 per calf born, in addition to the purchase cost, which for top bulls may be prohibitive. AI also avoids the potential health risks associated with using natural service.

The choice of bull for the females being served is vital. It is important to check the EBV for calving ease (direct), as this indicates how easily a calf sired by a particular bull will be born. Herd management should aim to reduce the risk of calving difficulties because they have a negative effect on subsequent cow fertility and calf performance.

Many other EBVs are available to help producers select bulls that will produce progeny to fit the farm's requirements and complement the females in the herd.

For more information, see **Choosing bulls for Better Returns** at [beefandlamb.ahdb.org.uk](http://beefandlamb.ahdb.org.uk)

### Synchronising heats

For maximum benefit from using AI, synchronisation can be used to:

- Facilitate block serving and a compact calving period
- Reduce the time and labour required for constant heat observation
- Improve the timing of AI

Synchronisation requires increased stock handling. It does not completely eliminate the need for heat detection because, unless a sweeper bull is used, females that don't hold to service must be identified and served again roughly 21 days later.

It is important to consider how AI and synchronisation will be integrated into the management of the herd. Producers must decide how non-pregnant cows will be detected, how many times a batch of cows will be synchronised and whether a sweeper bull will be used.

# Critical success factors

Successful synchronisation requires attention to detail in managing the cattle, setting up the handling facilities and planning the labour.

Successful synchronisation requires attention to detail when managing the cattle, handling facilities and labour requirements. It is vital to plan in advance how the programme is going to work on farm.

## Cattle

- The same management principles apply for natural service and synchronisation programmes
- Feed cows a consistent ration so they are on a rising plane of nutrition that meets their requirements, including minerals, for a minimum of six weeks before service and six weeks after
- Cows or heifers should be in the correct body condition. They should be fit, not fat. The ideal body condition score (BCS) at service is around 2.5–3. Exclude cows that are very thin (BCS <2) or very fat (BCS >4)
- Cattle should be kept in a stable social group for at least six weeks before and after service to reduce stress
- Heifers should weigh at least 65 per cent of their mature body weight at first service
- All stock must be free from disease
- All medication, eg vaccines and parasite treatments, should be given in advance of any synchronisation programme and/or service
- Ideally, some females should be observed cycling before synchronisation or AI\*
- Ideally, cows should have calved at least 50 days before the synchronisation programme begins\*
- Stock should have a post-service/pre-calving vet check to ensure they have a healthy and functional reproductive tract
- Ensure accurate calving, breeding and pregnancy records are kept

\*Some progesterone-based synchronisation protocols can help overcome non-cycling animals and can be beneficial when synchronising cows that have been calved for 50 days. However, pregnancy rates from service at the first post-calving heat may be reduced compared to serves at later heats.

## Facilities

- Facilities must be suitable for multiple handlings and minimise stress to the cattle
- The crush should be under cover to provide good working conditions for insemination
- Most synchronised females will calve within a two-week period and a significant proportion may calve in one day, so sufficient calving pens should be available

## Labour

- There should be enough staff to cover the increased workload at service and calving
- During synchronisation and AI programmes, cattle may be handled any number of times from once to over five times in a three-week period dependent on the programme being used
- Do-it-yourself (DIY) AI can make some synchronisation programmes more workable. However, it is important the inseminator is well practiced and competent to ensure good conception rates
- Synchronisation can be planned to avoid busy times or when help is limited

## Choosing the correct sire for AI

- Choose AI sires that are above average for the traits that are important to your herd. Calving ease (direct) should always be positive, especially if serving heifers
- Some EBVs are more important for maternal breeding and others for terminal breeding. It is important to consider whether the calves will be commercial or breeding animals and to choose sires accordingly



Good handling facilities are essential for AI



Self-locking yokes

# Signs of heat/oestrus

If not using a fixed-time AI programme, or when watching for return services, the timing of insemination relies on accurate heat detection.

A cow or heifer standing to be mounted is the most accurate (primary) sign of oestrus.

Cows or heifers on heat will allow other cows to mount them or move forward slightly with the weight of the cow that is riding them. Cows that move away quickly when mounted are not on true heat.

A cow or heifer standing to be mounted is the most accurate sign of oestrus.



Long, clear strings of mucus are often seen during heat

Secondary signs indicating that a cow or heifer will soon be coming into heat or has recently been on heat include:

- Restless behaviour, such as increased walking, following other cows and bellowing
- Rubbed tail head and dirty flanks caused by being frequently mounted – the hair around the tail head may be matted or rubbed off completely
- Swelling and reddening of the vulva
- Mounting other cows – mid-cycle females or those that are in-calf are less likely to perform mounting activity
- Discharge of clear mucus from the vulva – long, clear, elastic strings of mucus indicate an imminent heat, while cloudier, thicker mucus indicates a recent heat
- Bloodstains on the tail or vulva – some cows and most heifers have a bloody mucus discharge 1–3 days after oestrus. Blood is a sign that the cow or heifer has been in heat and does not mean they haven't held to a service. If they haven't been served and you observe blood on the tail, be sure to observe them 18–24 days later for signs of heat
- Decreased feed intake caused by increased activity and less time spent feeding



Mount detectors can be used to help detect heat but observation is also required

## Heat detection

In beef cows and heifers, standing heat tends to last for around 10–12 hours.

Successful heat detection relies on regular observation of the breeding groups. Ideally, they should be observed at least three times a day, including once early in the morning and once in the evening around dusk. Each observation should last at least 20 minutes.

Heat detection aids:

- Tail paint
- Mounting detectors
- Scratch cards
- Activity meters/collars (can be used while cows are outside)
- Teaser bull

Successful heat detection relies on carrying out regular observation of the breeding groups.

The more females on heat at the same time, the more heat activity will be exhibited.

There are several environmental factors that make activity hard to detect. High stocking rates and concrete or slippery flooring (as opposed to straw yards or pasture) are known to reduce oestrus behaviour. Beef cows with calves at foot often show very little bulling activity and activity often happens at night. The best time to inseminate a heifer or cow is just before ovulation, which occurs approximately 30–38 hours after the start of standing heat.



Tail paint can be used to help detect heat



Activity collars suitable for outside use to help detect heat



If cows or heifers are standing to be mounted, this indicates oestrus (heat)

Best time to inseminate  
– approximately 9 hours

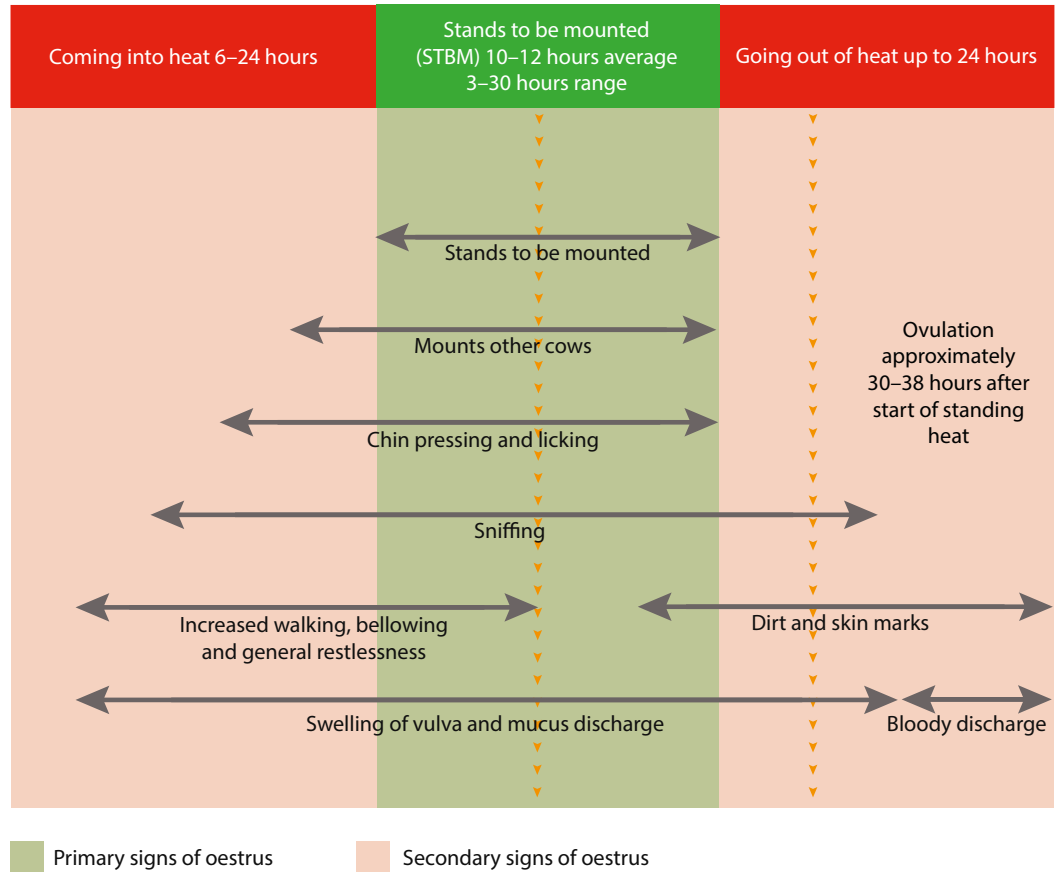


Figure 1. Changes in cow behaviour and signs of heat relative to heat onset, time of ovulation and optimum insemination time (adapted from Teagasc beef manual, 2012)

### When to inseminate: the AM/PM rule

If there is any doubt over when the cow started bulling, serve her straight away. If she is still showing signs of bulling 12 hours later, serve her again.

The general rule of thumb on timing of insemination after standing heat has been observed is as follows:

- Standing to be mounted in the morning = serve in the afternoon
- Standing to be mounted in the afternoon/evening = service the next morning

It is crucial to correctly time insemination to achieve good conception rates.

A cow's oestrus cycle averages 21 days and starts at day 0, when she shows signs of standing heat.

## The reproductive system

A beef cow's oestrus cycle lasts an average of 21 days, with a range of 18–26 days. It starts on day 0, which is when the cow shows signs of standing heat and is said to be 'on heat'. The whole cycle is driven by the release and decline of several hormones.

Ovarian follicles, the basic unit of female reproduction, each contain a single egg. Under the influence of follicle-stimulating hormone (FSH), several new follicles mature every 7–10 days. This is known as the 'follicular wave' and results in one follicle becoming dominant.

Oestrus occurs when a dominant follicle on the cow's ovary is almost ready to ovulate. The egg is released on day one (ovulation). This is ready to be fertilised if a cow has been served and semen is present inside her.

After ovulation, a progesterone-secreting body called a corpus luteum (CL) develops at the ovulation site. The presence of high levels of progesterone stops more eggs from being released.

From day 17, if the cow is not pregnant, hormones called prostaglandins produced by the uterus and declining progesterone levels cause the CL to regress. This fall in progesterone, combined with the increase of another hormone called oestrogen, produced by the dominant follicle, induces a peak in luteinising hormone (LH). This stimulates the next dominant follicle to release an egg.

If pregnancy occurs, the CL does not regress and continues to function and release progesterone, which maintains the pregnancy.

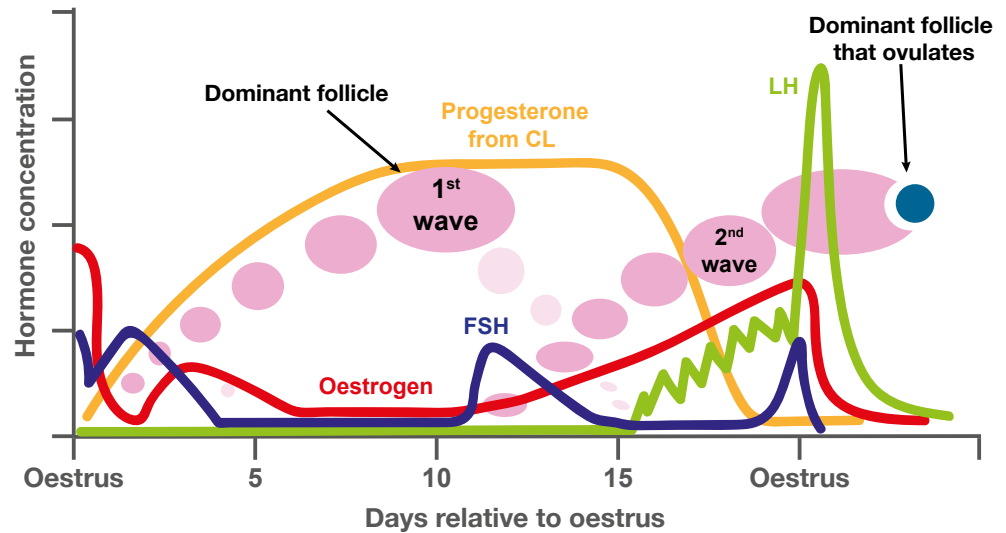


Figure 2. The normal oestrus cycle of a cow. Source: Penn Veterinary Medicine

## Synchronisation programmes

In controlled breeding programmes, synthetic hormones are used to control the breeding cycle of the cow. If performed correctly and hygienically, controlled breeding programmes cause no adverse effects to the cow's fertility.

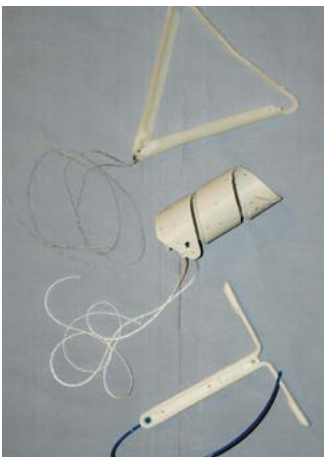
Fixed-time AI (FTAI) programmes are designed to:

- Control follicular wave dynamics
- Induce regression of the CL
- Induce ovulation of a dominant follicle

The following hormones are often used during synchronisation programmes:

### Progesterone (P4)

Progesterone suppresses the release of gonadotropin-releasing hormone (GnRH), which in turn regulates the release of LH and FSH. Progesterone-releasing devices (P4 devices) such as controlled internal drug release (CIDR) or progesterone releasing intravaginal device (PRID) can be placed in the vagina and imitate the function of the CL by releasing progesterone. Removal of the P4 device produces a surge of GnRH, generating more frequent and larger LH pulses, which induce ovulation 2–3 days later. Progesterone-based programmes are often used in cows because they are more effective at synchronising non-cycling animals.



Progesterone-releasing devices

## Prostaglandin (PG)

Prostaglandin shortens the reproductive cycle by inducing regression of the CL, causing ovulation of the dominant follicle 2–5 days later. If no CL is present when the prostaglandin is administered, it will have no effect. This means heifers or cows must be cycling to make use of PG.

## Gonadotropin-releasing hormone (GnRH)

GnRH stimulates the release of both FSH and LH, causing:

- Ovulation of dominant follicles, leading to the formation of a CL
- Stimulation of further follicular development

This hormone can therefore be used to assist the timing of ovulation in relation to insemination.

Other hormones are available for inclusion in the various programmes. Discuss options in more detail with a vet.

## Equine chorionic gonadotropin (eCG)/pregnant mare's serum gonadotropin (PMSG)

Research has shown that administering the hormone equine chorionic gonadotropin (eCG) at the same time as removing a P4 device can improve synchronised conception rates in beef cows. The greatest benefit is likely to be seen in thin cows (BCS <2) that calve <55 days following first AI. Caution is required as high doses may increase the risk of twins.

Note: Many hormone injections must be administered via a deep intramuscular injection. It is important to carefully follow the manufacturers' instructions.

# Oestrus synchronisation with fixed-time AI

FTAI programmes remove the need for heat detection because cattle are served at a predetermined time. There are several FTAI programmes – to choose the best one, discuss with a vet.

The following examples of FTAI programmes are popular in beef herds because the cattle require minimal handling and relatively good results can be achieved.

Synchronisation can be used to reduce the time spent observing standing heats to indicate the timing of AI.

### 1. Prostaglandin (PG) only

This programme is suitable for all cycling cows or heifers and consists of two PG injections administered on day 0 and between days 10 and 12. Prostaglandin programmes are not suitable for:

- Cattle that are not cycling, eg immature heifers
- Females that have recently calved (<50 days post-partum)
- Females in poor body condition (BCS <2)

Alternatively, there are less costly options using prostaglandin administration, however, these involve additional observed heat detection. The options are flexible but generally involve initial insemination to observed heat for a period of six days. For those not served, one or two injections of prostaglandin should be administered, with heifers and cows subsequently observed and inseminated to standing heat for periods of five days after injection. Consult a vet for more information on these options.

Note: Inadvertent administration of prostaglandin to a pregnant cow or heifer usually causes abortion.



It is important to serve cows at the precise time stated in the synchronisation programme

## 2. PG + GnRH

This programme is suitable for herds with a high percentage of cycling heifers or cows (cows >50 days post-partum and/or in good BCS 2.5–3). This programme tends to be less effective in heifers than mature cows

## 3. P4 + PG (+/- eCG)

This programme is suitable for herds with a high proportion of heifers or cows that are not likely to be cycling normally because they are too young or have not reached the correct weight (heifers), are in poor body condition (BCS <2), or have only recently calved (<50 days post-partum). For these cows or heifers, addition of eCG may increase conception rates, but care must be taken because higher dose rates can increase twinning rates.

There is the option of a single insemination at 56 hours, or double insemination at 48 and 72 hours. Double insemination usually increases pregnancy rates by 5–10 per cent.

If FTAI is being carried out, it is important to inject PG 24–48 hours before the P4 devices are removed. This reduces the risk of continued progesterone production so that the CL continues to function after device removal and ensures good oestrus synchronisation.

Addition of GnRH at the start of the programme is optional. It is used to cause any existing dominant follicles to ovulate, ensures a new follicle wave is initiated and could therefore eliminate the need for double insemination.

## 4. P4 + GnRH + PG

This programme is also suitable for herds with a high proportion of heifers or cows that are not likely to be cycling normally because they are too young or have not reached the correct weight (heifers), are in poor body condition (BCS <2), or have only recently calved (<50 days post-partum).

There are advantages to including progesterone-releasing devices in females not observed to be cycling (or examined by a vet). The addition of a P4 device prevents premature expression of heat (between days six and eight) and improves the chances of a fertile ovulation in non-cyclic cows.

Addition of GnRH at the start of the programme eliminates any existing dominant follicles and ensures a new wave. At the end of the programme, GnRH ensures timely ovulation.

This programme also has the advantage of only three handling sessions.

## Conception rates

Conception rates for the different synchronisation programmes vary within and between herds for several reasons. Conception rates of 50 per cent and above are achievable, although the range is between 30 and 75 per cent. Attention to detail and good planning will help to optimise results.

Generally, conception rates tend to be better with heifers than cows, as long as they are cycling before entering the programme.



Inserting the progesterone-releasing device



A scan of a cow that is 45 days pregnant



**KEY:**

FTAI = Fixed-time AI

GnRH = Gonadotropin-releasing hormone

PG = Prostaglandin

P4 = Progesterone

Table 1. Examples of fixed-time AI programmes

Programme (more details page 7 and 8)				
Day	1. PG only (x2)	2. PG + GnRH	3. P4 + PG (+/- eCG)	4. P4 + GnRH + PG
0	PG	GnRH	Insert P4 devices	GnRH + insert P4 devices
1				
2				
3				
4				
5				
6				
7		PG	PG*	PG + remove P4 devices
8			Remove P4 devices ** (eCG) ***	
9		GnRH + FTAI 56 hours after PG		GnRH + FTAI 56 hours after P4 removal
10			FTAI at 48 and 72 hours after P4 removal or single FTAI at 56 hours after P4 removal	
11	PG			
12				
13				
14	FTAI 72 and 96 hours after PG administration or single FTAI at 84 hours after PG			
15	or observe and serve to standing heat			

Note: These are examples only and there are many variations on these programmes. With any synchronisation programme, a compromise must be found between the number of cattle handlings and the potential conception rate achieved within the programme. Priorities between these two factors will vary by farm and should be discussed with the herd vet.

\* PG is usually injected 24–48 hours before P4 device removal

\*\* P4 is usually removed after 7–9 days, but this can vary depending on device and veterinary advice

\*\*\* eCG = inject 300–400iu of eCG or PMSG for thin/late calved heifers/cows

Once a programme has been chosen, it is important to carefully adhere to timings.



Most fixed-time AI programmes still rely on a sweeper bull

# Options for animals that don't hold to first service

## Sweeper bulls

A common way of serving cattle that don't hold to first service is to put a sweeper bull in with cows a few days after they have been served to AI.

## Repeat synchronisation

Repeat synchronisation programmes aim to synchronise cows or heifers that have failed to conceive following the first synchronisation, allowing second and third rounds of AI. These programmes can also include any late calvers into subsequent rounds of insemination.

The advantage of this is there are up to three opportunities for cows to be served with FTAI, so a stock bull may not be required. Disadvantages include increased handling and higher drug costs. Anyone considering this option should contact a vet for further advice.

## Observe heats and inseminate

Any cattle that have been synchronised and do not hold to first service are likely to repeat within a short timeframe of around 21 days. Cattle should be observed 18–24 days after service and any showing signs of heat should be re-inseminated.

## Sire identification

It is important to know the sire of the calves so it can be recorded on passports and so that performance data and any difficult calvings can be tracked.

Options for identifying the sire are to:

- Use a different breed of sweeper bull and AI sire so that calves are easily identified at birth
- Pregnancy diagnose (PD) cows early (up to two months) so that calves can be accurately aged and linked back to services (this will also help to identify empty cows)
- Keep accurate records of insemination dates, bull in/out dates and sire details
- Use DNA testing if in doubt

## Options for AI

AI should be performed by someone who is fully trained to ensure cow and handler safety and to achieve good conception rates.

Many suckler producers use AI technician services, however, this service is not available in all parts of the country.

It is therefore often a viable option for producers to undergo their own AI training and serve their own herd.

## Pregnancy detection

It is important to quickly identify any cows that are not in calf to avoid a prolonged calving period. Pregnancy scanning can be carried out by vets and licensed lay persons from around 30 days after breeding to confirm whether cattle are in calf or not and if they are carrying twins. It can also predict calving dates for cows and heifers that are up to three months pregnant.

## Further advice

Various modifications of these programmes are available. Choosing the most suitable synchronisation programme for a group of cattle should be done in conjunction with the herd's vet. They will be able to offer advice about achieving the best results from AI.

## *Pros and cons of DIY AI*

Do-it-yourself (DIY) AI has proved to be very efficient and cost-effective for some producers. Below are some of the pros and cons of DIY AI.

### *Pros:*

- Cost per pregnancy can be reduced following initial investment in equipment
- Cattle can be served at the correct time according to when they are in heat
- Reduces stress for the cattle as there is no need for them to be separated from the herd while waiting for a technician to arrive
- Cattle can be served by the same person every time, improving continuity
- Technician service may not be available in your area

### *Cons:*

- AI requires practice to achieve good conception rates
- Skills can be lost if you do not serve cattle on a regular basis

Produced for you by:

**Better Returns Programme**

AHDB Beef & Lamb  
Stoneleigh Park  
Kenilworth  
Warwickshire  
CV8 2TL

**T 024 7647 8834**

**E [brp@ahdb.org.uk](mailto:brp@ahdb.org.uk)**

**W [beefandlamb.ahdb.org.uk](http://beefandlamb.ahdb.org.uk)**

** @AHDB\_BeefLamb**

If you no longer wish to receive this information, please email us on [comms@ahdb.org.uk](mailto:comms@ahdb.org.uk)

While the Agriculture and Horticulture Development Board seeks to ensure that the information contained within this document is accurate at the time of printing, no warranty is given in respect thereof and, to the maximum extent permitted by law, the Agriculture and Horticulture Development Board accepts no liability for loss, damage or injury howsoever caused (including that caused by negligence) or suffered directly or indirectly in relation to information and opinions contained in or omitted from this document.

© Agriculture and Horticulture Development Board 2018.  
All rights reserved.

**AHDB**  
