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Manjusha Patil
Assistant Professor, Department of Animal Reproduction, Gynaecology & Obstetrics, College of Veterinary and Animal Sciences, (MAFSU), Parbhani. Maharashtra, India

PB Hase
Assistant Professor, Department of Veterinary Clinical Medicine Ethics and Jurisprudence, Mumbai Veterinary College, (MAFSU) Mumbai, Maharashtra, India

YM Wankhede
MVSc. Scholar, Department of Veterinary Clinical Medicine Ethics and Jurisprudence. College of Veterinary and Animal Sciences (MAFSU), Udgir. Maharashtra, India

SS Sawant
MVSc. Scholar, Department of Animal Reproduction, Gynaecology & Obstetrics, Post Graduate Institute of Veterinary and Animal Sciences (MAFSU), Akola, Maharashtra, India

MA Gole
Assistant Professor, Department of Poultry Sciences, Nagpur Veterinary College (MAFSU), Nagpur, Maharashtra, India

Corresponding Author:
PB Hase
Assistant Professor, Department of Veterinary Clinical Medicine Ethics and Jurisprudence, Mumbai Veterinary College, (MAFSU) Mumbai, Maharashtra, India

A review on recent oestrus synchronisation programs available for farm animals

Manjusha Patil, PB Hase, YM Wankhede, SS Sawant and MA Gole

Abstract
It is still possible to maintain good reproductive performance in dairy herds without estrus synchronization, but it requires a sound heat detection program. Unfortunately maintaining an efficient heat detection program and quality heat detection personnel can be a never-ending challenge in today’s expanding herds.
The major factor limiting optimum reproductive performance on many dairy farms is failure to detect cows in heat in a timely and accurate manner. Poor heat detection results in excessive number of days not pregnant (days open) which causes long calving intervals. This is economically important to the dairy business because for every day a cow is not pregnant beyond 120 days after calving it costs about Rs 100 per cow per day. For a 250-cow herd with an average of 140 days open, the cost would be Rs 200 per cow or Rs 10,000 per year compared to 120 days open.
Oestrus synchronization is a management technique that makes use of hormones to control or reschedule the oestrus cycle. The present paper discusses the different oestrus synchronization protocols available for farm animals with their success ratio.

Keywords: Oestrus synchronisation, farm animals, breeding programs

Introduction
The primary measure of reproductive performance that is almost immediately impacted by synchronization is days to first breeding (DFB). The average for a herd with exceptionally with good heat detection efficacy (greater than 70 %) will be the range of approximately 75 days. If average DFB in herd exceeds 80, one could likely benefit from a systematic breeding program. The major advantages of systematic breeding programs include improvement in the efficiency of heat detection, to achieve more timely first service, normally induced parturition forms part of synchronization programme which facilitate the supervision of parturition, possibly reduce involuntary culling for reproductive reasons and improve the overall reproductive performance of the herd. By improving the pregnancy rate there will be a reduction in the variation in calving intervals among cows. After successful control of breeding, it will help to permit weaning, fattening & marketing of uniform groups of animals.

Materials and Methods
The different oestrus synchronization protocols available for farm animals with their success ratio were considered and studied for the present study.

1. Prostaglandin f2 α (PGF)
The foundation hormone of any synchronization protocol is PGF. As in the naturally cycling cow, PGF brings cows into heat by removing the CL & the inhibitory effects of progesterone on gonadotropin (FSH &LH) secretion. However, PGF alone has sever distinct limitations. First, PGF is not effective in animals that do not have a CL. This includes prepubertal heifers, anestrous cow or cycling females in the first five to six days of the estrous cycle. Secondly, PGF has no effect on follicular waves. Cow to cow variation in the size of the dominant follicle at the time of PGF injection results in considerable Variation in the interval to estrus following PGF injection. Cows with large follicles at PGF injection may display estrus within 36 to 48 hours, whereas those with small follicles or in between waves at the time of PGF injection may not respond for four or five days. That’s why fixed time AI after PGF alone seldom produces acceptable results. However, PGF alone is a very effective management tool if most cows are cycling & if the heat detection program is intense enough to catch animals as they respond (De Jarnette *et al.*, 2003) [4].

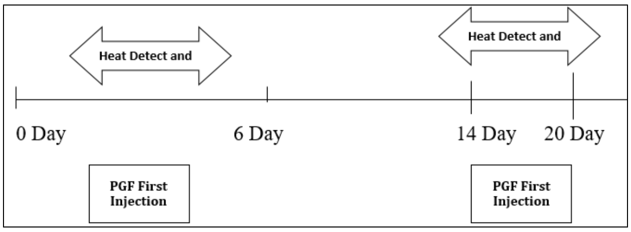

Fig 1

The CL is generally responsive to PGF2α only after day 5 of the estrous cycle & a single injection of PGF given at random should induce estrus in approximately 60 to 70 % of the cycling cows. When 2 injections of PgF2 α are given 10 to 14 day apart, over 90 % of the cycling cows are expected to respond to the second injection (illustrated in figure1). However, frequency of anestrus cows & lack of optimal estrus detection can have a major impact on the number of cows responding to PGF2α & observed in estrus. In most dairy farms, utilization of two PGF injections in the first 50-day postpartum results in 50 to 60 % cows in estrus following the second injection of PGF. (Santos *et al.*, 2003) [13] Most cows and heifers received AI after the first or second PGF2a injection; only 18% (lactating cows) and 23% (heifers) received the third PGF2a injection (Table 1). Of the lactating cows that received the third PGF2 α injection, almost all were bred by timed AI (92%), and the pregnancy rate from this AI was very low (Table1). In contrast, more than half of the heifers that received the third PGF2a injection were bred to a detected estrus (Illustrated in Table 1).

Table 1: Percentage of cows bred and pregnancy per AI after each treatment with $PGF_{2\alpha}$ (Pursley *et al.* 1997) [11]

	%Lactating cows		Heifers	
	% bred of total	**% pregnant of bred**	**% bred of total**	**% pregnant of bred**
First $PGF_{2\alpha}$	48.5	46.3	39.7	71.0
Second$PGF_{2\alpha}$	33.3	54.7	37.2	82.8
Third $PGF_{2\alpha}$				
AI to estrus	1.4	0	12.8	70.0
Timed AI	16.7	4.3	10.3	50.0

GnRH PGF based breeding Programs-

Gonadotropin-releasing hormone (GnRH) is commonly recognized by its brand names of Receptal, Cystorellin, Fertagyl & Gynarich, Similar to the natural release of GnRH (100µg) causes an LH surge that ovulates or luteinizes most large follicles Present in the ovaries. All cows then start a new follicular wave one to two days later. When GnRH is followed by a PGF injection seven days later, most cows will possess mature dominant follicles of similar size at CL regression, resulting in a more synchronous heat response (Wolfenson *et al*., 1994) [17].

Additionally, the GnRH induced luteinization of dominant follicles will stimulate cyclicity in many anestrous cows (Steven *et al*., 2000) [15]. There are several variations of GnRH-PGF based breeding programs commonly used in dairy herds. Each system operates from the same basic frame work, of GnRH& PGF administered at seven-day intervals, but vary in how animals are handled for heat detection & A.I (Pursley *et al.*, 1998) [12].

Ovsynch

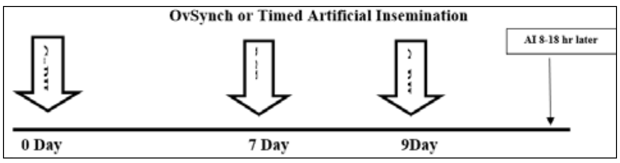

Fig 2

Ovsynch is a fixed-time A.I synchronization protocol that has been developed, tested & used extensively in lactating dairy cattle (Pursley *et al*., 1997; Stevenson *et al*., 1999) [14, 11]. The protocol builds on the basic GnRH-PGF format by adding a second GnRH injection 48 hours after the PGF injection. This second GnRH injection induces ovulation of the dominant follicle recruited after the first GnRH injection. Animals are inseminated at 8 to 18 hours after the second GnRH injection (illustrated in Figure2). Cows expressing estrus early should be inseminated like any cow in heat & do not need to be injected with GnRH (Stevenson *et al.*, 2000) [15].

Across large numbers of dairy cattle pregnancy rates to ovsynch typically average in the 30 to 40 percent range. (Table 3). Although these numbers may not appear impressive at first, it is important to understand them in terms of an applied reproductive management program (Geary *et al.*, 2001) [7]. Records from DHIA (Dairy Herd Improvement Association) processing centers suggest that the average dairy producer only detects 40 percent of the eligible heats in the herd and then only gets a 40 percent conception rate. Thus, in a 21-day period, the effective pregnancy rate in the average dairy herd is only about 16 percent. In that context, a 30 percent pregnancy rate to a single fixed-time AI without heat detection doesn't sound so bad (Pursley *et al.*, 1997) [11].

Although ovsynch allows for acceptable pregnancy rates without heat detection, it does not necessarily eliminate the need for heat detection. Ovsynch-treated animals should be observed closely for returns to estrus 18 to 24 days later (Stevenson *et al.*, 1999) [14].

Additionally, up to 20 percent of treated cows will display standing estrus between days six & nine of the ovsynch protocol (Geary *et al*.,2000; Dejarnette *et al*.,2001a & 2001b) [6, 2, 3]. Conception rates of these animals will likely be compromised if bred strictly on a timed AI basis. As shown in Table 2, lactating cows had a similar pregnancy rate per AI following the traditional PGF2a protocol (control) or the Ovsynch protocol. In contrast, control heifers had a greater pregnancy rate per AI than did heifers treated with Ovsynch. (Pursley *et al.* 1997) [11]

Table 2: Pregnancy rates in cows and heifers after treatment with PGF2a (control) or synchronization of ovulation (Ovsynch). (Pursley *et al.* 1997) [11]

	Pregnancy rate	
	Control	**ovsynch**
Cows	38.9(n=154)	37.8(n=156)
Heifers	74.4(n=78)	35.1(n=77)

Co-Synch

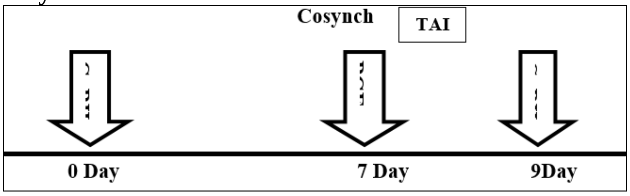

Fig 3

Co-Synch is an alternative to ovsynch that is used more extensively in beef herds (Geary *et al.,* 2001) [7]. The protocol is illustrated in figure 3. Co-synch eliminates one animal handling by breeding cows "coinciding" with the second GnRH injection. Most field trials indicate only a small reduction in conception rates when co-synch is compared to ovsynch (Pursly *et al*.,1998; Geary *et al*.,2001; Dejarnette & Marshall, 2003) [12, 7, 4]. As with ovsynch, pregnancy rates are maximized if early heats (± 24 hours of PGF) are visually detected & bred using the am-pm rule.

Select synch

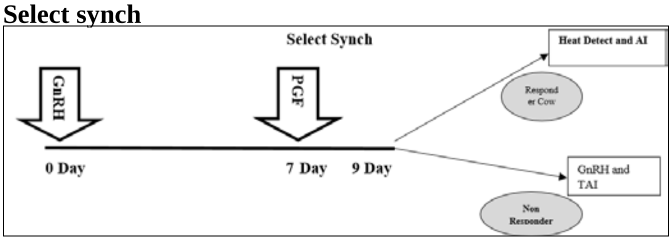

Fig 4

Select synch is a breeding option for those herds with good heat detection programs & that prefer to breed cows based to standing estrus. Cows are either bred to detected estrus for three to five days after PGF (Geary *et al*.,2000) [6] or bred to estrus for 72 hours after PGF with non-responder's time bred at 72 hrs with a concurrent injection of GnRH. (Dejarnette *et al*., 2001a, 2001b; 2003) [2, 3, 4]. This protocol is illustrated in Figure 4. This approach allows most cows (50 to 70 percent) to be bred at standing estrus & gives all cows an opportunity to conceive with the clean –up AI at 72 hours. The select synch approach saves on hormone costs because only those cows that fail to show estrus receive the second GnRH injection. Select Synch also facilitates more efficient use of expensive or genetically valuable semen by targeting its use in cows at estrus, whereas less expensive semen can be reserved for the timed AI services (Moreira *et al.,* 2000) [9].

Presynch

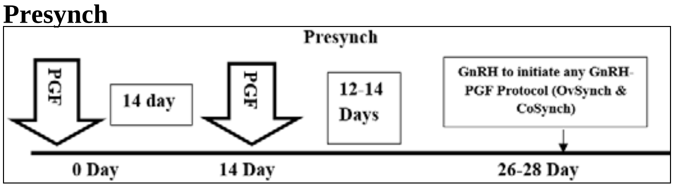

Fig 5

Although the initial GnRH injection is 90 percent effective at turning over follicles if cows are between days five & 12 of the estrus cycle, only 50 percent of cows between days 13 & 17 of the cycle have follicles that are capable of responding (Geary *et al*.,2000; Vasconcelos *et al*.,1999) [6]. Cows that fail to respond to the first GnRH injection may come into estrus early (36 to 48 hours before the PGF) or will have follicles that are ''out of synch" at the time of PGF injection. Presynch, as the name implies, is a protocol that "Pre-synchronizes" cows to the early stage of the estrus cycle for optimum response to GnRH, and thereby improves pregnancy rates to ovsynch (Moreria *et al*., 2000; Elzarkouny *et al*., 2004) [9, 5]. Presynch involves the use of two PGF injections, given at 14 days apart, with the last injection given at 12 to 14 days before initiation of any GnRH-PGF based breeding protocol. This illustrated in figure 5.

When considering a presynch program, each herd manager must carefully consider & answer the few questions. Am I implementing a presynch program for ovsynch or a PGF-based breeding program followed by ovsynch of all cows not detected in estrus? With a true presynch program, the set-up-PGF injections will be given prior to the VWP (Voluntary Waiting Period). Breeding cows after these early heats will likely result in compromised conception due to incomplete uterine involution. Also, pregnancy rates to Ovsynch may be reduced due to a higher percentage on non-responding problem cows remaining eligible for treatment. Thus, implementing presynch, but actually practicing PGF-based breeding, may actually decrease rather than improve reproductive performance of the herd. As described previously, PGF-based breeding followed by ovsynch is certainly a cost-effective program to implement in many herds; However, producers must recognize the distinction & appropriately schedule PGF breeding injections to occur after the VWP (Geary *et a.*, 2001) [7].

Progesteron

MGA

(This product is not approved for lactating dairy cows).Feed 0.5 mg/head/day of MGA (Melengestrol Acetate) for 14 days. MGA is generally fed in a grain carrier & either top dressed onto other feed. Inject a prostaglandin 31 days following the first MGA feeding.

CIDR is the newest synchronization tool. The CIDR is a T-shaped vaginal insert that delivers the natural hormone progesterone over a seven-day implant period. During the normal estrus cycle, progesterone is produced by the corpus luteum (CL) on the ovary & has two primary functions. In cycling cows, it prevents them from coming in to estrus, whereas in pregnant cows, progesterone is the primary hormone responsible for pregnancy maintenance. Any use of the CIDR could be considered similar to placing an artificial CL in the cow. Progestin stimulation helps to induce cyclicity in anestrous cows& advances puberty in beef heifers (Elzarkouny *et al.*, 2004) [5].

Used with an injection of lutalyse on day six or seven and insert removal on day seven, research has shown the CIDR to be a very effective means to synchronize estrus in both cycling & noncycling cows &heifers. Females are bred 8 to 12 hours after observed estrus for the next three to five days or at a single fixed time 48 to 64 hours after CIDR removal. The extra animal handling to give Lutalyse on day six versus day seven may reduce the average interval to estrus by about 12 hours with a slight improvement in synchrony of response, but will have no impact on the overall rate of estrus Stevenson (Elzarkouny *et al.*, 2004) [5].

Table 3: Pregnancy rates in cows following different protocols of synchronization

	Pregnancy rate					
Study	**Ovsynch**	**Cosynch**	**Select synch**	**$PGF_{2\alpha}$**	**GnRH and $PGF_{2\alpha}$**	**Heatsynch**
Kojima *et al.* 2000	-	-	47%	-	-	-
DeJarnette et al. 2001a Exp. No. 1 Exp No. 2	-	-	70% 52%	-	-	-
Peters and Pursley 2002 [10]	41.5%	-	-	-	38.3%	-
DeJarnette and Marshall 2002 [4]	29%	22%	-	-	-	-
Lean *et al.*2003	37.6%	-	-	41.4%	-	-
Mohan *et al.*2009	-	-	-	-	-	40%

Commercial Hormone Preparations -
1. Prostaglandin Products- Lutalyse, Pregma,Cyclix Vet, Vetmet, Estrumate, Clostenol
2. GnRH Products-Receptal Vet, Gynarich, Fertagyl, Cystorellin
3. Progesterone Products-PRID, CIDR insert device, Creaster (ear implant), MGA (Progestogen in feed).

Factors important in achieving success with synchronization programs
1. A high percentage of the cows must be cycling normally. Nutritional, environmental, or disease factors that prevent cows from cycling (anestrus) or cause low conception must be corrected before starting a synchronization program.
2. Although the presynch & ovsynch programs will induce some anestrus cows to ovulate, pregnancy rates will significantly increase in relation to the percentage of cows that are cycling at the onset of the program.
3. Pregnancy rates are significantly higher for cows with Body Condition Score (BCS) $\geq$ 2.5 compared to cows with BCS <2.5.
4. Efficient & accurate heat detection for the specified days is essential when using the synchronization programs that require heat detection. Heat detection must be intensified on the days when cows are likely to exhibit heat. Use of detection aids is recommended.
5. The proper amount of hormone must be given in the correct location.
6. Pregnancy examinations must be scheduled routinely so non pregnant cows are identified & scheduled back into the synchronization.

Conclusion
In the recent era, controlled breeding programs have allowed dairy producers to optimize service rate with little impact on conception and pregnancy losses in lactating dairy cows. In herds where estrus detection is high (>60%) implementation of TAI (Timed Artificial Insemination) protocols is expected to have little impact on reproductive efficiency, except during the first postpartum AI. Implementation of controlled breeding programs is expected to have the biggest impact during the first postpartum AI, when the entire herd is eligible to be pregnant. However, protocols that maximize returns to estrus and re-insemination of non-pregnant cows should optimize Pregnancy Rate and overall reproductive efficiency.

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