Four Systematic Breeding Programs with Timed Artificial Insemination for Lactating Dairy Cows: A Revisit

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Why Should We Consider Using Systematic Breeding Programs?

The failure to detect estrus in a timely and accurate manner is cited many times as the most common and costly failure of AI programs and perhaps the major limiting factor of reproductive performance on many dairy farms (1, 5). It is generally agreed that heat detection efficiency is less than 50% in most dairy herds. In fact according to DHIA records from DRPC in North Carolina the heat detection efficiency averages 43%. Low heat detection efficiency along with mean conception rate of 40% across the US dairy herds, increase the need for development of strategies to improve reproductive efficiency.

Systematic breeding programs provide an organized and efficient approach to administering artificial insemination and improving reproductive efficiency (2). Systemic breeding programs are used as reproductive management tools to control the timing of the estrus or ovulation by altering the length of the estrous cycle and/or manipulating the pattern of follicular growth. These systems facilitate the AI of more cows and increase the number of AI within given period and therefore, provide day-to-day convenience in managing the herd and the efficient use of labor for detection of estrus and AI (3). Nevertheless, any systematic breeding program must incorporate efficient and accurate detection of estrus (heat) and timely AI relative to the time of ovulation of the follicle in order to be successful and result in high pregnancy rates.

Targeted at breeding ™

Because prostaglandin F2α (PGF) was shown to be effective in regressing the corpus luteum (CL) and controlling the estrous cycle, it became a drug of choice for estrus synchronization in lactating dairy cows. The success of estrus induction with PGF, however, depends on the presence of a mature and functional CL (CL of day 6-17 of the estrous cycle) at the time of administration. Therefore, not all cows that received a single injection of PGF respond. Furthermore, depending upon the maturity of the dominant follicle at the time of PGF injection, cows may exhibit estrus from 2 to 7 days after injection. The use of PGF has benefits beyond the induction of estrus in individual cows. Programmed use of PGF can synchronize estrus, resulting in less time spent on heat detection and less veterinary visits for pregnancy examination (3). In order to create a tighter synchrony of estrus, an aggressive program has been developed which is known as **Targeted Breeding™**. This protocol involves series of injection of PGF 14 days apart (Figure 1). The first injection, usually called "the set up injection", is given at a random stage of the estrous cycle. No cows are inseminated after the first injection. The second injection, "the breeding injection", is administered 14 days later and cows are observed for heat and inseminated at estrus. The cows that are not observed in heat are given a third injection of PGF 14 days later. Once again cows are observed for heat and inseminated. Cows that are not observed standing in heat are timed inseminated at 80 hours after the third

injection. Results of conception and pregnancy rates using Targeted Breeding™ have varied over numerous studies, but they averaged >45% and ~ 40% for conception and pregnancy rate, respectively. Studies have shown that Targeted Breeding™ can decrease the number of days open by reducing days to first AI and offers an option of prolonging the voluntary waiting period (VWP) without extending calving intervals (6).

When Targeted Breeding™ program should be implimented Targeted breeding™ usually recommends that after VWP has been established for the herd, cows are listed according to their calving dates. Subsequently, the first PGF, "set up injection", should be administered about 2 weeks before the VWP ends. This way the "breeding injection" will be administered at the beginning or shortly after VWP starts.

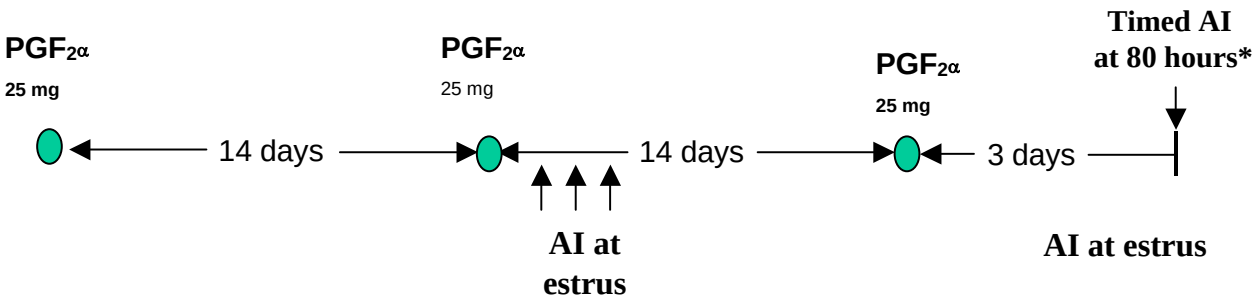

Figure 1. Targeted Breeding ™ Protocol (Pahrmecia-Upjohn, Kalamazoo). * In the absence of detected estrus, cows are inseminated at a fixed time after the third PGF injection

Modified Targeted Breeding Program

Several deviations from these standard protocols have been tested with varying degrees of success (example, Modified Targeted Breeding; Figure 1a). Pharmacia & Upjohn has developed this protocol as a core estrous synchronization program consisting of 3 injections of hormones followed by a period of observation for estrus with timed artificial insemintion at the

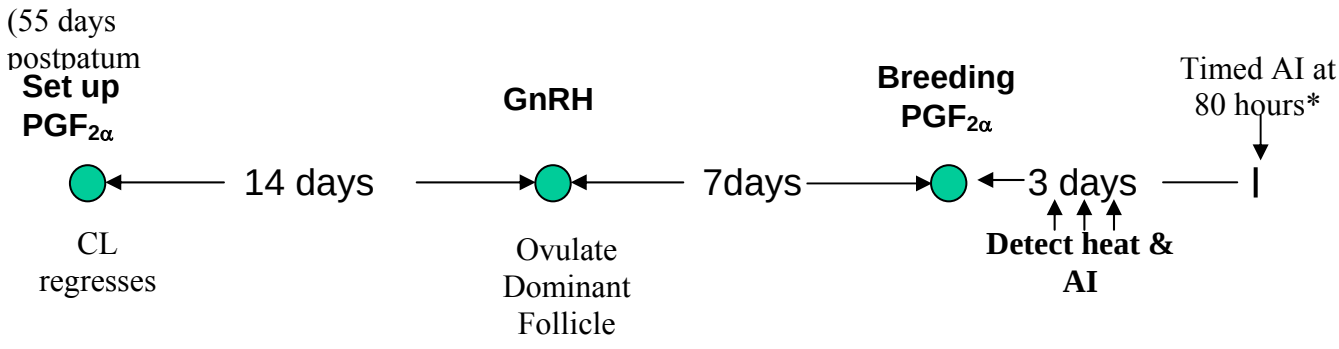

Figure 1a. Modified Targeted Breeding ™ Protocol (Pahrmecia-Upjohn, Kalamazoo). * In the absence of detected estrus, cows are inseminated at a fixed time after the second PGF injection

conclusion of the observation period. The program is initiated with a PGF injection followed in 14 days by an injection of GnRH. The initial PGF injection increased the proportion of cows that are between days 5 and 12 of the estrous cycle at the time of the GnRH injection.

Seven days after the GnRH injection, cows receive a second PGF injection. Cows are observed for estrus for 72-80 hr and bred on the basis of observed estrus. For the cows that have not been observed in estrus by 72 to 80 hr following the PGF injection, breeding is by TAI (Figure 7 and 8). The program has the flexibility to allow for a second injection of GnRH 48 hr after the second $PGF_{2\alpha}$ injection for the producer that prefers an exclusive TAI program.

It is important to choose a PG protocol that works best in the individual dairy herd situation. It must be easy to understand and implement, and yield consistent results. One should choose a simple yet effective protocol in consultation with the herd's veterinarian, and use it aggressively.

OvSynch®

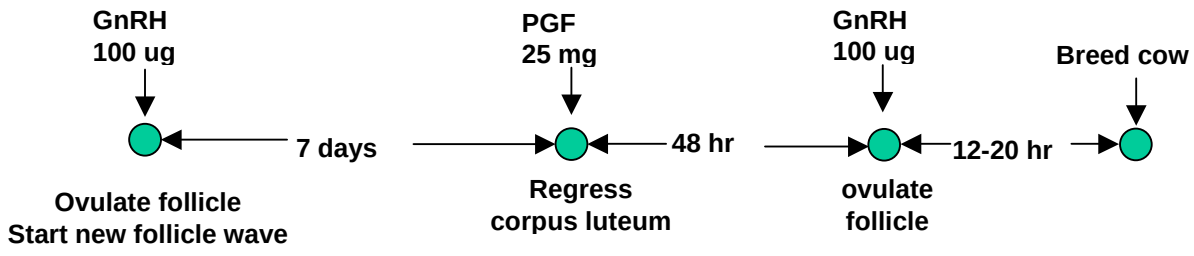

Figure 2. Description of OvSynch protocol and hypothetical mode of action.

Using GnRH (100 ug) and prostaglandin $F_{2\alpha}$ (PGF; 25 mg), Ovsynch protocol attempts to improve reproductive efficiency on the dairy farms by synchronizing ovulation rather than estrus and thus eliminating the need for estrus detection.

The first injection of GnRH (100 ug) is given at a random stage of the estrous cycle, causing either luteinization of ovulation of the largest follicle in approximately 85% of injected cows (Figure 2). Seven days later cows receive 25 mg of PGF. Administration of PGF regresses the CL or the luteinized follicle induced by the GnRH. Subsequently, a new dominant follicle merges, which is available for ovulation within 48 to 72 hours. Thirty-six to 48 hours after PGF, cows receive a second dose of GnRH (100 ug), which causes the ovulation of the ovulatory follicle. Cows are then inseminated at one fixed time between 8-20 hours (Figure 2).

Because of low frequency of estrus in high producing dairy cattle and inefficiency of methods used for estrus detection, the primary benefits of Ovsynch® is the elimination of need for heat detection. Further, since in this protocol all treated cow are submitted for AI, the pregnancy rate can increase. It should be noted that Pregnancy rate = AI submission X conception rate. There are some drawbacks associated with this protocol, including low conception rates, the costs of drugs and the increase in labor associated with animal handling. However, some researchers believe that reduced labor costs from less time spent on heat detection may offset the

cost of the drugs. Further, in order to reduce the cost of OvSynch®, researchers in University of Wisconsin suggested that GnRH dose can be reduced to half amount and still produce a same pregnancy rate. Although OvSynch® protocol has produced a comparable pregnancy rates but it has not improved the pregnancy rate to reach a desirable goal. . This in part could be attributable to a lower conception rate with timed AI when compared to other a systematic breeding protocols.

When OvSynch® program should be implemented Researchers in University of Wisconsin (4) have shown that OvSynch could produce a higher pregnancy rate when cows were treated after 75 days in milk. In that study OvSynch-treated cows greater than 76 days postpartum had 17% higher pregnancy rates than did cows that between 60 to 75 days postpartum. Not all cows conceive after the first OvSynch. Thus, if producers decide to not detect heat and use this protocol for the second time, they should realize that a second OvSynch® couldn't be utilized until pregnancy diagnosis is performed (30 to 35 days after AI) because in this protocol all eligible cows are inseminated in the first round.

CIDR and estrous synchronization

The FDA approval for use of the CIDR in lactating dairy cows is for synchronization of the returns to estrus. In this application, the CIDR is inserted on day 0 (random stage of the estrous cycle). The CIDR insert is removed seven days later (day 7; Figure 3) and a luteolytic dose of PGF administered. On days 7, 3 days after CIDR removal all cows receive GnRH (100 ug) and AI at the same. Some cows will have a synchronous return to estrus between day 8 and 10. If heat detection is efficient in the herd, one may choose to breed the cows that exhibit heat before day 10. Obviously, cows that receive AI upon heat detection and before day 10, are no longer subjected to the protocol and won't receive GnRH and(or) AI on day 10. One should realize that, there are some variations in the interval between CIDR removal and GnRH+AI (54 -784 hours). However, it appears that interval of greater than 60 hours might be a better choice.

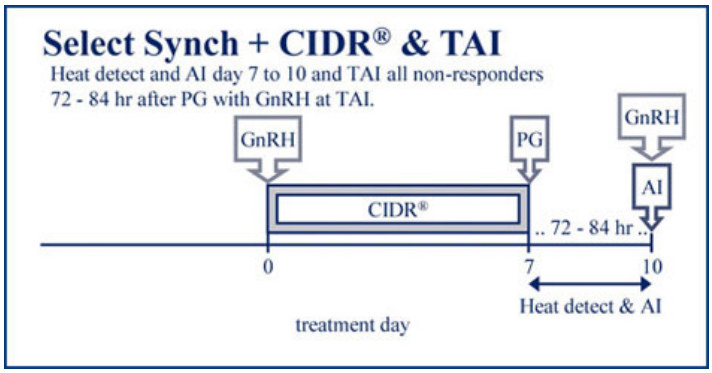

Figure 3. Adapted from Select Sires, Inc.

Summary

It is apparent that in all systematic breeding programs conception rate at first AI will not reach 100%. Therefore, cows will need to be inseminated a second or third time in order to become pregnant. Producers should make a decision about the follow up breeding program and decide whether they want to implement AI after detection of estrus or utilize a second OvSynch protocol.

If heat detection rate is low, but conception rate is high, producers should consider synchronization of ovulation (OvSynch) as it allows for cows to be inseminated without heat detection. One should understand the importance of each injection and realize that the sequential injection of GnRH, PGF, GnRH is critical and should not be modified. However, there is a general consensus among researchers that OvSynch is beneficial in herd situations where heat detection rate is poor. It may not be advantageous in herds where the heat detection rate exceeds 70%.

Dairy producers can benefit from estrous synchronization programs. Systematic breeding programs allow for efficient and convenient AI because they either make the occurrence of estrus more predictable or allow for appointment breeding without the need for estrus detection.

Selected References

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