

Industry Presentation
**Ten Lessons That We Have Learned about
Systematic Breeding Programs for Dairy Cattle**

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The Ovsynch program has been in existence for nearly ten years. During that span of time, numerous trials have been conducted that have identified various factors that affect the success of systematic breeding programs. To establish a benchmark for the success of the Ovsynch protocol, I summarized fifteen published papers and have shown results in Table 1. In

these trials, cows were bred either exclusively at a timed artificial insemination (TAI) or in combination with estrous detection and TAI. In a summary of these fifteen papers in the literature, the average pregnancy rate (PR) for 5671 cows was 33.2 %, with a range in PR from a low of 24.7 % to a high of 47 % (Table 1).

Table 1. Pregnancy rates to the Ovsynch protocol by trial.

Study	No. of Cows	Pregnancy Rate, %
Bartolome, 2000	209	31.5
Britt, 1998	98	47
Burke, 1996	171	29
Cartmill, 1999	188	31.3
Cartmill, 2001	207	33.3
Gümen, 2002	148	30.4
Jobst, 2000	209	30.1
Jordan, 2002	440	29.1
Kasimanikam, 2005	247	24.7
Momcilovic, 1998	118	33.0
Navanukraw, 2004	134	37.3
Pancarci, 2002	336	32.9
Pursley, 1998	732	29.0
Stevenson, 1999	115	35.6
Stevenson, 2005	314	27.7
Tenhagen, 2004	1584	33.9
Total	5671	33.2

The basic Ovsynch program has been the administration of either GnRH or a GnRH analog followed 7 d later by a luteolytic prostaglandin (**PGF_{2α}**). A second GnRH is given 48 h after the PGF_{2α}. The procedure between the second GnRH and TAI has varied from a combination estrous detection with the administration of a TAI to any cows that were not serviced to just a TAI without any estrous detection after the second GnRH from 0 to 24 h after the GnRH. Some trials have included estrous detection as a basis for breeding some of the cows showing signs of estrus and others have not.

After ten years of experience with Ovsynch, I believe there are at least ten factors that can affect the success of the Ovsynch protocol and herd PR.

1. Voluntary wait period or days-in-milk (**DIM**) at first service
2. Parity (first lactation cows vs. older cows)
3. Cycling vs. non-cycling cows
4. Effect of body condition score
5. Heat stress
6. Effect of periparturient diseases
7. Variations on the Ovsynch program
8. Timing of initiation of BST
9. Program compliance
10. Resynchronization of open cows

Days-in-Milk at First Service

The dairy industry has seen a decline in fertility of dairy cows over the past twenty years and an increase in the average number of days open. In response to the increase in average days open, many dairy producers have decreased the voluntary wait period (**VWP**) in an effort to reduce the average days open. A 40 to 45 day VWP is commonly used in the dairy industry. In spite of the adaptation of early VWPs, the

average DIM at first service has been trending upward. However, many producers would concede that a 10 ½ month calving interval, the result of conception at 40 DIM, is too short of a calving interval.

The use of systematic breeding programs like Ovsynch has allowed producers to actually increase the VWP, and at the same time, decrease the average DIM at first service; while concurrently increasing the number of pregnancies to first service. Pursley et al. (1997) were the first to report an improvement in conception rates from 26 to 43.4 % when the DIM at first service was increased from the interval of 60 to 75 DIM to the interval of greater than 75 DIM, respectively. In a subsequent trial, Pursley et al. (1998) reported an improvement in conception rates from 36 to 47 % when the DIM at service was increased from the interval of 50 to 75 DIM to the interval of 75 to 100 DIM, respectively.

The largest and most detailed study, to date, evaluating the effect of DIM at first service on conception rates and cumulative pregnancies was conducted by Tenhagen et al. (2003). A total of 1288 cows were assigned to one of two trials and classified into three categories of low, average, or high production. In trial 1, all cows were synchronized to have TAI between 73 and 81 DIM. The PR to the low, average, and high producing cows was 34.5, 34.0, and 28.2 %, respectively. In trial 2, the DIM for TAI for the low producing cows was 53-59 days, for average producing cows 73-81 DIM, and for high producing cows 94-102 days. The PR in the low producing cows bred early at 53-59 DIM, the average producing cows bred at 73-81 DIM, and high producing cows bred at 94-102 DIM was 14.4, 28.7 and 41.4 %, respectively. The percent of cows in each group pregnant at

200 DIM was 78.4, 80.4, and 71.9 %, respectively. The study clearly demonstrated that improved conception rates seen with delaying TAI to Ovsynch protocol could still result in similar proportions of cows pregnant at 200 DIM. The result of delaying TAI was improved reproductive efficiency with more pregnancies from fewer services and a tighter, more uniform distribution of pregnancies resulting from the Ovsynch TAI breedings.

The bottom line is that the tools are now available to be able to improve the reproductive performance of the herd and have more desirable calving intervals through the use of systematic breeding programs like the Ovsynch protocol.

Take home messages:

- Ovsynch programs have achieved higher PR when a VWP of 70 DIM or greater was used.
- A higher VWP for cows on Ovsynch programs has reduced costs per pregnancy by improving reproductive efficiency as a result of more pregnancies for set-up shots and semen costs.

The Effect of Parity on Pregnancy Rate

Records from the DHI processing center in Provo, UT show that first lactation cows have higher conception rates than second lactation cows by two percentage points and second lactation cows have higher conception rates by two percentage points more than second plus lactation cows. The PR following Ovsynch have been higher for first lactation cows compared to older cows in most trials where differences between PR of first lactation and older cows were reported. Pancarci et al. (2002)

observed a 43.5 % PR for 201 first lactation cows and a 30.6 % PR for 170 multiparous cows, a 13 percentage point advantage for the first lactation cows. Tenhagen et al. (2004) reported a 37.9 % PR for 583 first lactation cows compared to 31.6 % for 1001 second and later lactation cows, a 6.3 percentage point advantage for first lactation cows.

If PR for first cycle and subsequent cycles are lower for first lactation than second and later lactation cows, a problem exists. The list of problems which can reduce the fertility of first lactation cows includes: the presence of *Leptospira borgpetersonia* serovar *hardjo-bovis* infection in the herd, heifers that are over-conditioned at time of calving resulting in dystocia and vaginal trauma, excessive loss of body condition post-calving, a high incidence of calving difficulties, a high incidence of post-calving health problems including metritis, and too early a VWP for first lactation cows.

Take home message:

- First lactation cows should have higher PR than multiparous cows.
- If the first lactation cows have lower PR than multiparous cows, the underlying problem needs to be identified and corrected.

The Prevalence of Acyclicity or Anovular Anestrus

A summary of seven reports from the literature found the average prevalence of anovular anestrus was 22.7 % for 8660 cows (Table 2). In a single trial within that summary, Thatcher reported a prevalence of anovular anestrus in 500 cows of 23.5 %. The PR following an Ovsynch program for anovular cows was 22.4 % compared to 41.7 % for cycling cows, almost half the rate

Table 2. Summary of studies reporting cycling status of cows.

Study	No. of cows	Percent Acyclic
Pursley, 2001	634	28.7
Thatcher, 2001	500	23.5
Gümen, 2002	316	20.2
Lopez, 2003	267	28.4
Santos, 2004	840	18.5
Rutigliano, 2005	5820	22.6
Walsh, 2005	550	24.4
Total	8660	22.7

for acyclic cows. Although the PR for acyclic cows is about half the rate of cycling cows following an Ovsynch program, the PR for the acyclic cows without Ovsynch would have been near null. Rutigliano and Santos (2005) summarized nine studies and reported that the rate of acyclicity was 30.6 % for 2059 first lactation cows and 18.2 % for 3761 multiparous cows.

In spite of nearly twice the rate of acyclicity in first lactation cows, first lactation cows have higher PR than multiparous cows. It becomes apparent that if the average prevalence of cows with anovular anestrus is about 25 % and the PR of these cows following an Ovsynch program is about half of cycling cows, the overall results of an Ovsynch program on a herd basis could be improved if either the prevalence of anovular anestrus could be reduced or the fertility of these cows could be improved in response to the Ovsynch program.

Short-term exposure of cows to progesterone has been shown to improve the fertility of acyclic cows when incorporated into an Ovsynch program. One means of supplementing progesterone on a short-term basis is through the use of a Controlled Internal Drug Release (**CIDR**) intravaginal

insert containing progesterone. El-Zarkouny et al. (2004) compared PR of cows synchronized with either the Ovsynch or Ovsynch + CIDR protocol. PR were 59.3 vs. 36.3 % at 29 d and 45.1 vs. 19.8 % at 57 d after TAI for the Ovsynch + CIDR vs. Ovsynch, respectively. Embryo survival (75.9 vs. 54.5 %) from 29 to 57 d was greater for Ovsynch + CIDR than for Ovsynch alone, respectively. CIDRs have been incorporated into both Ovsynch and Presynch/Ovsynch programs. PR have been improved in some studies. It seems logical that CIDRs would have the greatest benefit in anovular cows.

Take home messages:

- The prevalence of anovular or acyclic cows at 60 to 75 DIM ranges from a low of 10 % to in excess of 30 % in some dairy herds. The average rate is about 22.5 %.
- Anovular cows have about half the PR to the Ovsynch protocol of cycling cows.
- Although anovular cows have lower PR than cycling cows following the Ovsynch protocol, the PR would have been considerably less without the Ovsynch protocol.

- First lactation cows have approximately twice the prevalence of acyclicity as multiparous cows.

Effect of Body Condition Score on Pregnancy Rate

Several studies have looked at the relationship between body condition score (BCS) and reproductive performance of cows on an Ovsynch program. These studies have reported lower PR to TAI for cows with BCS of less than 2.5 at time of service. Moreira et al. (2000a) reported that the PR at 45 days following TAI was 11.1 % for cows with BCS of less than 2.5, while the PR for cows with BCS of equal to or greater than 2.5 was 25.6 %. Part of the explanation for low PR of cows with low BCS is that a high proportion of these cows are anovular. Wiltbank et al. (2005) showed that as BCS declined, the proportion of cows that were anovular increased; and, for cows with BCS of 2.5 or less, the percentage of cows that were anovular was 80 % (Figure 1).

Take home message:

- A high proportion of cows with BCS of less than 2.5 are acyclic at 60 to 75 DIM.
- Acyclic cows have about half the PR of cycling cows with the Ovsynch protocol.

Heat Stress

Heat stress adversely affects various aspects of the reproductive physiology of the cow. Heat stress has a direct and adverse affect on the developing egg before ovulation, the fertilized egg following ovulation, and embryo survival if fertilization occurs.

Heat stress adversely affects the developing follicle, which results in a

smaller corpus luteum that produces less progesterone. Lower levels of serum progesterone post-ovulation are associated with low rates of embryo survival and PR.

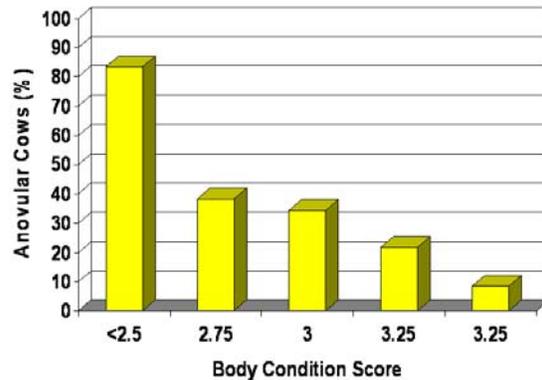


Figure 1. Relationship between BCS and percentage cows found anovular at 70 DIM (n=267; Wiltbank et al., 2005).

Heat stress also decreases the duration and intensity of estrous behavior. It should also be appreciated that heat stress is not an *all or none* affect, but is on a continuum scale from mild to severe. Systematic breeding programs with TAI are an effective counter to depressed heat detection rates associated with heat stress, since 100 % service rates can be attained with TAI following Ovsynch programs. Conception rates and embryo survival rates decline as the degree of heat stress increases. The advantage of higher service rates for cows on an Ovsynch program over heat detection in heat stressed cows is reduced with more severe heat stress because of a reduction in conception rates and embryo survival.

Take home messages:

- Ovsynch programs with TAI can improve PR for heat-stressed cows over cows on heat detection programs by increasing service rate.
- The advantage of Ovsynch programs over heat detection programs declines as the severity of heat stress increases due to declining conception

rates and lower embryo survival rates.

implemented when the incidence of these diseases increase.

Effect of Periparturient Disease

Cows that have had post-calving health problems have lower PR than cows which remain healthy following calving. Jordan et al. (2002) reported that the PR for healthy cows to an Ovsynch program was 34.3 %, but declined to 10.5 % for cows that had retained fetal membranes (RFM), 9.8 % for those that had twins, and 23.1 % for cows that had a case of clinical mastitis at less than 70 DIM. This PR occurred in spite of the fact that cows were on a sound fresh cow program.

Recent studies have demonstrated that cows that have RFM and metritis are at greater risk of having subclinical endometritis at 50 DIM and cows with subclinical endometritis have lower PR. Clinical and subclinical mastitis has also been shown to reduce pregnancies, whether it occurs before or after a service.

Take home messages:

- Post-calving diseases will result in lower PR of cows following Ovsynch programs.
- The incidence of post-calving diseases should be monitored and compared to benchmark goals. Corrective measures should be

Variations on the Ovsynch Program

Vasconcelos et al. (1999) demonstrated that the stage of the estrous cycle that cows were at when they receive the first GnRH injection in the Ovsynch protocol affected the subsequent conception rate. Cows that were started on the Ovsynch protocol between days 5 and 12 of the estrous cycle tended to have greater conception rates than cows started at other stages of the estrous cycle. Cows can be pre-synchronized with two injections of PGF_{2α} given 14 days apart with the second PGF_{2α} given 12 to 14 days before the first GnRH in the Ovsynch protocol. Several trials have demonstrated a 9 to 17 percentage point advantage in PR of cows pre-synchronized before Ovsynch compared to cows on a non pre-synchronized Ovsynch protocol.

Some dairies have chosen to breed cows on the basis of estrous detection following the second PGF_{2α} in a Presynch program. This practice is frequently referred to as *cherry-picking* heats. It should be appreciated that *cherry-picking* heats will impact the success of the Ovsynch protocol. By *cherry-picking* heats following the second PGF_{2α} in the Presynch protocol, the program will concentrate anovular cows into the Ovsynch protocol and reduce the PR to the Ovsynch part of the program.

Table 3. Summary of research trials evaluating Ovsynch with or without Presynch.

	Ovsynch % (n)	Presynch % (n)	Difference %
El-Zarkouny et al., 2004	37.5 (304)	46.8 (310)	9.3
Moreira et al., 2000b	29.2 (272)	46.5 (264)	17.3
Navanukraw et al., 2004	37.3 (134)	49.6 (135)	12.3

Various intervals have been recommended for the intervals between the last PGF_{2α} in the Ovsynch protocol, GnRH, and TAI. Pursley et al. (1998) administered GnRH 48 h after the last PGF_{2α} to cows in the Ovsynch protocol and varied the interval between GnRH and TAI breeding from 0 to 32 h at 8 h increments. The highest PR were observed in cows bred 16 h after the GnRH and pregnancies were detected with ultrasonography at 33 days post-breeding. The PR improved from 37 % for TAI at 0 h to 45 % for TAI at 16 h, an eight percentage point advantage.

Portaluppi and Stevenson (2005) subsequently compared three variations in intervals between the last PGF_{2α} in a Presynch/Ovsynch protocol and GnRH and TAI. The three treatment groups were GnRH and TAI 48 h post PGF_{2α}, GnRH at 48 h post PGF_{2α} and TAI 72 h, and GnRH and TAI 72 h post PGF_{2α}. The PR for the three treatment groups were 22.8, 23.5, and 31.4 %; respectively. Based on the current research, the highest PR were attained when GnRH and TAI occurred 72 h after the second PGF_{2α} in the Presynch/Ovsynch protocol.

Take home messages :

- Presynchronization has improved the PR of cows bred following the Ovsynch protocol by 3 to 14 percentage points.
- *Cherry-picking* heats following the second PGF_{2α} can reduce pregnancies to the Ovsynch protocol by increasing anovular cows in this group.
- The highest PR following a Presynch/Ovsynch program were obtained when GnRH and TAI were done 72 h after the last PGF_{2α}.

Timing of Initiation of BST Treatment

Coordination of the rBST treatment with breedings may improve conception and/or PR. Morales-Roura et al. (2001) initiated administration of rBST at the time of service and repeated the rBST ten days later to healthy cows that previously had three or more unsuccessful services. The conception rate for 201 cows in the rBST treatment group was 29.3 % and 16.9 % for 309 control cows. Moreira et al. (2001) reported on concurrently administered rBST in either Ovsynch or Presynch protocols at either the time of the first GnRH at 63 +/- 3 DIM or at TAI at 73 +/- 3 DIM. There was no difference in PR at 74 day post-breeding for Ovsynch + rBST cows vs. Ovsynch cows without rBST (29.1 vs. 30.1 %, respectively). However, there was a significantly higher PR at 74 days post-breeding for Presynch + rBST cows vs. Presynch cows without rBST (46.5 vs. 33.6 %, respectively). However, when only cycling cows were evaluated, there was an advantage to rBST over control Ovsynch or control Presynch cows.

Santos et al. (2004) reported the conception rate on d 45 after AI was numerically higher for rBST-treated cows, but not statistically different (40.8 vs. 36.3 %; $P = 0.13$). In addition, these researchers observed that losses of pregnancy between 31 and 45 d after AI were not affected by AI protocol, but rBST treatment tended to reduce embryonic mortality (8.4 vs. 14.1 %; $P = 0.06$).

Take home messages:

- Administration of first rBST at the time of service in cows in repeat service cows, either at the time of GnRH administration or service in Ovsynch or Presynch/Ovsynch

protocols, has demonstrated an advantage.

- The synergistic relationship between rBST and Ovsynch or Presynch only occurs in cycling cows.

Program Compliance

There are two aspects of program compliance. The first aspect of compliance is making sure the right cow gets the right injection at the right time. The Presynch program requires five injections of hormones that need to be administered at designated times to set-up the cow for a breeding. If the compliance for each injection in the Presynch series is 95 %, only 77 % of the cows would have completed the entire series of injections.

For the Presynch protocol to be successful, it is extremely important that the correct treatment is given to the right cows at the appropriate time. Anything less will reduce the success of the program. However, measuring compliance of injections is difficult. Entering IDs of cows that have been treated into a computer programs is time consuming and not likely to be accurate.

The second aspect of compliance is the breeding resulting from the Ovsynch or Presynch/Ovsynch protocol. If cows are enrolled in a systematic breeding program on a weekly basis, breeding should occur within a one week window of time. The *Hundred-Day Contract* software defines breeding compliance as the percentage of cows that are bred in the first ten days after the VWP of all the cows bred after the VWP. From Pfizer's Hundred-Day Contract web site and based on over 5000 uploads to the web site, we have found that for every ten percentage point increase in breeding

compliance, there is a corresponding two percentage point increase in first cycle PR.

Take home messages:

- Injection compliance is an extremely important determinant of the success of Ovsynch and Presynch/Ovsynch protocols.
- For every ten percentage point increase in breeding compliance, there is a two percentage point increase in first cycle PR.

Resynchronization of Cows Diagnosed Open following a Breeding

The goal of any method of pregnancy diagnosis is to identify the cows that have failed to conceive to a prior breeding and are open so they can be re-inseminated. We would like the diagnosis of the open state for a cow to occur as early as possible; we want a program that assures that 100 % of the open cows are re-inseminated as soon as possible; and we want the conception rate for this breeding to be as high as possible.

A disadvantage of early pregnancy diagnosis is that early pregnancies are associated with high rates of fetal attrition. Vasconcelos et al. (1997) reported that 11 % of the cows that were diagnosed pregnant between 28 and 42 days were subsequently diagnosed open. The pregnancy status of cows can be accurately determined with ultrasonography (US) at 28 days post-breeding. If cows were given GnRH seven days ahead of pregnancy diagnosis by US at 28 days post-breeding, open cows could be given PGF_{2α} and breedings would occur in two to three days. However, PR have been found to be lower than expected to this program, probably because the GnRH is being administered around day 0 of the estrous cycle for open cows.

Sterry et al. (2005) reported on a trial in which cows were divided into two groups relative to timing of GnRH, but all were examined with US for pregnancy status at 33 days post-breeding. All cows in the group were treated with GnRH seven days prior to pregnancy diagnosis and if open at pregnancy diagnosis, were given PGF_{2α} followed by GnRH and TAI. Cows in the second group were examined for pregnancy with US at day 33 post-breeding and if diagnosed open, were given GnRH, 7 d later PGF_{2α}, followed by GnRH and TAI. The PR tended to be higher for the cows given GnRH at day 33 vs. cows given GnRH at day 26 (38 vs. 29 %, respectively).

Take home messages:

- Every dairy needs a plan to assure 100 % of cows diagnosed open get re-inseminated following a diagnosis open.
- The timing of pregnancy diagnosis and initiation of resynchronization protocols need to be coordinated to obtain the best results.

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