Institution of Presynch Protocol

A Senior Project

Presented to

The Faculty of the Dairy Science Department

California Polytechnic University, San Luis Obispo

In Partial Fulfillment

Of the Requirements for the Degree

Bachelor of Science

By

Justin Breedyk

December, 2010

Table of Contents

List of Tables

List of Figures

Abstract

The objective of this study was to compare factors of reproductive efficiency between two separate ovulation synchronization programs, with one that includes presynchronization of all fresh cows and one that does not ovsynch cows until they have been found open after initial insemination. In recent years, reproductive efficiency has declined as other areas of the dairy business have continued to excel. The investigation was performed on two dairies in Hart, Texas, White River Ranch and VB Dairy. The dairies include herds of 5,000 and 3,000 milking cows, respectively. Data was retrieved using Dairy Comp 305 and covered a two month period of each program, on each dairy. Data compared included Days to First Breeding, Conception Rate, and Pregnancy Rate per AI. Results found that the presynch program was successful in all areas measured. The presynch program helped to lower days to first breeding, and raised conception rate as well as Pregnancy Rate per AI. An ovsynch program preceded with the presynch protocol, can increase reproductive performance on a dairy.

Introduction

As the dairy industry has advanced greatly in the past century from small, family businesses to massive production companies, we have become more and more efficient in almost every aspect of the business except one-reproduction. We have been able to multiply the amount of milk produced in a cow's life but have become less efficient in the reproductive category. The main cause of this loss in efficiency points is miss heats. Inaccurate heate detection means cows don't get pregnant in a timely fashion. As dairies grew larger, heat detection problems also increased, and the answer to the problem has been actively pursued.

Throughout the years, different ovulation synchronization programs have been utilized to try to combat the problem of missed heats. On White River Ranch dairy and VB Dairy, located in Hart, Texas, a Prostaglandin based program had been used in the past to help address the problem, but in recent times, was found to be ineffective on the dairy. The Prostaglandin program was replaced by a program that includes presynchronization of the cows prior to the initiation of an ovulation synchronization program. A comparison will be made between the previous program and the new program to help determine reproductive efficiency of each program. The outcome of results found will help to determine the most efficient program for these dairies.

Literature Review

History of Artificial Insemination

Artificial insemination (AI) in the U.S. dairy industry really began in 1938 when the first AI association was established in New Jersey. Since then, A.I. usage has become commonplace on dairies across the world. One big factor that helped to enhance use of A.I. was the creation of the DHI (Dairy Herd Improvement) Program in 1905. Records collected by this program allowed dairy producers to observe years of records and sire identification. With the use of these records, dairy producers could directly see what sires had produced the daughters with the highest milk production. At the same time semen marketing groups began to regularly evaluate sperm motility and concentration. These assessments resulted in a more consistent, high quality semen product and probably increased the number of cows becoming pregnant. (Moore, 2006)

Another breakthrough in A.I. occurred in the 1950's when a medium was created that could protect semen through the freezing process. (Moore, 2006) This development made it easier to ship semen throughout the country and the entire world. With semen readily available, dairy producers continued to breed their cows to produce more milk and to reproduce more efficiently. By the 1970's, semen companies had grown into large organizations and high quality semen was available to all dairy producers. Around the country, people were getting higher producing cows, and reproducing them at a faster rate. Dairies began to develop at this point from small, family operated dairies into the larger dairies seen in many places today that can milk thousands of cows two or sometimes even three times daily. Eventually, dairies moved to even controlling a cow's estrus cycle using ovulation synchronization (ovsynch)

programs. Once it was realized that heat detection was a problem on many dairies, scientists found a process by which they could control a cows estrous cycle by using hormones to regulate her heats. Many different ovsynch programs have been developed, and are still being developed today in order to raise reproductive efficiency, with the ultimate goal of lowering costs and raising milk production.

With all this new technology at hand, reproductive efficiency in cattle was now easier for dairy producers to monitor and control, and became an important benchmark of dairy management. "The frequency of calving determines to a great extent the amount of milk a dairy cow produces in her lifetime." (Spielman, 2000) With calving frequency determining a cow's productive life, it was realized that, to be most profitable, the most advantageous time for heifers to conceive for the first time is at or before fifteen months. (Matsoukas, 1974) The result of this timeline yields heifers calving at two years of age. After the first calf, the ideal interval between the first and second calf is about twelve months. This twelve month calving interval gives dairy cattle 90 d from when they come fresh to when they should become pregnant. Dairy cattle are usually given about 45 d after freshening before being bred on first visible estrus. This schedule usually allows for around three inseminations for conception and attainment of the desired calving interval of twelve months. (Matsoukas, 1974)

Reproductive efficiency can be measured by looking at services per conception, annual pregnancy rates, average days open or days from first service to conception. These measurements can be very useful to dairy producers in allowing them to determine problem cows in the herd as well as setting benchmarks for the herd averages. Evaluating a dairy's

progress in each of these areas helps dairy producers to determine where reproduction problems occur on their dairy, and where improvements can be made.

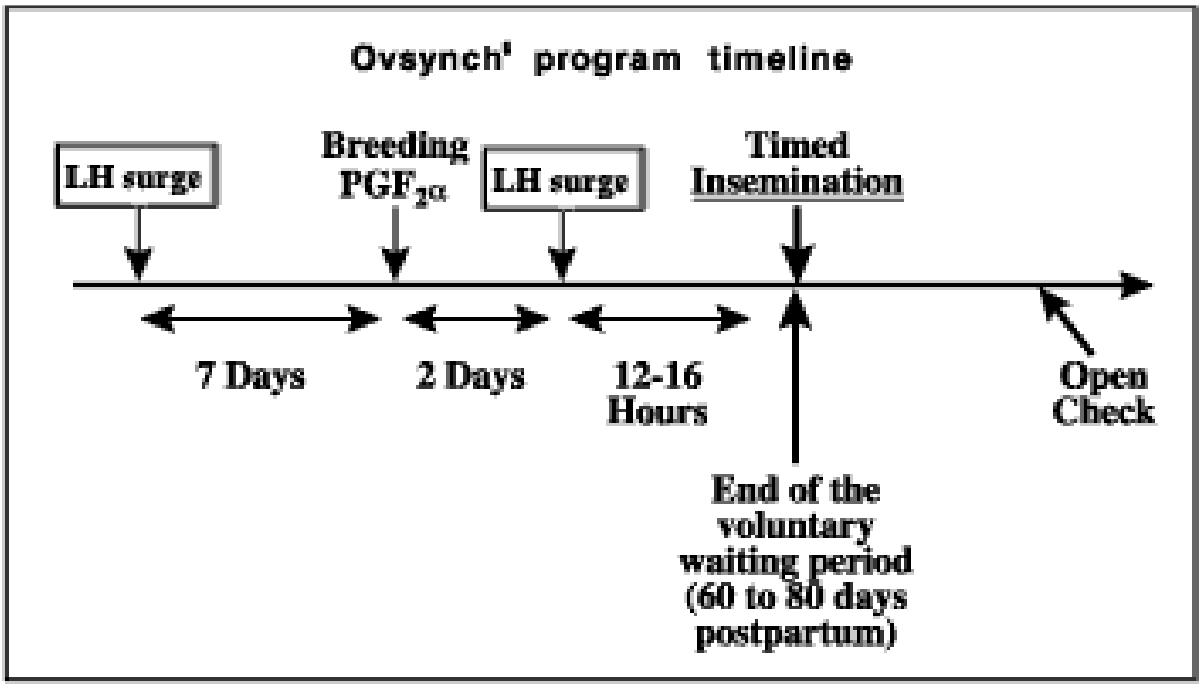
Need for Ovulation Synchronization

High levels of milk production, along with increased dry matter intake and metabolism of the lactating dairy cow have decreased efficiency of estrus detection and reduced pregnancy rates for inseminations at detected heat. (Moore) Often reproductive efficiency numbers can be depressed because heats are being missed that could have led to conception. As dairies grew larger, so did the problem of missed heats. One way to combat this problem was discovered in the 1970's. At this time, methods were discovered that could control the estrous cycle through use of hormones. Today, hormones most often used are Gonadotropin-Releasing Hormone (GnRH) and Prostaglandin F2α (PGF2α). Follicular synchronization could be utilized by using GnRH, and PGF2α could be used to cause the corpus luteum to regress. Using a combination of these two hormones produced the first timed insemination.

First, a shot of GnRH is given to the cow which releases a new follicular wave. Seven d later, a shot of PGF2α was given, followed by another shot of GnRH 48 hours later, and insemination 12 to 16 h after the GnRH injection regardless of whether or not estrus is shown. (Rabiee, 2005) A timeline for this program can be seen in Figure 1. This idea of Timed Artificial Insemination (TAI) can reduce the need for estrus detection. Estrus detection is often an area where loss occurs on dairies, since it can be difficult to determine, especially in high producing dairy cows that may not show strong heats due to reduced hormonal activity. The TAI procedure can also lead to cows being inseminated at a more exact time in the estrus,

allowing for the animal to be bred when she is most fertile. Synchronization programs allow large operations that may not be able to focus on individual heats and to be able to better control their herd's reproductive performance. (Portluppi, 2005)

Figure 1. Ovsynch Program Timeline

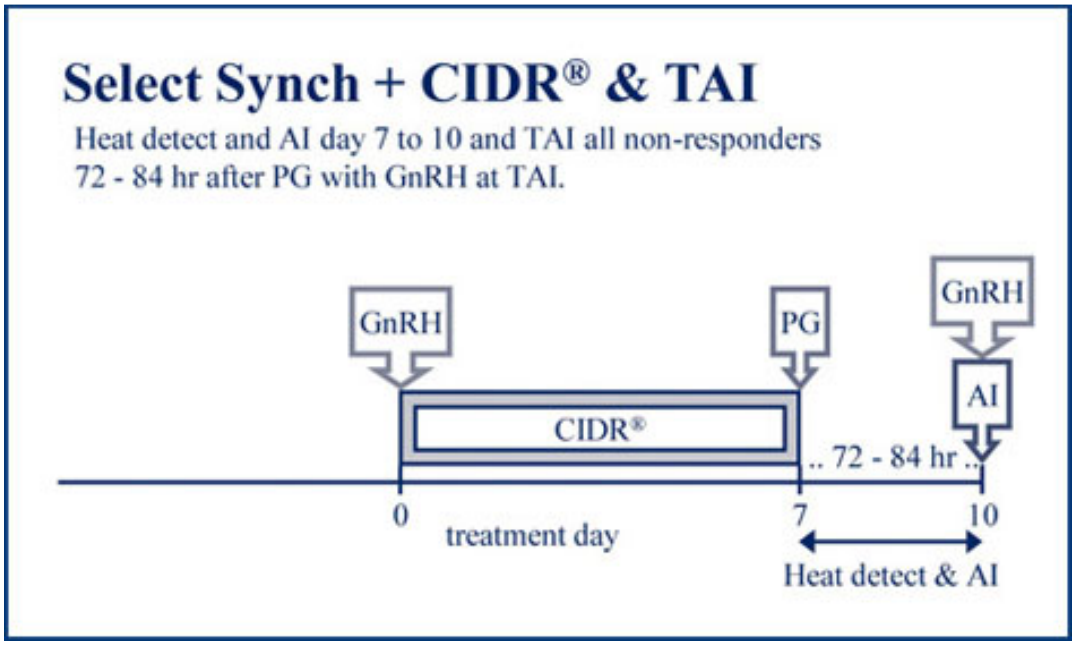


Systems of Timed Artificial Insemination (TAI)

Since the introduction of TAI, many different types of synchronization programs have been utilized. Synchronization programs include the aforementioned ovsynch, as well as Select Synch, Heat Synch, PGF2α, and modified ovsynch. Select Synch is a program that begins with a shot of GnRH, followed seven d later with an injection of PGF2α. After the injection of PGF2α, heats are detected by the breeder, and the cow is bred at either 48 or 72 h after the injection, whenever heat is shown. If no heat is shown, cows are bred at 72 h regardless. The Heat Synch program is similar to the select synch program with an added shot of estradiol

cypionate (ECP) 24 h after the injection of PGF2α. The ECP is a type of estrogen hormone that, in this case, causes for increased fertility. Some dairy producers also include the use of a CIDR (Controlled Internal Releasing Device) when using Select Synch as seen in the figure below. These devices can be inserted into a cow and further control hormonal release.

Figure 2. Select Synch Program Timeline



A PGF2α program can vary, but the basis is a series of PGF2α injections 11 to 14 days apart, followed by insemination at detected estrus following one of the injections. Modified ovsynch includes a presynch prior to the ovsynch program of one or two injections of PGF2α, 14 days apart prior to the beginning of ovsynch. Modified ovsynch or Presynch is the most controlling of the programs, beginning at as early as 22 d fresh. It is also the longest program, lasting over 30 d from first shot to insemination.

Comparison of Breeding Programs

Each of these programs has shown effectiveness in the past when compared to a natural breeding program in which cows are only inseminated when heats are found. In a study done in New Zealand, a group of researchers led by A. R. Rabiee reported in a meta-analysis how each of these programs compared to an ovsynch program, as well as comparing natural breeding to the ovsynch program. (Rabiee, 2005) This review examined 71 treatment and control comparisons from 53 research papers. When comparing ovsynch to natural breeding, it was found that pregnancy rates were higher ($p=<.0003$) on dairies using the ovsynch program. Ovsynch had a higher pregnancy rate ($p=<.0001$) than select synch as well as PGf2α ($p=<.0001$). Results for comparison of heat synch and ovsynch were not statistically significant due to lack of information. In the studies reviewed on modified ovsynch compared to ovsynch, some studies reported a higher conception rate was found for modified ovsynch, but there was not enough studies done to create statistical significance. Rabiee concluded that "Progress toward improving reproductive efficiency in lactating dairy cows may be achieved by combining timed artificial insemination with a protocol for synchronization of ovulation that can be initiated at any stage of the estrous cycle." (Rabiee) Other studies have also reported the effectiveness of programs that include Timed Artificial Insemination, such as the study done at Texas A&M University that compared a timed program to a program that depended on estrus detection. (Jordan, 2002)

Tenhagen and coworkers at the University of Berlin compared natural breeding to ovsynch. "The objective of this study was to compare the reproductive efficiency and economic benefit of OvSynch protocols with conventional reproductive management in a field

trial in two large dairy herds in Germany." (Tenhagen) This paper made the argument that if ovsynch is used with no estrus detection, time is lost between inseminations. When using an ovsynch program, heats can go undetected and cows are left open for an average of approximately 40 d before they are resynched and the process begins over again. Heat detection between ovsynch procedures can shorten this process, because it will catch the next heat, 18 and 24 d later that the cow experiences if she does not conceive on initial insemination.

In the same study, the economic processes that were considered included the cost of drugs and treatments necessary as well as the benefits from ovsynch. Economic analysis was drawn from total costs per pregnancy. The benefits of ovsynch include reduction of days open and the numbers of cows that are culled for infertility as well as the benefit of the elimination of estrus detection. Both natural breeding and ovsynch were used on both dairies, with the cows being separated into groups based on tag number. The dairies included 398 in herd 1 and 650 cows in herd 2, and differed in reproductive management before the study was conducted. The second herd offered "lower AI submission rates, long days open and a high proportion of cows culled for poor reproductive performance." (Tenhagen) In the first herd, cows on the ovsynch program were inseminated on average 16 days earlier. In the second herd, days to first service averaged 23 days lower than natural breeding, and at the end of the observation period significantly more cows were pregnant due to ovsynch as seen in the table below. Economically, herd 1 total costs per pregnancy varied only slightly between treatments, and natural breeding was found to be more economically superior. In herd 2, natural breeding costs per pregnancy were higher than costs per pregnancy for ovsynch, due to more open days and

more cows culled due to reproductive inefficiency. The authors of this report concluded that ovsynch was more reproductively efficient in both herds, but only more superior economically in herds that lack adequate reproductive management.

Table 1. Results of Tenhagen Study

Variable measuered	Ovsynch 1	Heat detected 1	Ovsynch 2	Heat Detected 2
Cows in protocol	200	198	289	361
Cows inseminated by 200 DIM	197	184	289	313
Days to 1st service	81.2	97	62.7	106.7
1st service conception rate (%)	34.5	45.1	35.6	49.8
Conception rate (%)	41.7	45.4	39	49.7
Cows pregnant at 200 DIM (%)	80.1	79.8	78.9	61.8
Days open in pregnant cows	111.5	121.3	94.4	117

Presynch Program Comparisons

The newest in all programs to be introduced into the synchronization of dairy cattle is the use of PGF2α for presynchronization (Presynch). Presynch includes 2 injections of PGF2α prior to the induction of ovsynch. Studies have shown that presynch can lead to higher levels of Progesterone at ovulation. Progesterone is very important to the pregnancy of a cow. It is the hormone responsible for preparing the uterus for pregnancy, and maintaining pregnancy if fertilization does occur. Another rationale for use of presynch is the idea that the earliest shots of progesterone will increase the likelihood of inseminating a cow at the most fertile time. The presynch causes initiation of ovsynch on a more specific stage of the cycle which can cause an increase in Pregnancy Rate per Artificial Insemination (PR/AI). This is due to the increased probability of "ovulating the dominant follicle of the first follicular wave of

the estrous cycle, thereby improving synchrony of emergence of a new wave and synchronized ovulation rate to the second GnRH injection of Ovsynch." (Navanukraw) Due to the potential of the presynch procedure, new studies have been conducted to determine the validity of a presynch program compared to an ovsynch program by itself.

One such study compared ovsynch to presynch at the University of Wisconsin. The North Dakota State University Research Unit in Fargo, North Dakota was the site used to perform their experiment, and PR/AI was selected as the reproductive performance benchmark on which to assess the experiment. Both programs were compared simultaneously during two data periods. Cows for each program were divided randomly on the dairy. The first period from which they used data was from August 1999 to August 2000, and the second period was from September 2000 through April 2002. The result of their study was finding that cows under the presynch program gained a 12% unit increase above those on the ovsynch program only. Other programs have since tried to modify the program even beyond adding a presynch, but results have been inconclusive thus far.

Materials and Methods

Herd Management

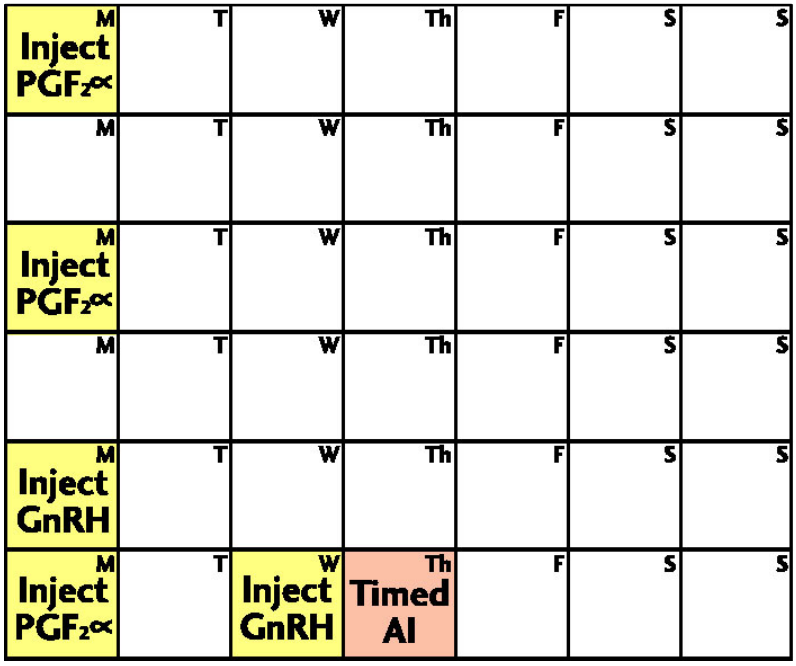
In this study, a new breeding program including presynch was initiated on two dairies, White River Ranch and VB Dairy. These dairies milk 5,000 and 3,000 cows, respectively. The new breeding program was compared to the previous breeding program used on these dairies. The new breeding program included a presynch program that was applied to open fresh cows. The program being used in the past was an ovsynch program only being implemented on cows if they were found to be open during first palpation by the veterinarian. The cows on these dairies where milked three times daily, and received shots of Bovine Somatotropin (BST) every 12 d after reaching 70 d in milk. Both dairies are open lot dairies in Hart, Texas. The cows were fed a TMR ration twice a day, and had free access to feed and water at all time. Cows were grouped to breeding pens by age and by milk production. The herds were made up of a mix of Holstein and Holstein-Jersey cross dairy cattle.

Program Design

Cows were moved out of fresh pens and into breeding pens at around 20 d fresh. The following Monday, cows received the first shot of the program, an injection of PGF2α (5 ml of Lutalyse; Pharmacia Animal Health, Kalamazoo, MI). Fourteen d later, a second shot of PGF2α was administered, followed by initiation of ovsynch protocol 14 days later (see Fig 3.). Ovsynch protocol included a shot of GnRH (2 mg of Cystorelin; Merial LLC, Duluth, GA), with a shot of PGF2α 7 d later, and another shot of GnRH 48 h later. Insemination followed the final shot 24 h

later. This breeding program was recommended by the dairy owner's Pfizer consultant, due to a depression in pregnancy rates among the herd.

Figure 3. Calender for Presynch Protocol



Both dairies initiated this program on their entire herds, and all open cows that had not already been placed on an ovsynch were introduced to the program beginning in September 2010. Variables taken into account for this study included days to first breeding, pregnancy rate per AI, and conception rate. The study also recorded the number of lactations each cow had completed.

Protocol was performed by breeders on each dairy by using the Alltech Electronic IDs (EID) eartags paired with the Pocket Cow Card (PCC). A wand is connected to the PCC that can be waved over a cow's EID and brings up cow information. The PCC is linked Dairy Comp 305 and carries all the herd information. With the PCC and EID tags, it is easier to sort through large numbers of cows in lockups without using printed lists. PCC also leaves less room for human

error since information can be entered simultaneously with the work being done, and further information can be retrieved while cowside. Commands can also be entered into the PCC such as ovsynch protocol that will inform the breeder which cows to inject or breed as they pass by the cows in headlocks.

Every Monday the presynch program began and fresh cows received the first shot of PGF2α. The protocol makes it easy for breeders to follow since 4 of the 5 shots fall on Monday, and only the final shot of GnRH given on Wednesdays and insemination on Thursdays. Breeders detect heats on all days, record all heats, and inseminate cows that have already completed the program and have come into heat outside the program. After completion of the program, if cows were found to be open during the bi-weekly veterinary pregnancy check, they were administered a shot of GnRH the following Monday and ovsynch protocol was followed. Prior to introduction of the presynch protocol, cows were only placed on ovsynch protocol after being found open during by a vet during bi-weekly pregnancy check.

Variations between herds that might confound results included the White River Ranch herd being bred earlier in the morning and multiple breeders on each dairy with varying conception rates. Other determining factors could include weather conditions and season in which the program was implemented.

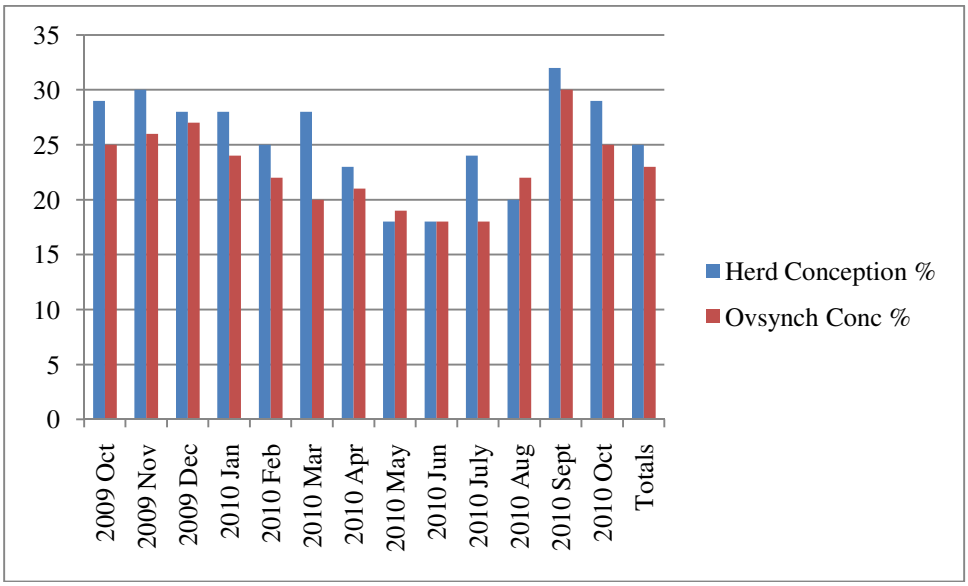
Data Collection Periods

Data collection period began at September 16th and ended October 27th. September 16th marked the first TAI brought about by the presynch program. October 27th was the last day that been pregnancy check information was recorded. Pregnancy status of cattle was determined between 42 and 50 d after insemination by palpation.

Results and Discussion

The results of this study indicated an increased conception rate for those cows that had been subject to presynch protocol. On White River Ranch, herd conception rates before implementation of presynch had averaged 22% for the last 6 months, with two months as low as 18%. In September and October, herd conception rates reached 32% and 29%, respectively, as seen in Figure 3. Conception rates for the cows placed on the presynch program for September and October equaled 30% and 25% respectively. September reached the highest conception rate that had been seen from ovsynch cows and from the entire herd. The September herd conception rate is the highest that has been seen on this dairy in two years.

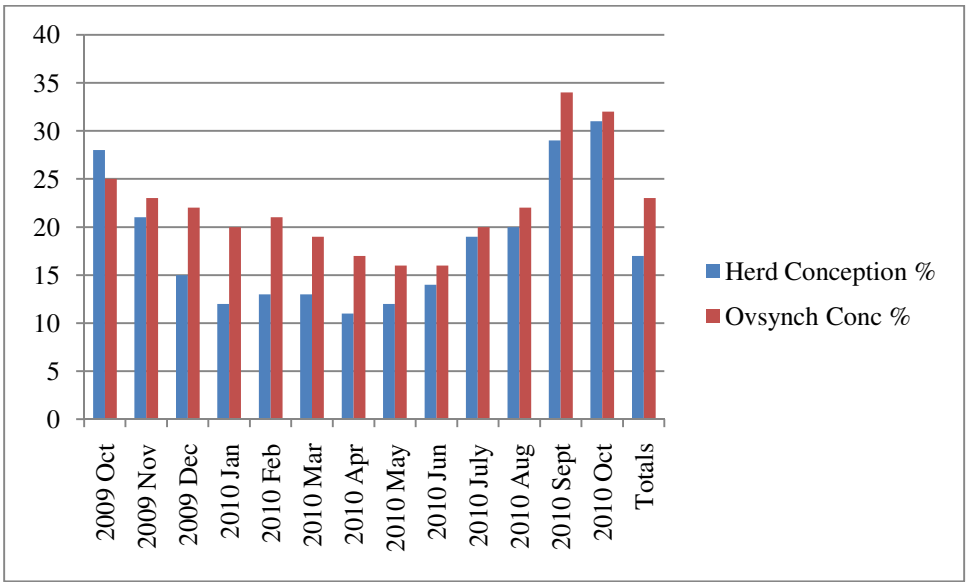
Figure 4. White River Ranch Conception Rates



On VB dairy, conception rates also rose in September and October. This herd's conception rates rose extensively from previous months up to 29% and 31% for September and

October after averaging under 20% for the previous year, as seen in figure 4. Ovsynch conception rate also increased to 34% and 32%, after averaging 23% for the previous year.

Figure 5. VB Dairy Conception Rates



The next factor that was examined at in this study was pregnancy rate per insemination. Since the data was taken from a short time, only pregnancy rate for first insemination was looked at. On White River Ranch, conception from first insemination rose from the year's average of a low 20% up to 34% for period. On VB Dairy, the spike for conception rate for first AI also rose from 17% up to 30%.

The last set of results examined days to first breeding. On both dairies this number decreased. On White River Ranch, days to first breeding dropped from 67 d to only 61 d for cows included in the presynch program. On VB Dairy, days to first breeding dropped from 70 to 63 d.

Conclusions

Results from this study support the use of Presynch protocol to increase pregnancy rate per insemination and conception rate, when compared to the previous program. On both dairies, results support the use of Presynch as the superior alternative, with substantial increases in both reproductive efficiency benchmarks as well as days to first breeding on both dairies being reduced. The program reduces the need for heat detection on cows that are recently fresh, and in turn reduces heat detection on cows in peak lactation that may not show strong signs of estrus.

This study was only conducted over a short period and on a relatively small percentage of the herd. Over a longer period of time, cows may not show such a strong reaction to the extra hormonal injections given in the presynch protocol. If this protocol continues to produce such strong results for multiple months, presynch could save money and time lost due to longer calving intervals.

Works Cited

DeJarnette, J. M. (2004). Sustaining the Fertility of Artificially Inseminated Dairy Cattle: The Role of the Artificial Insemination Industry. *Journal of Dairy Science* , E93-E104.

Galvao, K. N. (2007). Reducing the Interval from Presynchronization to Initiation of Timed Artificial Insemination Improves Fertility in Dairy Cows. *Journal of Dairy Science* , 4212-4218.

Jordan, E. R. (2002). Comparison of Two Timed Artificial Insemination Protocols for Management of First Insemination Postpartum. *Journal of Dairy Science* , 1002-1008.

Matsoukas, J. a. (1974). Effects of Various Factors on Reproductive Efficiency. *Journal of Dairy Science* , 540-544.

Moore, K. a. (2006). Major Advances Associated with Reproduction in Dairy Cattle. *Journal of Dairy Science* , 1254-1266.

Navanukraw, C. e. (2004). A Modified Presynchronization Protocol Improves Fertility to Timed Artificial Insemination in Lactating Dairy Cows. *Journal of Dairy Science* , 1551-1557.

Portluppi, M. A. (2005). Pregnancy Rates in Lactating Dairy Cows After Presynchronization of Estrous Cycles and Variatinos of the Ovsynch Program. *Journal of Dairy Science* , 914-921.

Rabiee, A. R. (2005). Efficacy of Ovsynch Program on Reproductive Performance in Dairy Cattle: A Meta-Analysis. *Journal of Dairy Science* , 2754-2770.

Spielman, A. a. (2000). The Reproductive Efficiency of Dairy Cattle. *Journal of Dairy Scienc* , 329-334.

Tenhagen, B. A. (2004). Comparison of Timed AI after Synchronized Ovulation to AI at Estrus: Reproductive and Economic Considerations. *Journal of Dairy Science* , 85-94.