Reproductive Analysis of 100% Delayed 1st Service Ovsynch Breeding During Summer Months at a Large Central Valley Dairy

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Abstract

As the Dairy industry evolves year by year it is becoming ever more important to be reproductively efficient. The implementation of various timed artificial insemination (TAI) programs has become very common in order to maintain reproductive stability throughout the herd. This can be harder than ever with the increase of herd sizes and hot summer temperature in the central valley. The objective of this study compares two ovsynch breeding programs during summer months on a large central valley dairy. The change in protocol was a delayed 100% timed artificial insemination at approximately 70 dim for the 5-month period from June to October 2012 when cows are most susceptible to heat stress. The delayed ovsynch protocol was implemented to observe the effect upon maintaining the 21-day pregnancy rate, conception rate, and 1st service conception rates throughout the summer months. The dairy's herd size is 3,500 milking cows and all data was collected from Dairy Comp 305 for both breeding programs. The results of this study show that the delayed 100% TAI breeding program during the summer months was more efficient in all of the areas observed. The herd maintained a higher 21-day pregnancy rate throughout the 5-month period and recorded a 3% rise in conception and 1st service conception.

Keywords: Timed Artificial Insemination (TAI), Ovsynch, heat stress,

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Introduction

The dairy industry is becoming even more competitive than ever and with current low milk prices coupled with high feed costs it is very important to maximize efficiency. Reproduction is the driving force of every dairy has become increasingly hard to manage effectively. Therefore systematic breeding programs have become highly applicable and have made dairyman able to improve pregnancy rates especially on such a large scale. These programs also known as Timed Artificial Insemination (TAI) have accounted for increased estrus detection and 100% percent submission rates therefore accounting for more pregnancies. There are many different types of synchronization programs and gave different costs making it prudent for the dairyman to implement one that is practical and profitable for the dairy.

There are many different factors that affect the reproductive efficiency of a large dairy as well as several different measurements to track the dairy's efficiency. Factors affecting breeding efficiency are estrus detection, heat stress, production, labor, and many other limiting factors. For the purpose of this study the productive performance of this large-scale central valley dairy will be measured by 21day pregnancy rate, 1st service conception rates, and estrus detection. All efficiency measurements are calculated through the herd records, which are recorded via Dairy Comp 305 (Valley Ag Software, Tulare, CA).

This central valley dairy, milking 3,500 Holsteins, made the management decision to switch from its previous ovsynch protocol to 100% TAI first service ovsynch during the summer months of 2012. Analyzing the data sets based on 21-day pregnancy rates, 1st service conception rates performed a comparative analysis of the two-ovsynch programs during the summer months to determine which program was more efficient.

Literature Review

Reproductive Importance

The Dairy industry today has become a greater challenge to effectively manage. With herd sizes on the rise coupled with high feed costs, the gap for error is narrower than ever placing a major importance on breeding efficiency. Systematic breeding programs are a proactive response to optimizing reproductive management on a dairy farm rather than waiting to identify cows in estrus before breeding the cows. (Nebel R.L., 1998) Today there are many variations of systematic breeding programs, many of which are known as Ovsynch. These particular variations can be used at various stages of lactation, stages of estrus, and in combination with natural detection of estrus. Reproduction is the driving force that keeps consistency within the milking herd, and can be gauged by the average calving interval. Studies have indicated that the calving interval for optimal milk production and profit lies between 12 to 13 months. (Nebel R.L., 1998) The calving interval is greatly affected by factors such as heat stress, designated voluntary waiting period (VWP), and estrus detection.

Estrus detection is a driving factor to achieving a good conception rate within the herd ultimately reflecting the pregnancy rate. Senger states that the single most important problem limiting high reproductive efficiency is poor estrus detection (Senger P.L., 1994). Research from milk and blood progesterone assays show that 5-30% of all inseminations occur in cows that are not in estrus. Therefore causing not only economic losses in semen costs and labor but also setting up inaccurate perception of days since last heat (DSLH) for the next insemination. Such failures in estrus detection have caused an estimated loss of over $300 million to the dairy industry in the U.S. (Senger P.L., 1994) On the basis of these losses it is important to maintain heat detection above a 65% to maintain desired conception and pregnancy rates.

Effects of Heat Stress Upon Breeding

The challenge of estrus detection can be often very difficult depending upon many factors including the size of the herd, percent of herd pregnant, facilities, body condition scores, and weather implications. However the effects of heat stress are quite often the biggest obstacles to overcome especially in Central Valley, where this study takes place. It is possible that the effects of environmental heat on reproductive performance are greatest when cows are exposed to prolonged periods of extreme conditions within each 24-h period (Morton et al., 2007). Heat stress is the major environmental factor responsible for lowering conception rates (CR) in the summer (Hansen, 1997a). Heat stress may cause a mild reduction in luteinizing hormone (LH) secretion and luteal progesterone secretion, which results in reduced fertility. The efficiency of follicular selection and dominance are also altered during heat stress, with adverse effects on the quality of ovarian follicles (Badinga et al., 1993). These affects often cause cows to either not cycle therefore showing no heat or cause the cows to not cycle completely therefore showing false heats. This causes a greater problem for employees that are actively carrying out heat detection via observation of tail chalk. About 50% of standing heats are undetected during the postpartum period. Therefore, when other protocols are used that depend on detected estrus, the major limitation to maximizing pregnancy rates in lactating dairy cows is the AI submission rate (Cartmill J.A. et al, 2001). This inefficiency in estrus detection can increase the average interval between successive inseminations to about 40 to 50 days and limits both reproductive efficiency and profitability (Alnimer M. A. et al, 2009). Synchronization of estrus in cattle can facilitate the use of artificial insemination by reducing the time needed for detection of estrus compared to cattle entering estrus spontaneously. There are clear seasonal patterns of estrus detection, day to first service, and conception rate in dairy cows (Cavestany et al., 1985; De Rensis et al., 2002;

Almier et al., 2002) and lower conception rates are consistently observed in the summer months compared to winter months.

Table 1 provides weather data comparison for the two 5 month periods of the trial, data was taken from Weather Underground website which provided the maximum temperatures. This data was provided to show not only the differences between the two periods but also to show the extreme temperatures that these cattle had to deal with throughout the summer months.

Table 1 Maximum Monthly Temperatures during the time of Trial

Max Monthly Temp	2011	2012
June	102	107
July	104	100
August	100	105
September	100	100
October	91	98
Avg by Year	99.4	102

Heat stress is a major contributing factor in the low fertility of dairy cows inseminated in the late summer months (Ray et al., 1992). High heat stress levels associated with the summer months cause major implications on large dairy herds trying to achieve profitable reproduction performance as well as a uniform calving interval. This is very important in order to maintain balance milk flow throughout the entire year and can only be achieved with stable reproduction performance. Several methods dairyman have used to combat heat stress to provide sufficient cooling for milk strings by implementing fans and soakers in both the group housing as well as the milking facilities. Cooling was performed throughout the entire study by temperature controlled fans and soakers on all milking strings with fans coming on at 70 degrees and soakers at 75 degrees therefore, stabilizing part of the variable that heat stress can be. Implementing such cooling advantages works best when combined with a specified Ovsynch protocol to improve estrus within cattle and reduces the challenges of heat detection.

Presynch-Cosynch Program

In the past 20 years dairies around the world have begun to implement timed artificial insemination (TAI) otherwise known as Ovsynch. Although there are very many variations of Ovsynch today many dairies are adapting to advanced versions one of which is Presynch-Cosynch. Such a protocol for synchronized ovulation and TAI in lactating dairy cows allows for AI submission rates close to 100% (Pursley et al., 1995).

Therefore ensuring compliance rates that all cows are being bred at a timely fashion as well as decreasing the average days open within the herd. Presynch-cosynch consists of the first injection of PGF followed by a second injection of PGF 14 days later, then an injection of GnRH 12 days later, followed by a third PGF injection 7 days later, and then bred 3 days later and injected with GnRH at the time of breeding (Figure 1). The only difference between a regular presynch protocol and a presynch-cosynch is that the final GnRH shot is given at the time of insemination rather than 12-24 hours prior. Studies have shown little varying effect between the time difference of the GnRH shot and therefore cosynch saves time and labor costs by not having to use the RFID reader the day prior seeing as all the cows must be found and bred the next day.

PGF	→	PGF	→	GnRH	→	PGF	→	GnRH/Breed
0 d		14 d		12 d		7 d		3 d

Figure 1 Standard Presynch-Cosynch Protocol

The first shot of PGF is injected in an attempt to cause the corpus luteum (CL) to regress as well as help clean up any lingering uterine infections the cow may be carrying post partum. This is the beginning step to synchronization and allows for the following procedures to follow up in making sure the cow ovulates and is ready for insemination. Implementation of a timed artificial insemination or Ovsynch program to ensure that all cows are inseminated within a predefined window after the voluntary waiting period can dramatically improve first-cycle pregnancy rates (Jordan E.R. et al., 2002). Ultimately affecting the economic benefit that is received from the reduction of days open within the herd and the number of cows that are either culled due to infertility or designated as do not breeds (DNB).

Comparison to Old Ovsynch Protocol

The previously arranged Ovsynch protocol was also a presynch-cosynch however it was designed without complete 100% submission throughout the entire synchronization protocol. In many cases such variation can be called an Ovysnch protocol that allows for "cherry picking". In the summer months of 2011 the presynch-cosynch protocol as stated above was implemented however cows that showed visual signs of estrus after the second PGF shot also known as LUT 2 were eligible for insemination. This was an attempt to try and catch cows in heat earlier at about 50 DIM. If cows were not detected to be in estrus after the LUT 2 then they would precede with presynch-cosynch protocols and the cows would be inseminated at the designated TAI. On the other hand during hot summer months estrus detection becomes very difficult ultimately reflecting poor heat detection rates. It has been recognized that Ovsynch is more beneficial in herds with poor estrus detection, (Mialot et al., 1999) therefore making it more beneficial to implement the full presynch-cosynch protocol.

Materials and Methods

A trial was conducted on a large California dairy located in the central valley. The sample herd size was derived from a milking herd of 3,500 Holsteins cows ranging in various lactations. All of the cows are fed a total mixed ration (TMR) twice daily and are housed in freestall barns equipped with self locking stanchions combined with fans and soakers for cooling.

The herd is milk 3 times daily in a double 30 parallel milking parlor also equipped with fans and soakers for cooling. All of the dairies management records including reproduction and milking efficiencies are recorded on Dairy Comp 305 ® (Valley Ag Software, Tulare, CA). All records are updated daily and all of the reproductive data collected for this trial was observed via Dairy Comp 305. For the purpose of analyzing the data the results that were taking from the "cheery picked" Ovsynch protocols will be taking at the same time as the presynch-cosynch protocols but from the previous year. Therefore data sets from June 1, 2011 to October 31, 2011 reveal data from the original breeding protocols. The delayed 100% first service TAI breedings from the presynch-cosynch protocols were implemented as for the purpose of this trial on the dates of June 1, 2012 to October 31, 2012 therefore such data sets reflect these dates. All other variables stayed constant throughout the trial with estrus detection occurring in a timely fashion every morning by the same employees. Tail chalk and visual detection was used throughout the trial while the daily shot schedule did not vary either. Every other Tuesday pregnancy checks were completed via rectal palpation by Valley Vets Veterinary services.

The data sets were chosen to be taken from the exact dates based on a one-year difference in an attempt to correlate a reproductive efficiency advantages between the two protocols by evaluating conception rates, pregnancy rates, heat detection, and number of cows enrolled. Table 2 above designates all of the prices for all necessities to implement the presynch-cosynch protocol along with each provider. All of the same brand name drugs used throughout the trial were provided by the same supplier and were giving in the same appropriate doses to avoid any variable affects.

Table 2 Actual Dairy Costs for Implementing Presynch-Cosynch

Item	Cost	Provider
Estrumate ® per 2cc	$1.82	Merck Animal Health
Fertagyl ® per 2cc	$1.75	Merck Animal Health
Labor per hour	$11.00	Bos Farms
Vet Fee per cow	$2.00	Valley Vets

The information provided in Table 3 designates the aspects of shots for both protocols. The only varying difference between the two protocols is the option to breed cows showing signs of estrus after the LUT2 injection. Therefore the new presynch-cosynch protocol designated a submission rate of 100% noting that all breedings take place after a VWP of 70 DIM.

Table 3 Bos Farms Presynch-Cosynch Calendar

Bos Farms Presynch-Cosynch Calendar

	SU	MON	TUE	WED	THUR	FRI	SAT
Week 1					LUT1 35-41 DIM		
Week 2							
Week 3					LUT2 49-55 DIM		can breed off Lut2
Week 4							
Week 5			GnRH 61-66 DIM				
Week 6			LUT3 68-74 DIM			Gnrh/breed 71-76 DIM	

Note: This cosynch calendar is for a single cow started on the cosynch protocol.
All cows that fit those dim ranges will be eligible for cosynch if not bred already.

Results and Discussion

The results of the study show that there was an overall increase in the herd's 21-day pregnancy rate, conception, heat detection, and total pregnancies on this 3,500 cow dairy when switching their ovsynch protocols. A statistical analysis of all the data was performed to determine exactly what elements had an effect on the overall outcome, observing whether the treatment protocol, year, and each individual month were a factor. Conception rate was not factored into the statistical analysis because Dairy Comp 305 already calculates conception rates with a 95% confidence interval. Each of these factors was measured by determining their affect on the 21day pregnancy rate and the total pregnancies.

The data in Table 4 shows that there was a significant 4-point increase upon the least squares means when analyzing the 21d pregnancy rate. Seen by the 4-point variance from the normal breeding protocol compared to when the 100% first service Presynch-Cosynch was implemented. The treatment also had a rising affect upon the amount of pregnancies total over the time of the trial rising from 151 to 185. The P value for treatment affect is 0.191 therefore it is 81% likely to have had an influence on the outcome. The data provided on the total amount of pregnancies over the trial period is also supported through Dairy Comp 305 records.

Table 4 Treatment Statistical Analyses

Treatment	Preg 21d Pct LSMEAN	Preg LSMEAN
Normal	12.2137	151.4139
100% 1st Service Ovsynch	16.0262	185.0167

Further analysis was performed to determine whether or not the year was a limiting factor upon the 21d pregnancy rate and total pregnancies. This data allows for analysis of year-to-year variance due to herd numbers, weather, and other factors. A analysis of year variance is important to make sure that it did not have a greater effect upon the reproductive outcomes than the treatment did therefore proving the treatment change effective.

Table 5 shows a very small variance between the effect 2011 and 2012 upon 21d pregnancy rate and total pregnancies. This data provides that although each year has a different effect there was a greater effect with the implementation of the new ovsynch program. The P value for then yearly affect on the 21 d pregnancy rate is 0.157 therefore it is 85% likely to have had an influence. The data reflecting year variance to total pregnancies shows a greater effect of 11 points, however that can be affected by weather, total breedings and other factors. Temperature factors can be observed in Table 1 when referring to maximum temperatures monthly by each year. Table 1 shows an average of a 3-degree increase in maximum temperature over the 5-month trial for Tulare, California, the location of the dairy. This data ultimately has an effect upon the slightly lower least squares mean for 21d pregnancy rate in 2012 due to the factors of heat stress upon reproduction as stated previously. Therefore reiterating the fact that the treatment change had a greater impact on the reproductive outcomes than the year-to-year variance.

Table 5 Year-to-Year Statistical Analyses

Year	Preg 21d Pct LSMEAN	Preg LSMEAN
2011	23.7360	189.3074
2012	22.3846	178.8691

A SAS analysis was performed to determine whether each month had an affect upon the 21d pregnancy rate and the total pregnancies. This data provides a visual example of exactly why the trial was performed from June to October because of the high heat stress issues that hinder reproductive performance on large central valley dairies.

Figures 2 and 3 show that month variation has a very large effect upon reproductive performance within this trial herd. This can be seen by the large dip in the two graphs in the months ranging from June to October. The P value for monthly variation is 0.0085 therefore it is nearly 100% likely that each month has an influence. This data supports the reason for performing 100% 1ST Service Ovsynch during these months in an attempt to improve reproductive efficiency. Acknowledging that in this location heat stress most susceptible throughout these five months it is very important to take all measures to maintain a persistent 21d pregnancy rate. The SAS analysis proved that the treatment had a positive effect upon maintaining higher 21d pregnancy rates and this can be seen in the Figure 4 below when comparing the year-to year rates over that 5-month period.

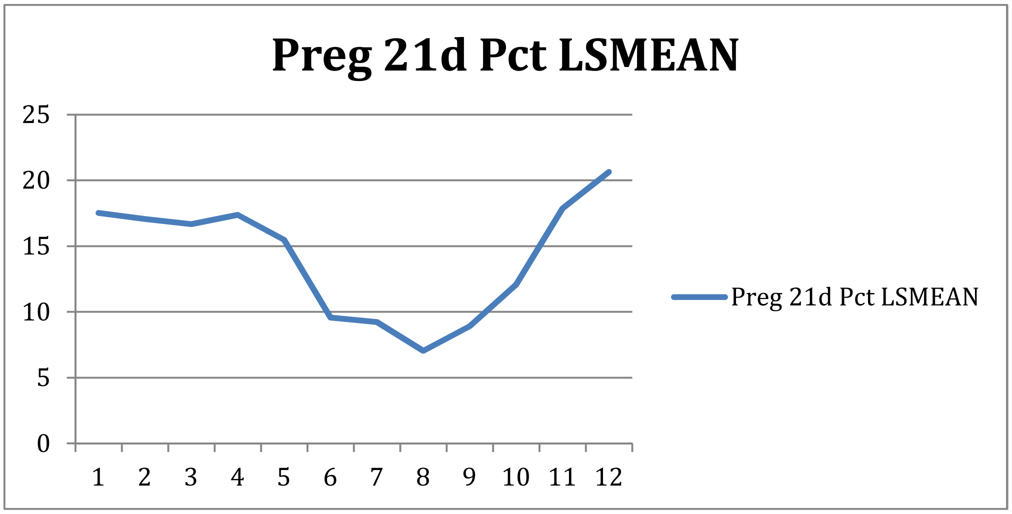

Figure 2 SAS Analysis of Month Variation on 21d Pregnancy Rate

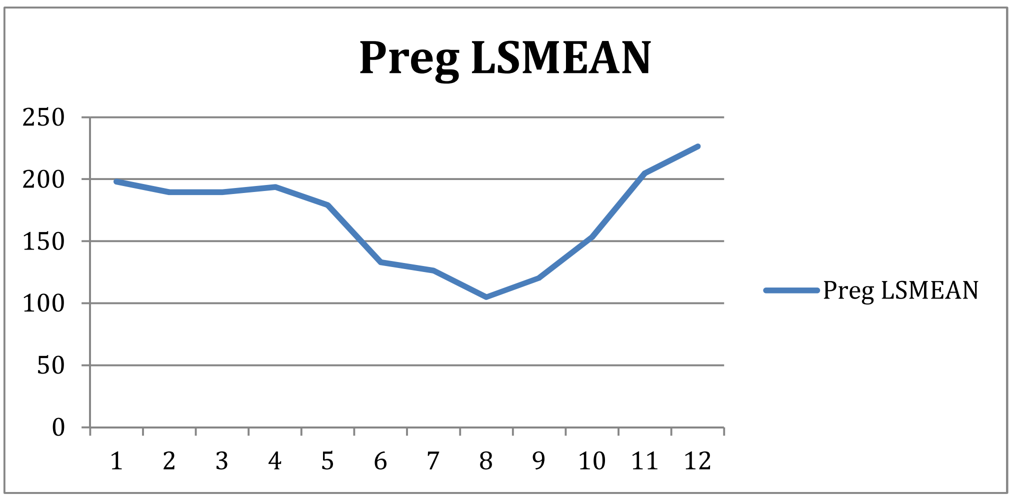

Figure 3 SAS Analysis of Month Variation on Pregnancies

Figure 4 shows that although there was also a dip in the 21d pregnancy rate in 2011 and 2012 the 2012 rates maintained higher throughout the trial. When comparing the two data sets as an average the 2011 average rate was 16.14% while the 2012 average was 19.43%. This data coupled with the data provided in Table 1 on temperature variance proves that there was a significant improvement from implementing the new 100% 1st service ovsynch protocol. Studies by Michael Overton at UC Davis show that a 1% increase in 21d pregnancy rate is equivalent to

$20/cow in the milking herd. Therefore by increasing the 21d pregnancy rate at Bos Farms by 3% on a 3,500 cow milking herd that equates to over a $200,000 economic gain by simply improving upon their pregnancy rate. This economic gain affects many other factors such as lower the herds average DIM and DOPN while allowing for more consistent milk flow, culling, drying off.

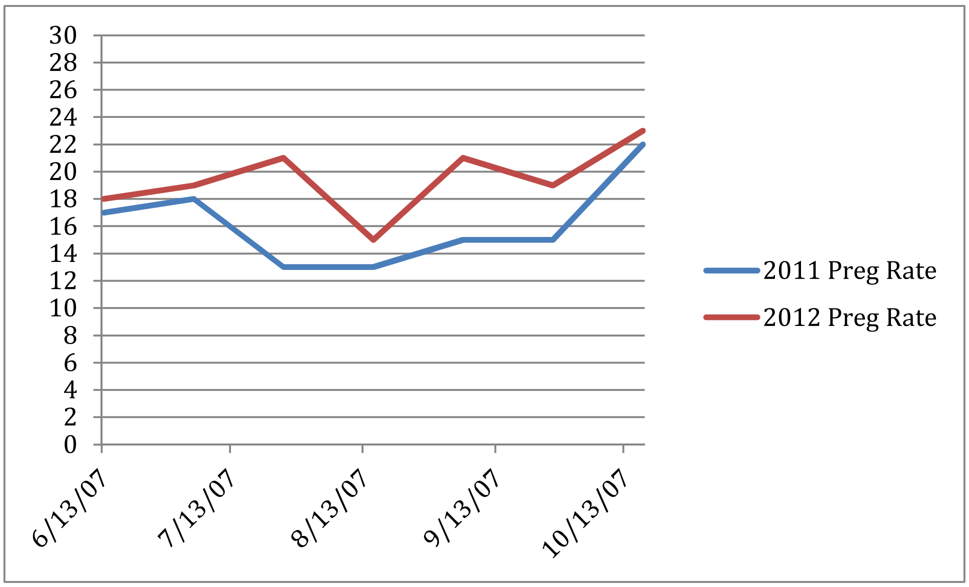

Figure 4 Year-to-Year Comparison of 21d Preg Rate for the 5-month trial

Conception rates are the driving force behind maintaining a consistent pregnancy rate. With Dairy Comp 305 calculating conception rates based on a 95% confidence interval it gives a range from which the rates could vary. The data provided below shows that the two different data sets overlap slightly within their respectful ranges however there is a distinguishable difference between the two.

Table 6 Conception Rates from 2011

Bred Number	95% CI	%Conc	#Preg	#Open	Other	Abort	Total	%Tot	SPC
1	25-30	27	418	1106	37	57	1561	33	3.6
2	24-29	26	278	781	23	48	1082	23	3.8
3	17-23	19	137	566	17	18	720	15	5.1
4	15-22	18	85	385	13	12	483	10	5.5
5	15-23	19	61	264	10	7	335	7	5.3
6	8-16	11	24	187	7	4	218	5	8.8
7	9-20	14	20	125	8	4	153	3	7.3
8	7-21	12	11	77	11	2	99	2	8
OTHERS	5-22	11	6	48	8	0	62	1	9
TOTALS	22-24	23	1040	3539	134	152	4713	100	4.4

Table 7 Conception Rates 2012

Bred Number	95% CI	%Conc	#Preg	#Open	Other	Abort	Total	%Tot	SPC
1	28-33	30	441	1024	24	15	1489	33	3.3
2	25-31	28	266	686	28	16	980	22	3.6
3	20-26	23	147	505	24	13	676	15	4.4
4	23-31	27	127	350	18	9	495	11	3.8
5	19-28	23	73	239	7	4	319	7	4.3
6	012-22	16	33	171	13	3	217	5	6.2
7	16-29	22	30	109	10	1	149	3	4.6
8	7-22	13	10	69	5	2	84	2	7.9
OTHERS	7-21	12	10	74	10	1	94	2	8.4
TOTALS	25-27	26	1137	3227	139	64	4503	100	3.8

The data in Tables 6 and 7 above show that there was a 3% difference in actual 1st service conception rates between 2011 and 2012. This 3% difference accounts for a major impact when analyzing data sets over 4,000 animals bred. With the ovsynch changes implemented on the 1st service it is important to critique that data more than anything however the success or failure of that breeding affects the following services. The 1st service breeding accounted for 33% of the total number of animals bred for each period designating an equal impact for each year. With the conception rate rising from 27% to 30% on 1st service and a change from 23% to 26% on all services this displays that the change implemented had a positive affect upon conception.

Furthermore when observing the data in Tables 6 and 7 it is important to observe the amount of animals bred each period as well as the number of pregnancies. These numbers are what make up the conception rates however, observing them side-by-side allows for further emphasis of the impact that the change provided. In 2011 there was 4,713 total animals bred over the 5-month period with successful pregnancy on 1,040 animals. In 2012 there was 4,503 total animals bred over the 5-month period with successful pregnancy of 1,137 animals. This data shows that between the two data sets there was 210 less animals bred in 2012 while achieving 97 more pregnancies in 2012 than 2011.

Conclusions

After comparing the two previous summer ovsynch protocol compared to the delayed 1st service timed AI protocol, at this large central valley dairy, I found that the data supports the delayed 1st service ovsynch program to be more efficient. Upon analyzing the 21day pregnancy rate, total pregnancies, monthly effect, and treatment effect within the statistical analysis system all measures showed a significant increase based on the new protocol. When conception rates were compared side-by-side, this data also supported the increase in efficiency in the year 2012. Furthermore the analysis of heat stress upon the two different time periods showed to be a factor but seeing as temperatures in 2012 were higher and results still remained higher therefore stability within all reproduction measures was obtained. According to this study, delayed 1st service timed AI during was successful in maintaining reproductive efficiency throughout the summer months for this large central valley dairy.

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