Chapter 1

INTRODUCTION

Cattle ranchers have long faced the problem of dealing with heifers calving for their first time. The heifers are usually young and the bulls they are bred by are not forgiving with their calving ease or high birth weight calves. The technology that has evolved with the development of the artificial insemination (AI) industry has helped make things easier on the cattle, not to mention the rancher. However, few beef producers in the United States use AI as a primary option for reproduction. This is due to the time, labor, money and results involved with implementing a successful program. During the first experiments, using AI was found to produce very low conception rates compared to natural insemination. This low success rate was concluded due to the unsuccessful detection of estrus at the time of insemination. Beginning in the 1970's, drugs began to be developed that would greatly revolutionize the synchronization of estrus as well as the AI industry. Producers were now able to synchronize an entire herd to ovulate within hours of each other therefore allowing for a timely and successful artificial insemination. Once synchronization was fine tuned, specialty bulls such as low birth weight and calving ease bulls were developed to make it more practical to use artificial insemination with first calf heifers. In other circumstances, high performance, fast growth rate bulls have been used for larger, performance based cattle.

Many ranchers with large cattle herds on large ranches may not want or need to develop a successful AI program to increase beef productivity or profitability. The process takes time, money, and the facilities to handle and administer the programs requirements. Most ranchers will

most likely continue to let their bulls do what they do best and accept decent birth rates. However, many producers tend to grow their own cows from heifer calves produced. This is an excellent way to keep good genetics within the herd and helps to build a rancher's herd without having to buy more cows. The only problem found with growing replacement heifers is the calving difficulty associated with their first calf. As stated before, bulls from the home ranch are not always concerned with having high calving ease or low birth weight calves. There are many different types of synchronization programs that have been developed; however, some may be targeted more towards beef heifers than others.

Problem Statement

Using two synchronization artificial insemination programs, is there one program that is more beneficial than the other for beef first calf heifers considering all financial costs?

Hypothesis

There is a preferred method of synchronizing and artificially breeding first calf beef heifers that can be tested through conception rates and heat detection. The cost is different for each process of synchronization and this is directly related to the conception rates for the groups of heifers. Therefore, the synchronization program with a higher initial cost will be more beneficial in the long run.

Objectives

1) To assess different types of synchronization processes and choose two different processes to test and use in the field.
2) To track all expenses to calculate the exact cost per head using labor, equipment, materials, and vaccinations.

3) To examine the cattle 45-60 days post insemination and record signs of pregnancy through visual observation and pregnancy checks.

Significance of the Study

Beef producers have constantly had problems with calving out their first calf heifers. Mortality rate is high and the extra labor involved with assisting the cattle in calving instead of a natural birth is extensive, not to mention the stress and strain put on the heifer and her calf. According to the National Agricultural Statistics Service (NAAS), there were 4,051,000 cattle deaths in 2005. Of those deaths, 3,861,000 were due to non-predator occurrences. Of the non-predator deaths 572,000 deaths were due to calving problems. This is 14.8% of the total U.S. cattle non predator deaths and totals $328,193,000 in cattle value lost. NAAS further develops this information by breaking it down into California statistics. In California in 2005 there were 98,600 cattle and 159,000 calves that died due to a non-predator cause. Out of these statistics 10,300 and 6,400 cattle and calves respectively died because of calving problems. These statistics show that there is definitely a problem in the U.S. and California with losing cattle because of calving difficulties. Developing a financial plan, along with which system worked the best for specifically beef heifers, along with what type of bull semen was used and conception rates/calving ease, would be very helpful for small cattle ranchers and possibly some larger ones in raising their own mother cows. This will be able to happen because they will have less risk in losing heifers calving let alone the calves. This will be most helpful for the small, sustainable rancher because there is chance of very high conception rates at a generally low cost.

Chapter 2

REVIEW OF THE LITERATURE

Financial Implications

Some of the biggest issues surrounding the use of artificial insemination practices are the financial implications involved with executing a successful program. Every business has financial costs that must be met which are just another part of running a business. Beef producers are definitely aware of these financial obligations and have developed their programs accordingly. Only 21% of all beef cattle operations in the United States have used artificial insemination for part or all of their operation (Ott 1998). This is a low percentage for a practice that has been proven to be effective. Much of this figure is due to the fact that most operations purchase replacement cows or heifers instead of raising home grown cattle. This would cut down on the incentive to practice artificial insemination on a group of first calf heifers that were raised on the home ranch. Ott (1998) points out the fact that a study found that ranchers whose cattle were their primary source of income were twice as likely to practice things such as dehorning, castration, and use artificial insemination as ranchers whose herds were not their primary income source. This indicates that many of the smaller cattle producers in the United States do not see the point in investing extra time and money into a new idea that may not make a difference in the income that they receive from their cattle.

Why would people want to use artificial insemination if they already had bulls and all they had to do was turn the bulls out on a certain date with the cows, and bring them in another

day? Time is a huge factor when dealing with the financial aspects of developing a synchronized artificial insemination program. Dale (1983) emphasizes the point that developing and carrying out a successful program would not only incur costs surrounding drugs, semen, and a veterinarian, but the time involved would be worth more than these things combined. People may forget how much their time is really worth, especially when running a business. Carrying out a synchronized artificial insemination program, especially on the commercial level, would take hundreds of hours out of the already busy schedule.

Factors Influencing Use of Artificial Insemination

The main factor influencing the use of artificial insemination is simply the adoption of new technology (Parcell 2010). Many beef producers have been implementing their program for years and do not see a reason to fix something that isn't broken. Parcell (2010) stresses the fact that less than ten percent of beef producers in the U.S. practice artificial insemination, opposed to most of the dairy industry adopting it. This is mainly due to the fact that dairies already have all the cattle in small areas along with the facilities to accommodate implementing an artificial insemination program. However, artificial insemination is becoming more widely used by beef producers for their first calf heifers (Parcell 2010). Different types of bull semen can be chosen that will promote lower birth weights and higher calving ease which would help when dealing with first calf heifers.

It seems if you manually inseminate each cow/heifer individually then the pregnancy rate would be very high. However, the main problem associated with AI is not bad semen, inaccurate placement, or personal error; it is an inaccurate detection of estrus in the recipient animal (Taponen 2009). This is a problem usually avoided in free ranch breeding programs where a bull

is turned out with a group of females and the bull knows when the females are in heat by way of nature. Taponen (2009) underlines the main problem with failure in AI programs is not having a sure way to know that your animals are in heat and ready to be inseminated. This could be solved by a program developed to make sure all the animals are in heat at the same time.

Benefits of Synchronization

To really see the effects of synchronizing estrus, a comparison must be made between natural serviced animals and artificially serviced animals. Tests were done to observe the difference between groups of cattle bred by four different methods (Parcell 2008). The four methods were: natural service (bulls breed female naturally), calving ease (AI using low birth weight semen), and low accuracy (AI using semen without proven results), and high accuracy (AI using semen with proven results). Synchronization programs were used with all random groups. The study found advantages of the estrus synchronization to be: females are in estrus in a predictable time period which allows for successful AI, decreased labor expense due to reduced time detecting estrus, and the high accuracy calves were older and heavier at weaning time. Parcell (2008) also indicated that within the first 30 days after insemination, 90% of cattle synchronized were found to be pregnant.

Lamb (2006) illustrates the possibilities of implementing a successful synchronization program to be: a shortened calving season, more uniform group of calves, and an enhanced possibility of using AI. Lamb (2006) explained the benefits of AI. AI allows producers to incorporate far superior genetics into their herds at costs much lower than buying the same caliber bulls to breed the females. Artificial insemination is more economically feasible to

achieve when a synchronization program is in place. This will cut down on the amount of times the AI process must be completed to achieve desired pregnancy results (Lamb 2006).

Methods of Synchronization

There are many different methods of synchronization that have been developed over the years. Roberts (1979) explained an older method of estrus synchronization that is still being used today. This involved implanting a device that would release progesterone to start the estrus cycle. This was found to be very effective in range cattle because they would not have to be brought in and handled as much as other methods of synchronization (Roberts 1979). Another early method that is widely used now is not only synchronizing the cattle, but using heat detection along with synchronization to pin point the best time to breed (Missildine 1984). Missildine (1984) found that there was a 30% increase in pregnancy when a heat detection program was added to a synchronization program, opposed to synchronizing without heat detection.

There are many different drugs associated with the synchronization of beef cattle. Deutscher (1994) lists many of the drugs involved: prostaglandin, gonadotropin releasing hormone (GnRH), progesterone, melegene acetate (MGA), controlled internal drug release device (CIDR), and sychromate B implant. These drugs are combined with a stringent timeline to produce a uniform group of females in heat. For example, a program called Ovsynch requires ten days to make a full cycle. First a shot of GnRH is injected. After waiting seven days you again inject the animal with GnRH. Finally, you wait 24 hours and can either breed the female or for higher conception rates inject a third time with GnRH (Deutscher 1994).

Another method of synchronizing for artificial insemination is called the CIDR program. This stands for controlled internal drug release and involves a mechanism which is inserted into

the vagina and releases progesterone into the female, beginning the synchronization of the estrus cycle. There is also a program called Co-synch which involves giving injections of GnRH and PG during allotted times on the timeline. Busch (2007) ran a test between these two programs and recorded the results. All heifers were administered the optional shot of GnRH at the time of insemination. Both AI programs were based solely on timing and not estrus detection. Results found that heifers receiving the CIDR implant had significantly higher pregnancy rates than the heifers subjected to the Co-synch program (Busch 2007).

In conclusion, synchronizing females before the use of a heat detected or timed artificial insemination program greatly increases the pregnancy rates and success of implementing new technology.

Chapter 3

METHODOLOGY

Procedures for Data Collection

Data collection will begin with specifying the two different synchronization programs to be used and to outline a timeline that will define what materials will be needed, along with when and how the material will be used. The two synchronization programs being used are CIDR and Ovsynch. These require certain drugs such as prostaglandin, gonadotropin releasing hormone (GnRH), and controlled internal drug release (CIDR) inserts which release progesterone while in place. The timeline for each synchronization program is very important because heat synchronization, detection, and success of the synchronized artificial insemination process are all based on good timing. The CIDR program takes 11 days to synchronize heat. The Ovsynch program takes a little less time; beginning 10 days before insemination (see Figures 1 and 2). Below are two timelines including the drugs administered and on what dates.

CIDR Synchronization Program

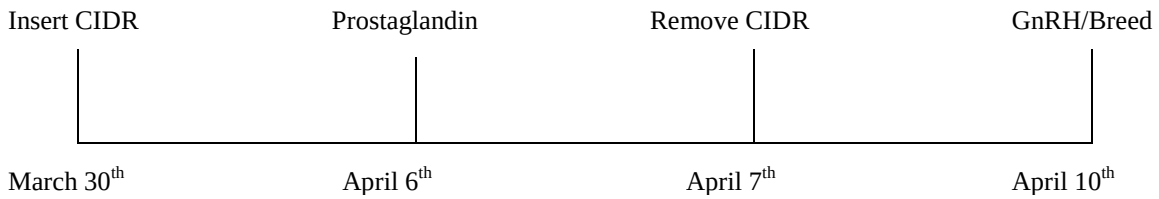

Figure 1. CIDR Timeline

Ovsynch Synchronization Program

Figure 2. Ovsynch Timeline

The next step will be collecting the materials needed for each program and recording financial costs of each part. Besides financial costs, the time involved with acquiring and carrying out each step will be noted and taken into account when assessing the overall cost of each different process.

Once the synchronization process is completed, the animals are inseminated. Once inseminated, the heifers will be turned out on pasture and the date will be recorded. All heifers will be tested for pregnancy on the same day about 45-60 days after the insemination day. These results will be recorded for the two separate groups and compared.

Procedures for Data Analysis

Now that the synchronization processes are chosen, the heifers to be used for each program will be selected and recorded. In order to keep track of the individual animals in each different program, an ear tag will be given to each animal at the time of the first step in the synchronization process. With identity, the heifers can be mixed together in natural pasture conditions, instead of being locked up in a corral separately.

Next, the financial budget will be created by recording the costs of all materials, time, and equipment involved. This will be done by simply observing how much everything costs and using the concept of an opportunity cost to value the time involved.

More pieces of data that need to be analyzed will be the pregnancy rates achieved by each separate program. The heifers will be pregnancy checked on the same day and results will be recorded and analyzed. The pregnancy rates will then be compared to cost per animal for the entire process. This will illustrate if there is a real benefit to use a more time consuming, costly process compared to a cheap, quick process.

Finally the value of the pregnant heifers will need to be evaluated considering factors such as how much that calf is worth once born and what costs will be incurred to ensure that. It will also include things such as what the cost will be to keep the heifer instead of selling it. These factors will also be considered for the heifers that are not pregnant. What is that cow worth to us now that the synchronized breeding program will not work? This will illustrate the total overall opportunity cost of implementing the program.

Assumptions

This study assumes that the heifers chosen to carry out the procedures all have a normally functioning reproductive tract. The tracts will not be checked before carrying out the project to simulate the randomness experienced if this were to be done solely to breed one's heifers.

Limitations

Although this research will look at the synchronization and artificial insemination programs generally, it is mainly focused on beef first calf heifers. Results from this study could possibly be the same for dairy cattle or beef cows, but should be limited to beef first calf heifers.

Chapter 4

DEVELOPMENT OF THE STUDY

The project began on March 31st. The first group of 24 heifers that was worked received white ear tags and CIDR inserts were placed in each vagina. The second group received yellow tags and was injected inter-muscularly with 2 cc's for gonadorelin diacetate tetraydrate Cystorelin (GnRH). The heifers were then turned back out into their natural pasture environment.

On April 7th the heifers were gathered and sorted according to tag color. The CIDR group's vaginal inserts were removed and they were injected with 5cc of Lutalyse (prostaglandin) inter-muscularly. They also received an estrotect sticker on their tail head so it was easier to tell which ones were in heat. The Ovsynch group received a different color estrotect tag and was injected with 5cc's of Lutalyse also.

In the morning on April 9th, the Ovsynch group was injected with 2cc's of GnRH and both groups' estrotect tags were observed. In the afternoon, an AI technician arrived and we began to breed any heifers that were in heat. That afternoon nine were bred from the ovsynch group and eleven were bred from the CIDR group. The CIDR group also received two more cc's of GnRH at the time of breeding. The rest of the heifers were bred the next day, April 10th in the morning.

On May 7th, the heifers were observed and checked for signs of heat. The CIDR group had seven possible heifers that were in heat and the Ovsynch program had a possible ten in heat. This means that there were a possible 17 and 14 bred from the CIDR and Ovsynch programs,

respectively. The heifers were then pregnancy checked by an ultra sound machine on June 1st, 53 days after they were inseminated. The results were 16 bred from the CIDR program and 12 bred from the Ovsynch program.

Table 1. Price of synchronization programs

	#/Ovsynch	$/Ovsynch	#/CIDR	$/CIDR
Semen @ $10/dose	24	$240	24	$240
Labor @ $20/hr.	8	$160	7	$140
Estrotect Tags @$1.20 each	24	$28.80	24	$28.80
Liquid Nitrogen/Holding Tank @100	0.5	$50	0.5	$50
Ear tags & Syringes @ $1/each	40	$40	40	$40
CIDR Vaginal Inserts @ $9.28/each	0	$0	24	$222.70
Cystorelin GnRH @ $2.3/dose	72	$165.60	24	$55.20
Lutalyse Prostaglandin @ $2.3/dose	24	$55.20	24	$55.20
Veterinarian Hiring Fee @ 4/hd.	24	$96	24	$96
Total		**$836**		**$928**
		24 hd.		24 hd.
Total Synchronization Cost Per Animal		**$34.82**		**$38.66**

The price difference between a bred heifer and open heifer must be looked at before the cost per bred animal is factored in. According to Beef Magazine, a study conducted by the University of Georgia from 2000-2005, bred heifers range anywhere from $900-$1300 with a premium paid for heifers bred by AI. A heifer that was found open would take a serious discount in price, although they would be sold soon and would not have to continue to be taken care of. According to the Chicago Mercantile Exchange (CME) the rate for live cattle in the months from June 2010 to October 2010 average out to be $90/cwt. The heifers averaged 700 lbs. during the project. The bred heifers would be sold when they are five to eight months bred which would involve maintaining them until that time. Assuming there will be no problems that have to be paid for, maintaining one heifer would be approximately $1/day for 5-8 months.

Table 2.Difference in cost and selling price/animal

	Ovsynch		CIDR	
	Bred	Open	Bred	Open
Cost of Synchronization Program	$34.82	$34.82	$38.66	$38.66
Cost of Pasturing Bred Heifer 5-8 Months	$150-$240	$0.00	$150-$240	$0.00
Total Cost	**$184.82-$274.82**	**$34.82**	**188.66-278.66**	**$38.66**
Price Received when sold	$1,100.00	$720.00	$1,100.00	$720.00
Difference	**$915.2-$825.18**	**$685.20**	**$911.34-$821.4**	**$681.34**

The chart shows the returns based on the future prices that would be received for these animals if the bred heifers were sold after 5-8 months and if the open heifers were sold soon. On a per animal basis, the bred heifers are worth around $200 dollars more for each program (See Table 2).

The CIDR program returned four more bred heifers than the Ovsynch program. This is an extra $740 when you take the difference between four bred heifers compared to four open heifers. Considering the CIDR program only cost an extra $3.84 per animal, this seems like a better choice for a synchronization designed for beef first calf heifers. The return on the $3.84 investment would be an extra $185 per animal (See table 3).

Table 3. Extra Added Value

Avg. value/bred heifer	866.37
Extra Bred heifers CIDR program	4
Total value of 4 extra bred heifers	**3465.48**
Value of four open heifers	$2,725.36
Total extra value gained	$740.12
Extra Value/bred heifer	**$185.03**

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Two synchronized artificial insemination programs were researched, implemented and reviewed to conclude whether or not there was one that worked better on two groups of first calf beef heifers. Financial data was recorded throughout the experiment to analyze the cost and returns achieved during the project. The heifers were synchronized following two specifically timed programs using different types of drugs and timing. This was so two similar, yet different, programs could be compared and contrasted. Bull semen was acquired according to birth weights and calving ease statistics. The insemination was carried out and the heifers were checked twice over the next month and a half.

Conclusions

It was found that the CIDR program successfully bred 16 heifers and the Ovsynch program bred 12. The financial implications were then looked at and the benefits and costs were analyzed. There was a significant extra value added to the heifers that got bred. The extra cost/pregnancy for the CIDR group was definitely worth the return on investment.

This was a single trial and therefore there was not enough statistics to provide concrete facts about these methods. It was a good start to begin statistical analysis of these programs, but

with only two trial groups of such small numbers, this information should not be used as sufficient evidence to support a theory.

Recommendations

My recommendations if anyone decides to use this project are to adjust cost values accordingly on costs that were estimated by our ranch, such as: labor, AI technician, and cost of maintaining one animal/day.

Recommendations for the expansion of this study would be to explore other AI synchronization programs. There are many more than two and they could possibly work better than these two.

Our family owns and operates a beef cattle operation and has actually used one of these programs on a larger scale. We synchronized a group of 500 beef first calf heifers using the CIDR synchronization program that I used in this project. We artificially inseminated the herd and put in a group clean up bulls in a month later to breed any open heifers. We had a 90% conception rate overall with 75% - 80% bred by the AI program. This was possible to estimate because all those heifers calved a month earlier. Even though with this high conception rate the time, labor and money involved with implementing a synchronized artificial insemination program on a large scale was too much. This may explain why many large beef operations do not use these methods. Instead of using this method, we have begun to buy pricier bulls that specialize in low birth weight calves for our first calf heifers. This greatly cuts down on time, labor, and costs and still keeps calving problems at a minimum.

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ABSTRACT

This study was designed to compare the benefits and costs of two different synchronized artificial insemination programs on two groups of beef fist calf heifers. A financial budget was developed that would include cost of synchronized insemination per animal and the added value of a bred heifer compared to an open one.

The two synchronized programs were called controlled internal drug release (CIDR) and Ovsynch. They used a specific timeline and drugs to complete the synchronization process. A single low birth weight high calving ease bull was used for both groups to enforce conformity between the groups. Costs of all inputs, including labor, were budgeted and calculated on a per animal basis.

The CIDR program had a higher pregnancy rate than the Ovsynch. Because the test groups were so small there was not enough data to produce legitimate statistical analysis. This process is very time intensive for a beef cattle operation and this may explain why large beef operations do not practice these methods very often.