ADOPT DEMONSTRATION REPORT

(Agriculture Demonstration of Practices and Technology)

RESEARCH AGRICULTURE

20110343

ESTROUS SYNCHRONIZATION & ARTIFICIAL INSEMINATION IN COMMERCIAL BEEF PRODUCTION

Funded by:
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Prepared by: Rudy Feeder Co-operative Ltd.

Saskatchewan Ministry of Agriculture

Project Identification

1. **Project Title:** Estrus Synchronization & Artificial Insemination in Commercial Beef Production

2. **Project Number:** 20110343

3. **Producer Group Sponsoring the Project:**
   Rudy Feeder Co-operative
   Box 670
   Outlook, SK
   S0L 2N0
4. **Project Location(s):**
   Hanley, SK – Ivan and Lee Carpenter
   Elbow, SK – Brent and Karin Griffin
   Parkbeg, SK – Jason and Karla Hicks
5. **Project start and end dates (month & year):**
   Project started in May 2012 and was completed in December of 2013

6. **Project contact person & contact details:**

Travis Peardon
Livestock Specialist
Saskatchewan Ministry of Agriculture
Outlook Regional Office
(306) 867 - 5504
travis.peardon@gov.sk.ca

Colby Elford
Livestock Specialist
Saskatchewan Ministry of Agriculture
Moose Jaw Regional Office
(306) 694 - 8953
colby.elford@gov.sk.ca

Objectives and Rationale

7. **Project objectives:**
   This objective of this project was to directly compare estrus synchronization and fixed-time artificial insemination with natural service breeding. This includes a complete economic analysis of both systems.
8. **Project Rationale:**

Estrus synchronization is a management practice that can help beef producers improve production efficiency and economic returns. Its purpose is to control estrus and ovulation in cycling females so that the breeding can be completed in a short period of time. Instead of females being bred over a series of 21 day cycles, synchronization can result in the majority of animals being bred in a matter of hours at the start of breeding season.

The objective of this project is to demonstrate the advantages of progesterone-implant based estrus synchronization protocols combined with artificial insemination. This will be directly compared to natural service breeding. This project will include a complete economic analysis of both breeding methods.

In the past, estrus synchronization protocols had low levels of reliability which resulted in correspondingly low pregnancy rates. New protocols are showing more success and as a result, more animals are becoming pregnant in a desired time frame. However, despite the fact that many of these protocols were developed in Canada, producer uptake of this technology has been slow in the beef sector; much slower than our rival beef producing nations.

Methodology and Results

9. Methodology:

This project was replicated at three different sites in Saskatchewan. The number of animals included at each location varied due to the amount of heifers that were available to be bred. At the Hanley location (Carpenters') a total of 42 heifers were included. Twenty one were estrus synchronized and artificially inseminated (Fixed-time artificial insemination, FTAIed), and 21 were included in the natural service group. At the Elbow location (Griffins') a total of 40 animals were included in the project. Twenty were FTAIed and 20 were in the natural service group. At the Parkbeg location (Hicks') a total of 59 heifers were included in the project. Twenty-nine were FTAIed and 30 were included in the natural service group. All heifers involved in this project were rectally palpated by a veterinarian to determine if they were cycling prior to inclusion. No heifers were found unsatisfactory for breeding.

At each location, heifers were randomly allocated to both the natural service groups and the FTAI groups.

The same FTAI protocol was employed at each location. On the first day of the protocol (Day 0) , animals received 2 mL of estradiol benzoate (Estradiol Benzoate 1 mg/ mL, Compounded by the Western College of Veterinary Medicine Pharmacy) intramuscularly and a progesterone-releasing vaginal implant (CIDR - Controlled Internal Drug Release, EAZI-BREED^{TM} CIDR®, Zoetis)containing 1.38 g of progesterone. On Day 7 the progesterone implant was removed and the animals were given 2 mL of cloprostenol (Estrumate® 500 µg/mL, Merck Animal Health) intramuscularly. On Day 9 , the animals were artificially inseminated (AIed) 54 to 56 hours following vaginal implant removal and 2cc of gonadotropin-releasing hormone (Cystorelin® 50 µg/mL, Merial) was administered intramuscularly. All intramuscular injections were administered in the neck muscle. Fixed-time artificial insemination took place on the following dates. Hanley – May 10; Elbow – July 3; And Parkbeg June 20, 2012.

At each location, bulls were turned out with the natural service groups on the same day that their contemporaries were AIed . Ten days following AI , all heifers in the FTAI groups were also turned out with bulls to facilitate breeding of any animals that were not pregnant as a result of the AI (clean-up)..

All animals were pregnancy tested following the breeding season during the fall of 2012. Although pregnancy testing does give us an indication of the success of our program it was more useful for determining overall pregnancy rate. Actual calving data was preferentially used to determine the success or failure of the FTAI program..Both pregnancy test data and calving data are provided below.

Through the calving data, we were be able to compare calving interval of both the natural service and synchronized groups and determine how many animals were pregnant to AI .

After weaning all calves were individually weighed. Weaning weights of the natural service group were compared to the FTAI group.

10. Results

Pregnancy Test Results – Elbow Location (Griffin Herd)

In the Griffin herd, 20of 20 (100%) of animals in the FTAI group were diagnosed as pregnant and 18of 20 (90%) of animals in the natural service group were diagnosed as pregnant.

Table 1.1 – Griffin Heifers (preg check on Nov. 14)

Months Pregnant	Synchronized Group	Natural Service Group
4 months	9	3
3.5 months	7	10
3 months	1	4
2.5 months	1	0
2 months	1	1
Open	0	2

Calving Data– Griffin Herd (Elbow Location)

In the Griffin herd, 20 heifers were part of the natural service group and 20 were part of theFTAI group. As seen in Table 1.2, 13 of 20(65%) of heifers in theFTAI group calved AI-sired calves.. In the first natural heat following FTAI, 5 of20 (25%) became pregnant as a result of natural service mating. It is apparent that no animals became pregnant at the second natural heat and the remaining 2 of 20or 10% heifers became pregnant at the third natural heat following FTA.

According to the calving distribution, the natural service group achieved 12of 20 (60%)pregnancy during the first 21 days of the breeding season; 4 of20 (20%)during the second 21 days; and 2 of20 (10%) of heifers became pregnant during the third 21-day period. Two of 20 (10%) percent of the heifers in the natural service group did not conceive and were open at the end of the breeding season.

Table 1.2 – Griffin Herd Calving Data

	Heifers Bred in Each Estrous Cycle (%)				Total Pregnant (%)
	Fixed Time AI Service	1st Natural heat	2nd Natural heat	3rd Natural heat	
FTAI Group	65	25	0	10	100
Natural Service Group	N/A	60	20	10	90

Note: Natural heats are assumed based on the number of days post-FTAI and assuming an approximate 21-day estrus cycle

Weaning Weights – Griffin Herd (Elbow Location)

Individual weaning weights were taken on all the progeny resulting from both breeding t groups. Table 1.3 shows that the FTAI heifers raised calves that weighed an average of 27 pounds more than calves that were born to heifers in the natural service group.

Table 1.3 Griffin Average Weaning Weights

	Average Weaning Weights (lbs)
FTAI Group	473
Natural Service Group	446

Pregnancy Test Resuts – Hicks Herd (Parkbeg Location)

The Hicks herd was pregnancy tested using ultrasound approximately one month following the breeding season. In the FTAI group, 28of 29 (96%) of animals in the FTAI group were diagnosed as pregnant and 27of 30 (90%) of animals in the natural service group were diagnosed as pregnant.

Table 2.1 – Hicks Heifers (preg check on Sept 17)

Days Pregnant	FTAI Group	Natural Service Group
80-90 days	15	1
70-80 days	3	4
60-70 days	3	9
50-60 days	4	8
40-50 days	3	2
30-40 days	0	1
Open	1	3

Calving Data – Hicks Herd (Parkbeg Location)

In the Hicks herd, 30 heifers were part of the natural service group and 29 were part of FTAI group. As seen in Table 2.2, 18 of 29 (62%) of heifers in the synchronized group became pregnant as a result of FTAI. Four of 29 (14%) became pregnant as a result of natural service mating at the first estrus post-FTAI with an additional 5 of 29 (17%) becoming pregnant during the second natural heat. No animals in the FTAI group became pregnant at the third and fourth natural heats. One animal did not carry her calf to full term. This animal was examined by ultrasonography and listed as being pregnant to the FTAI breeding, but did not deliver a calf. It is assumed that the pregnancy ended unexpectedly while on pasture.

According to the calving distribution, in the natural service group 12 of 30 (40%)became pregnant during the first 21-days of the breeding season; 10 of 30 (33%) during the second cycle and 4 of 30 (13%) during the third cycle.. Three of 30 (10%) of the natural service group heifers did not conceive and were open at the end of the breeding season.

Table 2.2 -- Hicks Percentage of Heifers Bred in Each Estrous Cycle

	Heifers Bred in Each Estrous Cycle (%)				Total Pregnant (%)
	Fixed Time AI Service	1st Natural Cycle	2nd Natural Cycle	3rd Natural Cycle	
FTAI Group	62	14	17	N/A	93
Natural Service Group	N/A	40	33	14	86

Note: Natural heats are assumed based on the number of days post-FTAI and assuming an approximate 21-day estrus cycle

Weaning Weight Results – Hicks Herd (Parkbeg Location)

Individual weaning weights were taken on all the progeny of the heifers in both the FTAI and the natural service groups. Table 2.3 shows that the synchronized group of heifers raised calves that weighed an average of 14 pounds more than calves that were born to heifers in the natural service group.

Table 2.3 Hicks Average Weaning Weights

	Average Weaning Weights (lbs)
FTAI Group	450.4
Natural Service Group	436.4

(Note: One heifer was removed from the natural service group because of a broken leg. This animal did not wean a calf.)

Pregnancy Test Results – Carpenter Herd (Hanley Location)

The Carpenter herd was not pregnancy checked until December 12, 2012. Due to the animals being very far along in pregnancy we were not able to have an indication of how many animals were bred in the first cycle. All animals in the FTAI group were pregnant while one animal in the natural service group was diagnosed as being open and not carrying a calf.

Calving Data – Carpenter Herd (Hanley Location)

In the Carpenter herd, 21 heifers were in the natural service group and 21 were in the FTAI group. As seen in Table 3.2, 16 of 21(76%) heifers in the synchronized group became pregnant as a result of FTAI. Five of 21 (24%)t became pregnant at the first natural heat following FTAI.

Calving dates of the natural service group were not recorded at this location. However, the co-operator did note that no calves were born as a result of breeding in the first natural cycle.

Table 3.2 – Carpenter Heifers Conception Rates

	Heifers Bred in Each Estrous Cycle (%)				Total Pregnant (%)
	Fixed Time AI Service	1st Natural Cycle	2nd Natural Cycle	3rd Natural Cycle	
FTAIGroup	76	24	0	0	100
Natural Service Group	N/A	0	N/A	N/A	95%

Weaning Weight Results – Carpenter Herd (Hanley Location)

Individual weaning weights were taken on all the progeny of the heifers in both the FTAI and the natural service groups. Table 3.3 shows that the FTAI group of heifers raised calves that weighed an average of 174 pounds more than calves that were born to heifers in the natural service group.

Table 3.3 Carpenter Average Weaning Weights

	Average Weaning Weights (lbs)
FTAI Group	695
Natural Service Group	521

Cost Analysis Estrus of Synchronization and Artificial Insemination versus Natural Service

After feed and yardage, cost of natural service breeding is one of the largest expenses realized by commercial cattle producers in Saskatchewan. As shown in Table 4, current estimates on the cost per calf of using a $4000 bull for four years of natural service breeding are $70.83.

Table 4 – Cost of Natural Service

Cost of Bull	$4000
Salvage Value	$1500
Depreciation	$2500
Yardage, Feed, Pasture/Year ($1000/year*4 years)	$4000
Death Loss (10%/year*4 years)	$1600
Vet Costs ($100/year * 4 years)	$400
Total Cost (4 years of service)	**$8500**
Number of calves sired	120
Natural Service Cost/Calf	**$70.83**

In comparison, estrus synchronization and artificial insemination (FTAI) costs for this project were $93.87 (See Table 5). This total cost included all drugs, implants, syringes, semen, technician costs and also a pro-rated clean-up bull costs. For this project, we assumed a 60% conception rate would be achieved through FTAI resulting in 40% of the animals requiring clean- up by natural service.
Based on this assumption, the pro-rated clean- up bull cost of was determined to $28.33/heifer for the FTAI group heifers . A producer labour charge was not calculated as the cooperating producers anecdotally reported that whatever labour was involved in the breeding process was saved at calving due to calves being born in a more concentrated timeframe. Total time involved in the synchronization and breeding process averaged one hour for each time animals were processed with a total of three hours per location..

Table 5 – Cost of Breakdown of Fixed-time Artificial Insemination Program on a Per Animal Basis

Estradiol Benzoate	$1.32
Progesterone Implant (CIDR)	$14
Prostaglandin (Estrumate®)	$4.93
Gonodotropin Releasing Hormone (GNRH) (Cystorelin®)	$4.29
Needles/Syringes etc.	$1
Semen	$25
Technician Cost	$15
Clean Up Bull Cost (40% * $70.83)	$28.33
Total Cost	**$93.87**

As shown in Table 6, two herds involved in the project experienced an economic benefit to the use of estrus synchronization and artificial insemination while one herd experienced a small loss. The Carpenter herd experienced an increase in net returns of $246 per animal, the Griffin herd experienced an increase in net return of $18.01 while the Hicks herd had a small loss in profit of $1.34 using FTAI. When averaged across the three herds involved in this project, a net gain in profit of $87.56 was experienced.

Table 6 – Economic Comparison

Herd	Weaning Weight Advantage (lbs)	Economic Advantage ($)	Additional Cost of AI Program ($)	Overall Profit ($)
Carpenter	174	269.7	23.04	246
Griffin	27	41.85	23.04	18.01
Hicks	14	21.7	23.04	-1.34
Average Profit Across Herds				**$87.56**

Weaning Weight Advantage = (Synchronized Group Average Weaning Weight – Natural Service Weaning Weight)
Economic Advantage = (Weaning Weight Advantage * Average Calf Price 2013 ($1.55/lb))
Additional Cost of AI Program = (Cost of Synchronization Program and AI (Table 5) – Cost of Natural Breeding Program (Table 4))
Overall Profit = (Economic Advantage – Additional Cost of AI Program)

Extension Activities

This project was discussed at Saskatchewan Ministry of Agriculture's Breeding for Profit – Heifer Development Workshops in Alameda on December 7th and Maple Creek on December 8th 2012. There were approximately twenty producers at each location. Excerpts of data from this project have also been highlighted in a newspaper article that was published in twelve Saskatchewan newspapers in January of 2013.

On June 25, 2013, details of this project were presented during seminars delivered by Dr. Colin Palmer, Travis Peardon and Colby Elford at the Western Beef Development Centre Field Day. Estimated attendance at those seminars was 100 people. Travis Peardon also presented highlights of this project at the Saskatchewan Beef Industry Conference held at the Saskatoon Inn, Jan. 23, 2014 with an estimated attendance of 250 people at that seminar.

The design and results of this project were also presented at Saskatchewan Ministry of Agriculture's Breeding For Profit Artificial Insemination Schools held in Yorkton on December 3, 2014 and in Saskatoon on February 2, 2014. There were ten people in attendance at each of these meetings.

This project is also featured in the Saskatchewan Stock Grower's Association Beef Business publication in March 2014.

11. Conclusions and Recommendations

Fixed-time artificial insemination has not been widely adopted by commercial, beef cattle producers in Saskatchewan. We believe this is in part due to myths surrounding this type of technology. Commonly held beliefs include too much labour involved, difficulty processing animals three times in nine days, synchronization protocols are too complicated, conception rates are marginal at best and also the economic benefit does not outweigh the costs involved.

Through this project we have learned that none of these myths are true. At each location, minimal time was involved in this project. A total of approximately three hours was dedicated at each location to running animals through chutes. As well, our producers all commented on how each time the animals came through the processing facilities it became easier. It is theorized that the animals learned the systems and became accustomed to handling. While the synchronization protocols involve three different drugs and a vaginal implant, it was not hard to follow. For this project each producer received a written protocol explaining what was necessary for each day of the project. No mistakes were made as a result. Typical industry expectations of this type of breeding system are conception rates between 40 and 60% with an average of 50%. The herds in this project had conception rates that exceeded these expectations with a

range from 62% to 76% with an average of 67%. This project also demonstrated that on average an economic benefit of $87.56 per head could be realized by the use of this technology. This is substantial as it did not require any more land or animals to substantially increase the revenue to these producers. Existing resources were simply maximized.
Fixed-time artificial insemination is a technology that should be adopted by commercial cattle producers to increase returns.

Supporting Information

12. Acknowledgements

This project has been discussed at several Saskatchewan Ministry of Agriculture meetings and has been the focus of several print articles. The ADOPT program was acknowledged during each presentation and article.

13. Appendices

Abstract

14. Abstract/Summary

Estrus synchronization and fixed-time artificial insemination has been in use on seedstock operations in Saskatchewan for several years. Key benefits of this technology have been access to superior genetics that would otherwise be unaffordable, the use of proven bulls with high accuracy expected progeny differences (EPD's), and a shortening of calving periods. The same benefits realized by the seedstock sector are also available to commercial producers. The aim of this ADOPT project was to demonstrate that these benefits can be realized by commercial cattle producers here in Saskatchewan.

At each of 3 locations throughout the province 40 to 60 heifers were identified for inclusion in the project. Half of the heifers were put into a natural service treatment group; the remaining animals were placed in a progesterone implant based estrus synchronization treatment group (Fixed-time artificial insemination, FTAI). The animals in the FTAI group were put through the chute a total of three times. Each producer selected the bull to be used for artificial insemination (AI) and the natural service heifers were bred to bulls owned by the respective producer. AI was performed by an experienced technician. Approximately 10 days after insemination the AI group heifers were turned in with a clean-up bull to breed any that did not become pregnant to the AI.

Conception rates to FTAI ranged from 62 to 76 percent with an average of 67 percent across all three herds. This exceeded current industry expectations of a range from 40 to 60% with an average of 50%.

A definite weaning weight advantage was evident for the FTAI treatments. This advantage ranged from 14 to 174 lbs with an average 72 pound advantage for the FTAI treatments. Using an average calf price for steers and heifers of $1.55 per pound (typical of 2013 fall prices), there is an average economic advantage of $112 dollars per calf. The total cost for FTAI during this project, including all drugs, semen, AI technician fee and clean up bull, was approximately $94 per heifer. This is approximately $23 more per calf than the cost of recent estimates of using a $4000 bull for natural service on heifers. Even when considering these costs, the FTAI treatment still showed an average economic advantage of approximately $88 a head over the natural service treatment.

Extension Activities

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