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FINAL REPORT

20120435

A CONTINUATION OF ESTRUS SYNCHRONIZATION AND ARTIFICIAL INSEMINATION IN COMMERCIAL BEEF PRODUCTION

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Project Identification

1. **Project Title:** A Continuation of Estrous Synchronization & Artificial Insemination in Commercial Beef Production

2. **Project Number:** 20120435

3. **Producer Group Sponsoring the Project:**
   Rudy Feeder Co-operative
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4. **Project Location(s):**
   Hanley, SK – Ivan and Lee Carpenter
   Elbow, SK – Brent and Karin Griffin
   Humboldt, SK – Shaun Stadnyk
   Kipling, SK – Jamie Husband
   Glenside, SK – Trevor Simonson

5. **Project start and end dates (month & year):**
   Project started in May 2013 and will be completed in November of 2014

6. **Project contact person & contact details:**
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Objectives and Rationale

7. **Project objectives:**
   The objective of this project was to directly compare estrus synchronization and artificial insemination with natural service breeding in both virgin heifers and mature cows.

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 periods, synchronization can shorten the breeding period to a matter of hours.

The objective of this project is to demonstrate the advantages of progesterone-implant based estrus synchronization protocols combined with artificial insemination (AI). 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 involved five different herds in total. One herd entered groups of both heifers and cows into the project. Two herds entered only groups of cows into the project while two herds entered only heifers. In total the project involved three groups of cows and three groups of heifers See description of protocols below.

Heifer Projects

This project was replicated in three commercial beef herds around the province. At each site approximately 40 to 60 replacement heifers were used in the comparison of estrus synchronization and AI versus natural service breeding. Prior to breeding, all heifers were rectally palpated by a veterinarian. Any heifers found unsatisfactory for breeding were culled from this demonstration. Half of the heifers were turned out with a bull for natural mating. The other half of the heifers were synchronized using a progesterone implant-based protocol and AIed. This synchronization program required animals to be processed three times in a nine day period. Bulls were placed with estrus synchronized and AIed heifers as a "clean-up" for any heifers that did not conceive as a result of artificial insemination.

Cow Projects

Two producer partners from the 2012 project (project # 20110343) expressed considerable interest in follow-up projects in mature cows with calves at foot. As a result, we worked with two producers from 2012 as well as the Simonson herd and repeated the project with mature beef cows at three locations.

Only cows that were least 40 days postpartum with calves at foot were included in this project. At each site, approximately 30-45 mature beef cows with calves were randomly selected from the main cow herd. These animals were synchronized using a progesterone implant-based protocol and AIed. Another group of mature beef cows were randomly chosen from the herd to be the control group which were bred by natural service.

In the spring of 2014, all animals involved in the projects had calving details recorded to determine conception rates, calving interval and intensity. At weaning time, calves from both AI and natural-service groups were weighed if possible.

Synchronization Protocol

The same Fixed Time Artificial Insemination (FTAI) protocol was employed at each location with a minor variation for cows versus heifers. 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 heifers 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. Cows were AIed 56 to 58 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. FTAI took place on the following dates. Kennedy (heifers) – May 1 ; Humboldt (heifers) – May 25; Glenside (Heifers) - July 5; Elbow (cows) – July 18; Glenside (cows) - July 18, 2013; and Hanley (cows) – July 31..

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 animals 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).

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 where facilities were available, calves were weighed. Weaning weights of the natural service group were compared to the FTAI group.

Results – Heifer Projects

Calving Data– Husband Herd (Kennedy Location)

In the Husband herd 31 heifers were part of the Natural Service Group and 28 were part of the FTAI Group. There were some unfortunate incidents at this location resulting in a slight disparity in the two groups. Some animals died and others were removed from the project as a result of escaping from their pasture for the bulk of the breeding season.

As seen in Table 1.1, 16 out of 28 heifers (57%) in the FTAI group calved to the AI sire. In the first natural heat following FTAI six out of the 28 heifers (21%) became pregnant as a result of natural service mating. There were no females that became pregnant during the second opportunity for natural service mating. After this, the bulls were pulled and therefore no females had the opportunity to be bred in the third natural heat following FTAI. This resulted in a high percentage of females exposed but not pregnant; 6 out of 28 or 21%.

According to the calving distribution data, the natural service group in the Husband herd achieved 13 out of 31(42%), heifers pregnant in the first 21 days of the breeding season. In the second cycle six more of the exposed heifers became pregnant (19%). After this the bulls were removed from the breeding field. This management resulted in 12 individuals in this group not becoming pregnant for an open rate of 39% (Table 1.1).

Table 1.1 – Husband Herd Calving Data

	Heifers Bred in Each Estrous Cycle (%)					Total Pregnant (%)
	Fixed Time AI Service	1st Natural heat	2nd Natural heat	3rd Natural heat	Non-Pregnant	
FTAI Group	57	21	0	0	21	82
Natural Service Group	N/A	42	19	0	39	61

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

Weaning Weights – Husband Herd (Kennedy Location)

Individual weaning weights were taken on all the progeny resulting from both breeding groups. Table 1.2 shows that the FTAI heifers raised calves that weighed an average of 40 pounds more than calves that were born to heifers in the natural service group.

Table 1.2 Husband Average Weaning Weights

	Adjusted Average Weaning Weights (lbs)
FTAI Group	631
Natural Service Group	591

Note: The actual weights were not taken on the same day so the averages have been adjusted to reflect average daily gain.

Calving Data– Stadnyk Herd (Humboldt Location)

In the Stadnyk herd, 20 heifers were part of the natural service group and 20 were part of the FTAI group.

The producer reported that 6 of 20 (30%) of animals in the FTAI group conceived to FTAI. Due to the lack of success, the producer was unwilling to provide anymore results. He was contacted several times but chose to not provide information requested.

Table 2.1 – Stadnyk Herd Calving Data

	Heifers Bred in Each Estrus Cycle (%)					Total Pregnant (%)
	Fixed Time AI Service	1st Natural heat	2nd Natural heat	3rd Natural heat	Non-Pregnant	
FTAI Group	30	N/A	N/A	N/A	N/A	N/A
Natural Service Group	N/A	N/A	N/A	N/A	N/A	N/A

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

Weaning Weights – Stadnyk Herd (Humboldt Location)

Individual weaning weights were not taken in the Stadnyk herd. The producer felt the data would not show much difference since conception to AI was very poor.

Calving Data– Simonson Herd (Glenside Location)

In the Simonson herd, 26 heifers were part of the natural service group and 23 were part of the FTAI group. As seen in Table 3.1, 11 of 26 (42%) of heifers in the FTAI group calved AI-sired calves. In the first natural heat following FTAI, 5 of 26 (19%) became pregnant as a result of natural service mating. In the second natural heat following AI, one of 26 (4%) became pregnant as a result of natural service mating and the remaining 7 of 26 (27%) heifers became pregnant at the third natural heat following FTAI. Two of 26 (8%) remained open at the end of the breeding season.

According to the calving distribution, the natural service group achieved 12 of 23 (52%) pregnant during the first 21 days of the breeding season; 3 of 23 (13%)during the second 21 days; and 3 of 23 (13%) of heifers became pregnant during the third 21-day period. Five of 23 (22%) percent of the heifers in the natural service group did not conceive and were open at the end of the breeding season.

Table 3.1 – Simonson Herd Calving Data

	Heifers Bred in Each Estrus Cycle (%)					Total Pregnant (%)
	Fixed Time AI Service	1st Natural heat	2nd Natural heat	3rd Natural heat	Non-Pregnant	
FTAI Group	42	19	4	27	8	92
Natural Service Group	N/A	52	13	13	22	78

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

Weaning Weights – Simonson Herd (Glenside Location)

Individual weaning weights were taken on all the progeny resulting from both breeding groups. Table 3.2 shows that the FTAI heifers raised calves that weighed an average of 29 pounds more than calves that were born to heifers in the natural service group.

Table 3.2 Simonson Average Weaning Weights

	Average Weaning Weights (lbs)
FTAI Group	498.4
Natural Service Group	469.4

Results – Cow Projects

Calving Data– Simonson Herd (Glenside Location)

In the Simonson herd, 26 cows were part of the natural service group and 26 were part of the FTAI group. As seen in Table 4.1, 11 of 26 (42%) of cows in the FTAI group calved AI-sired calves. In the first natural heat following FTAI, 4 of 26 (15%) became pregnant as a result of natural service mating. Four of 26 (15%) became pregnant in the second natural heat following FTAI while 3 of 26 (12%) became pregnant in the third natural heat following FTAI. Four of 26 (15%) were open at the end of the breeding season.

According to the calving distribution, the natural service group achieved 13 of 26 (50%) pregnancy during the first 21 days of the breeding season; 6 of 26 (23%) during the second 21 days; and 4 of 26 (15%) of heifers became pregnant during the third 21-day period. Three of 26 (11%) percent of the cows in the natural service group did not conceive and were open at the end of the breeding season.

Table 4.1 – Simonson Herd Calving Data

	Cows Bred in Each Estrous Cycle (%)					Total Pregnant (%)
	Fixed Time AI Service	1st Natural heat	2nd Natural heat	3rd Natural heat	Non-Pregnant	
FTAI Group	42	15	15	12	15	84
Natural Service Group	N/A	50	23	15	11	88

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

Weaning Weights – Simonson Herd (Glenside Location)

Individual weaning weights were not available on the Simonson herd. Calves were weaned on pasture and taken direct to market.

Calving Data– Griffin Herd (Elbow Location)

In the Griffin herd, 30 cows were part of the natural service group and 45 were part of the FTAI group. As seen in Table 5.1, 27 of 45 (60%) of cows in the FTAI group calved AI-sired calves. Due to bull problems, no other animals in this group became pregnant during the breeding season. Eighteen of 45 cows remained open at the end of the breeding season.

According to the calving distribution, the natural service group achieved 15 of 30 (50%) pregnancy during the first 21 days of the breeding season; 7 of 30 (23%) during the second 21 days; and 8 of 30 (35%) of cows became pregnant during the third 21-day period.

Table 5.1 – 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	Non-Pregnant	
FTAI Group	60	0	0	0	40	60
Natural Service Group	N/A	50	23	35	0	100

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 not taken on the Griffin herd. There was no method available to weigh calves at weaning. As well, due to the bull problems which resulted in a high open rate in the treatment group it was determined that calf weights would not provide any meaningful data.

Calving Data– Carpenter Herd (Hanley Location)

In the Carpenter herd 46 cows were reported as being in the Natural Service Group and 30 were part of the Fixed Time Artificial Insemination (FTAI) Group

As seen in table 6.1, 22 of 29 (76%) of the cows exposed to FTAI became pregnant to the AI sire. The remaining seven animals (24%) became pregnant in their 1st natural heat following the AI service. In this group there were no non-pregnant animals to report.

The calving distribution data for the Natural Service Group includes 46 cows that were bred in the first and second cycles of the breeding season. In this group, 27 of 46 (59 %) were bred on the 1st natural heat, while 19 out of 46 (41%) were bred during the second cycle (table 6.1

Table 6.1 – Carpenter Cow Herd Calving Data

	Heifers Bred in Each Estrous Cycle (%)					Total Pregnant (%)
	Fixed Time AI Service	1st Natural heat	2nd Natural heat	3rd Natural heat	Non-Pregnant	
FTAI Group	76	24	0	0	0	100
Natural Service Group	N/A	59	41	0	0	100

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

Weaning Weights – Carpenter Cow Herd (Hanley Location)

Individual weights were taken on all the progeny resulting from both breeding groups. Table 6.2 shows that the cows in the FTAI group raised calves that weighed an average of 58 pounds more than calves that were born to cows in the natural service group.

Table 6.2 Carpenter Average Weaning Weights

	Average Calf Weights (lbs)
FTAI Group	679
Natural Service Group	621

Note: Although both groups were weighed on the same day, the herds were not weighed at weaning.

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 7 current estimates on the cost per calf of using a $4000 bull for four years of natural service breeding are $70.83.

Table 7 – 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 $100.11 (table 8). This total cost included all drugs, implants, syringes, semen, technician costs and also a pro-rated clean-up bull cost. To determine pro-rated clean-up costs we calculated the average conception rate to FTAI, in this case, 51.2% which leaves 48.8% to be serviced by the clean-up sire through natural service. Based on these calculations, the pro-rated clean-up bull cost of was determined to be $34.57 per animal for the FTAI groups. 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 8 – Cost of Breakdown of Fixed-time Artificial Insemination Program on a Per Animal Basis

Estradiol Benzoate	$1.32
Progesterone Implant (CIDR)	$14.00
Prostaglandin (Estrumate®)	$4.93
Gonodotropin Releasing Hormone (GNRH) (Cystorelin®)	$4.29
Needles/Syringes etc.	$1.00
Semen	$25.00
Technician Cost	$15.00
Clean Up Bull Cost (48.8% * $70.83)	$34.57
Total Cost	**$100.11**

Note: In this project, across herds an average of 51.2% of animals became pregnant to FTAI, leaving 48.8% to become pregnant to the clean-up bull. Individual results will vary.

As seen in table 9, three herds were unable to weigh their calves at weaning. The three herds that did weigh their calves reported higher weaning weights from calves that were in the FTAI group over calves from the natural service group. On average across herds, calves born to animals in the FTAI group were 42 pounds heavier than calves in the Natural Service group. The average calf price in Saskatchewan for the second week in November 2014 was used to estimate a value of the increase in calf weight. At this time the average calf price was $2.68/lb. Using these numbers we calculated an average economic advantage, or net gain, of $84.68 after the additional costs of FTAI are removed.

Table 9 – Economic Comparison

Herd	Weaning Weight Advantage (lbs)	Economic Advantage ($)	Additional Cost of AI Program ($)	Overall Profit ($)
Husband	40	107.60	29.28	78.32
Stadnyk	N/A	N/A	29.28	N/A
Simonson Hfrs	29	78.01	29.28	48.73
Simonson Cows	N/A	N/A	29.28	N/A
Griffin	N/A	N/A	29.28	N/A
Carpenter	58	156.02	29.28	127.00
Average Profit Across Herds				**$84.68**

Weaning Weight Advantage = (Synchronized Group Average Weaning Weight – Natural Service Weaning Weight)
Economic Advantage = (Weaning Weight Advantage * Average Calf Price November 2014 ($2.68/lb))
Additional Cost of AI Program = (Cost of Synchronization Program and AI (Table 8) – Cost of Natural Breeding Program (Table 7))
Overall Profit = (Economic Advantage – Additional Cost of AI Program)
Note: The herds that were less successful in their FTAI program were less likely to report results. The data available was used to calculate averages. If all herds that participated had submitted weaning weights, there is a strong possibility that the economic advantage would be lower.

10. Conclusions and Recommendations

Many beef producing countries have adopted artificial insemination as a practical and efficient method for breeding large groups of commercial animals. In western Canada and Saskatchewan in particular, artificial insemination has been mainly reserved to purebred producers who want access to better and better genetics without having to purchase a high priced bull. With cattle prices rising and optimism in the commercial cattle business, it makes sense that commercial cattle producers also take advantage of those proven genetics at a time when there will almost surely be an economic benefit.

As with most worthwhile and profitable endeavours, using FTAI on commercial herds requires a change and a commitment to increased management. Many producers, including several involved in this project were unfamiliar with the idea of synchronization. Most producers are apprehensive of the increased management required to achieve success with this practice. The synchronization protocols, which involve three different drugs and a vaginal implant, initially seemed daunting on paper but the producers quickly found that they were not hard to follow.

This project took place on working ranches where things often do not go as planned, and changes are made all the time. As a result we were not able to collect all of the data that we had planned. Of the data that was available we saw an average conception rate of 51.2% to FTAI. Although we had hoped for better, this is typical of an industry average of 50% conception. Conception rates to FTAI in this project ranged from 30% to 76%. We found that those producers who heavily invested in the management of their animals had better results.

Typically in Saskatchewan calves are sold as weanlings in the fall. Therefore weaning weight was used as an attempt to determine the economic advantage to FTAI. For the herds that submitted weaning weight data we saw an economic advantage of $84.68 per head for animals that were in the FTAI group. This was calculated using average November calf prices and removing the additional costs associated with FTAI.

This substantial increase in revenue per animal did not require an increase in land or animals to the producers operation. In this project we demonstrated how existing resources can be maximized to increase profit on a typical Saskatchewan operation. Fixed time artificial insemination is a viable option for Saskatchewan commercial cattle producers.

Extension Activities

This project was discussed at Saskatchewan Ministry of Agriculture's Bull Selection Workshops held in Moose Jaw on Feb. 12, 2014 and Saskatoon on Feb. 13, 2014. Approximately 40 people were in attendance at each meeting. It was also presented at the Breeding for Profit – Introduction to Artificial Insemination workshop held in Saskatoon Jan 30, 2014 and Feb. 2, 2015. Approximately 15 people were in attendance at each of these meetings.

This project will be highlighted at extension events organized by Ministry of Agriculture Livestock Specialists in the coming year. As well, it will be featured in print articles.

Supporting Information

11. Acknowledgements

This project has been discussed at several Saskatchewan Ministry of Agriculture meetings in the past year. The ADOPT program was acknowledged during each presentation.

12. Appendices

Abstract

13. 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.

This project involved five different herds in total. One herd entered groups of both heifers and cows into the project. Two herds entered only groups of cows into the project while two herds entered only heifers. In total the project involved three groups of cows and three groups of heifers

Half of the animals 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 animals were bred to bulls owned by the respective producer. AI was performed by an experienced technician. Approximately 10 days after insemination the AI group animals 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 30 to 76 % with an average of 51 % across all three herds. This fell within 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 29 to 58 lbs with an average 42 pound advantage for the FTAI treatments. Using an average calf price for steers and heifers of $2.68 per pound (typical of 2014 fall prices), there is an average economic advantage of $84.68 dollars per calf. The total cost for FTAI during this project, including all drugs, semen, AI technician fee and clean up bull, was approximately $100.11 per animal. This is approximately $29.28 more per calf than the cost of recent estimates of using a $4000 bull for natural service. Even when considering these costs, the FTAI treatment still showed an average economic advantage of approximately $84.68 a head over the natural service treatment.
