# Department of Agriculture, Trade and Consumer Protection
# Division of Agricultural Development
# Agricultural Development & Diversification Program (ADD)
# Grant Project Final Report

Contract Number: **17059**

Grant Project Title: **Turning Cull Cows into Cash Cows - Combining In Vitro Embyro Production and Sexed Semen Technologies to Enhance the Profitability of Wisconsin's Top Dairy Farmers**

Project Beginning Date: **July 1, 2002** Project End Date: **June 30, 2003**

Amount of Funding Awarded: **$20,000**

Name of Principal Contact Person: **Kent Weigel, UW-Madison Department of Dairy Science**

Address: **1675 Observatory Drive, Madison, WI 53706**

Telephone: **608-263-4321** Fax Number: **608-263-9412**

E-Mail Address: **weigel@calshp.cals.wisc.edu**

WEB Address: **www.wisc.edu/dysci**

Report Submitted on: **July 22, 2003**

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Please use the following questions as a guide for writing your grant project final report. In your final report, please answer each question as it relates to your grant project.

1) What did you want to accomplish with the grant?

Our objective was to enhance the development of new products and services based on sexed semen and/or in vitro embryo production (IVP) within the Wisconsin (WI) dairy genetics industry. Technology for artificial insemination (AI) is more than 40 years old, and commercial AI companies (four of the five largest US AI companies are located in WI) have offered essentially the same product for several decades. As a result of this "mature market", prices have been driven extremely low, and achieving growth or profitability is a challenge. At the same time, high replacement heifer prices, in conjunction with low milk prices, have stifled expansion of the WI dairy industry. We sought to demonstrate that sexed semen technology could be used to alter the sex ratio on WI dairy farms, thereby enhancing the availability of high quality replacement heifers in this state.

2) What steps did you take to reach your goal?

Our approach was as follows. Seven commercial dairies in WI were enrolled, including farms operated by: Crave (Waterloo), Larson (Evansville), Keller (Mt. Horeb), Rickert (Eldorado), Ruedinger (Van Dyne), Zwald (Baldwin), and Holterman (Watertown). From August 2002 through June 2003, these farms identified high genetic merit cull cows that (despite their usefulness as potential parents of the next generation) were forced to leave the herd due to illness, injury, or infertility. In total, 88 "donor cows" were slaughtered at Batlar Enterprises in Sun Prairie, and their ovaries were transported to BOMED, Inc. for IVP with sexed semen. From these donors, 344 transferable (fresh) embryos were produced. A total of 238 embryos were transferred back into recipient cows and heifers on the same farms, and the resulting conception rates for transferred embryos were 40% with virgin heifer recipients and 18% with milking cow recipients. As of today, eleven calves from this project have been born on the cooperating farms, and all have been female. The graduate student who was supported by this ADD grant presented these results at the American Dairy Science Association Annual Meeting in Phoenix, and the principal investigator presented an invited paper at the same meeting entitled "It's a girl! Exploring the impact of sexed semen on dairy cattle improvement programs". In the latter, three novel breeding programs that rely on sexed semen (with or without IVP) were presented to applied dairy scientists and industry workers. In addition, we hosted an (extremely popular)

exhibit at Farm Technology Days in which we presented the results of our study and displayed three full-sibling heifer calves resulting from the project.

- What worked?

  Timing of the program, with respect to the cooperator farms, the slaughterhouse, and the IVP laboratory worked very well. In other words, we timed the collection of ovaries from donor cows and subsequent development and transfer of embryos to match the heat synchronization protocol of each herd. In this manner, the program was implemented nearly "seamlessly" with respect to the management of these herds. In addition, collaboration with the commercial slaughter plant (Batlar Enterprises) was quite good, as was our collaboration with the IVP laboratory (BOMED, Inc.). Donor cows produced more oocytes than expected, and the number of fertilized ova and transferable embryos (3.8 per donor) met or exceeded expectations. Lastly, "buy-in" of the cooperating farms was quite good, as only two of the seven herds (one of which was a "late entry" anyway) withdrew from the program prior to completion.

- What did not work?

  Four "limitations" surfaced in our project. First (and least important), we initially tried to obtain the ovaries from our "donor" cows surgically (via ovariectomy) while these animals were still alive. One of the first cows died due to complications from the surgery, and because most of these cows were to be sent to slaughter relatively soon anyway, we chose to obtain the ovaries after the cows were slaughtered instead. This strategy worked very well throughout the rest of the study. Second, conception rates with transferred IVP embryos were lower than expected, particularly when milking cows were used as recipients. We anticipated conception rates of 30-35%, but we achieved only 18% in practice due to the "stress" (on the embryo) of being produced in vitro using semen that was sometimes damaged during the staining and sorting process. However, conception rates in virgin heifer recipients were acceptable (40%). Third, "large calf syndrome", a developmental problem that was once quite common with IVP calves (but is largely controlled with new culture media), is still a concern with virgin heifer recipients. One of the first recipient heifers had an abnormally large calf, and both the calf and recipient died. Fourth, the amount of variation in embryo production (between donors) was difficult to manage. Although 344 embryos were produced, only 238 were transferred, due to a lack of recipient heifers (for fresh embryos) and unwillingness among the cooperator farms to accept embryos from donor cows other than their own.

- What would you do differently?

  This program is "close" to working in practice, but a few minor modifications will be needed. Most importantly, the group of cooperator farms must be chosen very carefully. Five to ten herds are needed, and each must be willing to share both donor cows (i.e., ovaries or oocytes) and the resulting embryos. Donor cows from all farms should be slaughtered on the same day, thereby enhancing the efficiency of ovary collection (at the slaughterhouse) and embryo production (at the IVP laboratory), as well as minimizing or "averaging out" variation between donors in the number of transferable embryos produced. Far too many viable embryos were thrown away in our study due to a lack of recipients, and this could be managed easily in practice using the aforementioned strategy (many of our cooperator farms were "too interested" in genetics, such that they didn't want embryos from the other farms). In the future, transferring female IVP embryos into milking cows should probably be avoided, because conception rates in these cows with conventional AI or embryo transfer are already quite low.

3) What were you able to accomplish?

   Our biggest accomplishment was to increase awareness of the potential of sexed semen and/or IVP as a truly legitimate or practical strategy within dairy cattle breeding. Prior to our study, many had considered these technologies to be "far away", costly, infeasible in practice, and so on. We

demonstrated that female embryos and, hence, heifer calves could be produced in a cost-effective manner using these technologies. This study and the resulting scientific presentations and Farm Technology Days exhibit generated quite a lot of interest in this topic among dairy producers and industry decision-makers. I think it is safe to say that our efforts will help to speed-up the commercialization of sexed semen in WI and the US as a whole.

4) What challenges did you face?

The aforementioned challenges with availability of recipients can be managed by sharing donor cows and embryos across farms. Likewise, the problem of low conception rates can be corrected by using only heifers as recipients. Large calf syndrome, though rare, will continue to be a concern, because the economic loss associated with one dead recipient heifer can offset the economic gains from several extra heifer calves. An additional challenge, in practice, will be finding commercial abattoirs (slaughterhouses) that will allow technical personnel "on the kill floor". We were fortunate to find such a cooperator in our study, but this could be a challenge for routine, large-scale implementations of these technologies. Lastly, the use of "known donors" (donor cows selected by the producers) decreases the efficiency of embryo production, because of the need to keep ova and embryos from each donor separate throughout the IVP and transfer processes.

5) What do you plan to do in the future as a result of this project?

We will embark on a large follow-up project this fall. In this project, ovaries from "anonymous donors" (i.e., any old Holstein cow) will be obtained from a large commercial abattoir, and the oocytes will subsequently be fertilized in vitro with sexed semen. The resulting embryos will be transferred into beef cows and heifers, rather than dairy recipients. In fact, the cooperator herd in this project expects to have 450 beef recipients available, and through heat synchronization and the seasonal nature of beef production, we can transfer a very large number of embryos very efficiently over a three- to six-week period. Other advantages of this "modified protocol" include: higher conception rates (beef cows and heifers are more fertile than their dairy counterparts) and fewer calving problems (beef cows and heifers also have less dystocia or calving difficulty). In this manner, we hope to demonstrate the potential of sexed semen and IVP in generating additional income for commercial beef producers via production of extra dairy replacement heifers.

6) How should the agricultural industry or the State of Wisconsin use the results from your grant project?

These technologies have great potential for enhancing the economic well-being of dairy farmers, as well as that of commercial AI companies and IVP laboratories in this state. The State of Wisconsin can further enhance commercialization of these technologies by promoting capital investment and by encouraging public/private joint ventures that will speed-up the transition from "dream" to commercial reality. Furthermore, the State could cooperate in programs that would make these technologies available only to WI dairy producers. For example, one could envision a public/private partnership in which the State (or perhaps an entity such as the WI Milk Marketing Board) subsidizes investment by WI-based AI companies in semen sorting machines and commercial licenses to use this technology. In return, the license could be written such that the resulting sexed semen can only be used to inseminate animals (e.g., via professional technicians) within the boundaries of the State of Wisconsin. In this manner, WI dairy producers would have a competitive advantage, and this would fuel growth of the dairy industry in this state.