

Galloping Towards a Fertile Future

Horses have provided us with transportation, ploughed our fields, carried our heavy loads, and now equine reproduction research has shown that horses may again help humans – in a totally new way.



Home to about 35% of Canada's horses, Alberta is a major player in the world of horse production. "The main occupation for a horse in Western Canada is as a broodmare, whether this is for the production of estrogen for medicine or the production of performance horses that are seen at Spruce Meadows or the Calgary Stampede," Dr. Claire Card explains. And through her advanced research on assisted reproduction in horses, Card is on the cutting edge of this industry.

A Professor at the Western College of Veterinary Medicine (WCVM) in Saskatoon, Card is interested in reproduction of many species but has a special interest, and a diverse background of research experience, in reproduction of horses. Her work on assisted reproduction – largely funded by the members of the Alberta Agriculture Funding Consortium – has two main areas of investigation: frozen semen and embryo transfer.

"We are the first group to look at how hormonal manipulation affects ovarian and uterine tissues and examine if that can help us predict many things, including whether a horse is going to have a fertile ovulation, when she is going to ovulate, and if the uterus is healthy or diseased," says Card. For this research, advanced techniques are used involving computer-assisted ultrasound image analysis. Because a computer can identify 256 shades of grey vs. only 8-12 with the human eye, more information is obtained from the ultrasound images by digitizing and then analyzing selected areas of reproductive tissues such as the uterus or ovaries. Changes in the pixel elements, which are the building blocks of the ultrasound image, are evaluated in the reproductive tissues and related back to hormonal levels and physiological events.

"Findings show ultrasound image analysis to be a very useful tool in breeding management. We can now make specific recommendations for individuals working in reproductive management, specifically in hormonal manipulation, based on these studies," explains Card. Hormonal manipulation involves injecting hormones to induce the egg to leave the ovary, thus actually shortening the period when the mare is receptive from a natural six-day cycle to a two-day cycle.

Different treatments affect the amount of estrogen the mares produce. Estrogen is the main steroid hormone that initiates the softening of the ovarian and uterine tissues and accumulation of mucus in these tissues. "Understanding this physiology and how the treatments affect it can aid in sorting out which mares are and aren't responding to the treatment, so that we can optimize their ability to conceive," says Card.

When using assisted reproduction, such as breeding mares with cooled, transported semen, using on-farm artificial insemination, or using frozen semen, shortening the estrous period has definite benefits. "With a short window of two vs. six days you are more likely to have 85-90% of the mares

responding when they are treated and insemination may be timed to increase the chance of conception. Pinpointing ovulation with a natural cycle is much more labour intensive, requires many more examinations, and can be much more expensive for the producer," says Card.

Spreading the Seed

Unlike cattle, achieving conception in mares using frozen semen has incredibly low success rates. Card's work with frozen semen is moving towards discovering why the pregnancy rates are lower when using frozen semen vs. cooled semen (which can survive for about 48 hours). Frozen semen can have a success rate of somewhere between 20-40% while cooled boosts this rate up to around 50-55% (only about a 5% difference than on-farm conception). Cooled semen offers tremendous economic benefits to producers because it allows them to access genetics from all over the country without having to truck their mares to conceive on-farm. "Improving the pregnancy rates with frozen semen offers even more benefits to the breeding industry as this semen is viable in perpetuity, allowing genetics to be preserved for hundreds of years," explains Card.

"Since the horse sperm cell is much smaller than in bulls and boars, the protocols for these animals are simply not suitable for horses," says Card. In her search for discovering new ways to keep the little swimmers viable, Card has been examining two cryopreservatives, the standard glycerol, and a relatively new preservative, dimethylformamide.

Card's research in frozen semen has become even more critical to the breeding industry: both the American Quarter Horse Association and the American Paint Horse Association, which comprise the bulk of the horse population, recently approved frozen semen. These changes to the guidelines of the breed associations now make it possible to register a foal conceived using artificial insemination.

Perpetuating Greatness

The American Quarter Horse Association has also decided that, in the future, breeders will not be restricted to registering only one foal from embryo transfer per mare per year. "You might have had one of the top 10 mares in North America for cutting or reining and previously you would only have been able to register her natural foal and one foal from embryo transfer. Because their pregnancy is so long (11 months), having 10 foals in a mare's



Research at the WCVM is solving reproduction riddles in the equine industry with far-reaching implications.

lifetime is pretty exceptional. That exceptional mare's impact on the breed is pretty minimized," Card explains. The change means Card's work will have even more impact.

Current methods of embryo transfer are very inefficient, especially since only half of the good embryos transferred result in a pregnancy. Since there are no commercial agents that induce ovarian super stimulation, Card is investigating the use of equine follicle stimulating hormone (a product being developed commercially) as a means of getting more than a single embryo per recovery. "This hormone has shown to increase the number of embryo recoveries to 10-15 per year from about five, basically doubling the number of foals. It is a much more affordable alternative and it allows exceptional mares to make a bigger impact on their breed," says Card.

Horses Helping Humans

This research offers tremendous benefits for the horse breeding industry, which plays such an important role in Alberta's economy. "We are looking to devise methods that are easier and more affordable for the producers. By looking at enough horses, using these different assisted reproduction techniques, we can stay on the cutting edge of this new technology and help them develop the most effective protocols for use," says Card.

Not only does Card recognize the benefits for the horse industry, but she also sees this research as a very important opportunity to use as a model for human health issues. "Most human reproductive technology, such as artificial insemination and super ovulation, was first pioneered with cattle

Did you know?

Alberta is home to 35% of Canada's equine population.

This year Spruce Meadows was voted to be the number one show jumping venue in the world.

Each year, the Calgary Stampede draws about 1.2 million people and generates about \$150 million dollars in tourism to the Alberta economy.

There are more horse owners in Canada (approximately 110,000) than beef cattle owners (about 100,000).

and horses," explains Card. "We are also noticing similarities between the problems that can occur in mares and humans when their ovaries are over-stimulated. We can now investigate further into why this is happening to mares, and try to devise methods to carry the findings over to help humans." Some of her work also holds tremendous potential for humans by detecting genetic defects that are carried on certain chromosomes, with the possibility of avoiding these problems.

The support of the Funding Consortium is significant for Card, who recognizes that funding for equine research is hard to come by. Ultimately, Card hopes to see improvements to both horse and human health as a result of her research, bringing literal meaning to the age-old adage: "healthy as a horse"! **r&d**