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Sustainability: It's not new and it's here to stay!

Authored by Jeremy Daubert, Extension Agent—ANR, Dairy, Rockingham County, Virginia Cooperative Extension; jdaubert@vt.edu

Sustainability can mean different things depending on the situation and perspective. Webster defines sustainability as "a method of harvesting or using a resource so that the resource is not depleted or permanently damaged". Farms today have made great strides in sustainability compared to the days of the dust bowl. Much of this progress has come as farmers' awareness has grown about how their practices affect others and the future effects of what they do today. Additionally, technology has made it easier to preserve soil and conserve water resources.

In a poll done by American Farm Bureau most people have a positive view of farmers' sustainability practices and 88% of respondents say that they trust farmers. In addition, there are many farmers utilizing social media channels to show the general public what they are doing daily to conserve resources and produce food. This is positive news for farmers who are weary of being in the public eye. Maintaining a positive image is important for farms. This doesn't mean that farms should do things exactly the same tomorrow as they did yesterday. As the population grows there is continued pressure to grow more food with less—or at least the same—resources.

I believe that dairy farmers are up to the task. Milk production per cow has doubled in the last 50 years and will likely go over 24,000 pound of milk per cow in 2022. From a sustainability point of view, this means that less cows are needed to make the same amount of milk. These great strides have come due to increased genetic ability, better forages, and better cow management. Some people ask what is possible? Can we continue to increase production at the rate we have been? There doesn't seem to be much slowing it down at this point and all signs point to continued increases in per cow production. The really exciting news is that cows have also increased component levels and productive life, making each cow more sustainable.

There is a lot of public and political interest in sustainability and in the next 10 years there will be an unprecedented amount of research and public money available to develop new technologies to make farming produce more with less. Recently the U.S Department of Agriculture announced $2.8 billion in funding for 70 "climate-smart" projects. Many farms will benefit from these projects in the next few years. The intent is to make farms more resilient and sustainable.

There is interest from farms to capitalize on carbon markets. There are many startup companies exploring carbon markets where farms that are capturing carbon can sell these "carbon credits" to companies who may be emitting carbon. To date, these markets have been sparse, inconsistent, and unreliable. But, as interest increases there may be good opportunities for farms to become involved. There is currently as least one company paying farms per cow to reduce enteric methane emissions. There are other companies offering to pay a per acre or per ton of carbon sequestered incentive. At this point, it is worth your time to keep good records of practices such as cover crop acreage so that you have a solid baseline of when these markets may be more lucrative. More research will go into quantifying different management practices that could reduce carbon secretion or absorb carbon. Be ready when the opportunity comes to capitalize on these markets in the future.

Will there be a day in the future when we find equilibrium? Only if the population does not grow and every person on earth is fed a healthy diet. I do not see this happening in my lifetime and probably not in my children's lifetime. So that means farmers will need to continue to become more efficient and more sustainable.

There will most likely be new technologies and more precise management techniques available in the future that will keep farms sustainable. While sustainability may seem like a moving target, it is a target that farms must continue to chase. You are probably not farming exactly like your parents and grandparents did; your children and grandchildren will not be farming the same as you do today—and that is ok! Sustainability today just means that your great-grandchildren will still be able to farm, albeit much differently than you do.

Can changes to your FSH stimulation protocol improve embryo outcomes?

Authored by John McGehee, M.S. student with Dr. Rebecca Cockrum, Assistant Professor, Dairy Genetics; School of Animal Sciences, Virginia Tech; rcockrum@vt.edu

Embryo transfer is an assisted reproductive technology that has been around for a few decades now and is utilized by many animal production industries. For the year 2020, the International Embryo Transfer Society reported that more than 1.5 million embryos were collected and over 1.1 million were transferred in cattle alone. While there have certainly been many advances in this field within both human and animal procedures, there continues to be room for improvement. One such area, for cattle, is the usage and optimization of superstimulation protocols that utilize the injection of exogenous follicle-stimulating hormone (FSH). In the cattle industry, the scheme for FSH injections will vary amongst practitioners and even its usage is optional in the case of ovum pick up (OPU) collections. Therefore, this article will look at aspects of the embryo production procedures such as the duration of FSH supplementation and the "coasting" period following supplementation as a way of improving embryo quality and numbers.

Embryo transfer is a tool that can help improve the genetic progress of a herd, by increasing selection intensity and decreasing generation interval. Embryos are produced via one of two methods; either they are collected from females that have been superovulated, inseminated, and flushed (multiple ovulation embryo transfer,

MOET), or the oocytes are collected using OPU and the embryos are produced in a lab (in vitro production, IVP). One of the major barriers to the more widespread use of this technology continues to be the cost per embryo. A MOET embryo cost ~$150 and OPU-IVP embryos $200-$250. This is one of the reasons that we seek to get as many high-quality, viable embryos from each collection procedure as possible hence the use of exogenous FSH.

During a follicular wave, a group of follicles is recruited for growth following a surge of FSH. A dominate follicle will emerge from this group and hormonal feedback will cause the other follicles to undergo atresia while the dominant follicle and oocyte continue to develop. During natural ovulation, the dominant follicle will rupture due to increasing LH surges and release the oocyte. Supplementation of FSH beyond this initial peak however will cause the smaller, non-dominant follicles to continue to grow and become co-dominant. In the case of MOET, FSH supplementation is essential as it is the only way to ensure that multiple follicles will be mature enough to respond to LH and release an oocyte. In OPU-IVP procedures, stimulation is not necessary as smaller follicles can be aspirated and matured, however, it is helpful particularly in *Bos taurus* as it does increase the follicle size, population number and improve embryo development rates. One trade-off the lack of superstimulation in OPU procedures has is the ability to be performed more often, which ultimately results in more embryos per week, however this only remains true if collections do occur 2-3 times per week.

The duration of FSH stimulation is a very important factor. An injection scheme will often start 48 hours after the removal of the dominant follicle and follicles that may become dominant (follicles >4mm). This timeline is due to the peak of endogenous FSH occurring approximately 36 hours after the removal of the dominant follicle. The injections are administered at 12-hour intervals, a timeline that can often lead to compliance issues. The duration varies depending on the procedure MOET typically requires supplementation for 4 days while OPU may use 2-3 days. There has been a plethora of research looking to reduce the number of injections needed by slowing the release of FSH however they have typically shown reduced yields. In contrast, Dias and colleagues examined the effects of a longer stimulation period, 7 days vs. 4 days, and found they may be able to improve the quality of oocytes that were ovulated and produce a more homogenous batch. After conducting a transcriptome analysis of granulosa cells, they noticed an upregulation in gene makers for LH responsiveness, oocyte maturation, and competence and downregulation in markers associated with cellular death and disease. This differential expression could lead to the production of more competent embryos. Silva and colleagues performed a similar experiment examining the difference in yield between 2- and 3-day stimulation in an OPU protocol and found no significant difference between the two. However, they did note a significantly higher number of medium-sized and lower number of small follicles when compared to unstimulated animals. They did theorize that the lack of difference in yield may be due to the lower individual dose given in the longer duration group. Another important factor to consider is the period of FSH coasting (the period between stimulation and aspiration or ovulation). This may vary from cow to cow and range from 24 - 48 hours, but it can be optimized through either repetition of collection or examination of gene expression in the granulosa cells or oocytes such as the MYC gene.

In conclusion, no one protocol will work for every producer, however they can be optimized.

This may mean a longer duration of FSH stimulation or adjustment of the coasting period after stimulation, but the improvement of embryo outcomes may very well offset the cost.

Upcoming Events

Fall Pasture Program
TBD (Franklin County)

National 4-H Dairy Quiz Bowl
November 5, 2022 (Louisville, KY)

Dairy Sustainability Summit, Dayton
December 8, 2022 (Dayton, VA)

Virginia Holstein Annual Meeting
January 7, 2023

Virginia Dairy Princess Pageant
January 9, 2023

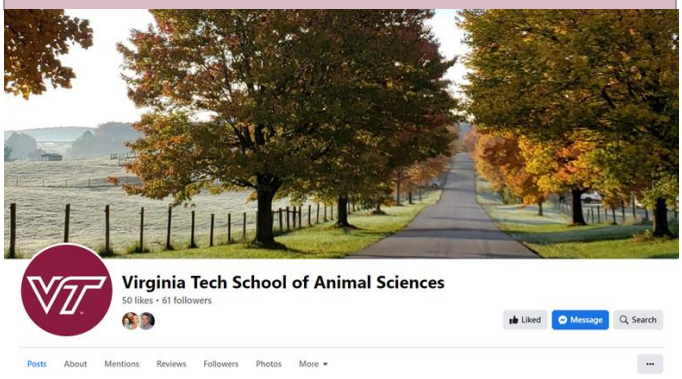
Managing Milk Price Using Futures Market
February 20, 2023 (Amelia)

Managing Milk Price Using Futures Market
February 21, 2023 (Dayton)

Science of Dairy Foods Workshop
with Dr. Bob Horton
March 18, 2023

If you are a person with a disability and require any auxiliary aids, services or other accommodations for any Extension event, please discuss your accommodation needs with the Extension staff at your local Extension office at least 1 week prior to the event.

Updates and information previously shared on the Virginia Tech Dairy Science Facebook page will now be distributed via the brand-new VT School of Animal Sciences page. We invite you to follow the VT School of Animal Sciences on Facebook for dairy updates and so much more!



For more information on Dairy Extension or to learn about current programs, visit us at VTDairy—Home of the Dairy Extension Program online at www.vtdairy.dasc.vt.edu.

Dr. Christina Petersson-Wolfe,
Dairy Extension Coordinator &
Extension Dairy Scientist,
Milk Quality & Milking Management

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