

Overview of the Development of an Advanced Precision Feeding System for the Dairy Industry

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The premise of the Agricultural Cooperative Research for Environmental Sustainability (ACRES) Program is to develop/model/assess economically sustainable farming practices while considering technical advances within the broader context of environmental stewardship. Self-sufficiency, energy efficiency and sound resource management are the hallmarks of emerging farm operations, and these drivers are reflected in the emerging trend of more extensive use of owner produced forage/legume mixtures in dairy feed rations. Forage crops, such as alfalfa, require far less energy input, fertilizers and pesticides than corn. In addition to the tangible short-term cost savings, there are other considerations that should be characterized to better understand the longer-term macro-scale influences these changes will have on the overall environmental footprint and economic viability of farm operations. These include:

- 1) Addressing adequate storage and delivery of increased volumes of forage crops;
- 2) Adjusting feed rations to optimise animal nutrition, long-term health and productivity;
- 3) Reducing on-farm energy consumption via enhanced crop and protein production;
- 4) Downstream affects of optimised precision feeding on manure quality and quantities;
- 5) Developing the capacity to better manage feed wastes and manures to enhance crop production and reduce impact on environmental resources.

Increased use of legume forages in a total mixed ration (TMR) can be viewed as central to a precision feeding system (as opposed to row crops). In addition to reducing a farmer's dependence on energy intensive nitrogen fertilizers, it may also help to sequester/maintain soil carbon levels. The initial phase of research under the ACRES Program is to attempt to maximize feed efficiencies through:

- development/demonstration of better storage methods to preserve on-farm produced feed quality;
- increase the level of automation in TMR delivery systems to reduce labour costs and enhance energy conservation practices;
- improve the accuracy of mixing TMRs to minimize the variability of daily diet and thereby improve rumen health, herd productivity and individual animal longevity; and
- reduce costs by taking advantage of the ability to formulate to feed requirements more accurately.

The ACRES Research Team is initiating research into comparative assessments of different feed storage methods based on energy requirements related to packing/extracting feed components and the preservation of feed component quality over time as measured by:

- physical changes in stored feed components (temperature, moisture, density);
- change in feed nutrient quality (DM, protein [crude, DIP & UIP], CF, ADF, NDF, fats, etc.); and
- off-gas emissions from feed storage (CH₄, CO₂, VOC's).

This is being further complimented by research and development of an automated precision feed system to monitor and adjust feed rations on a real time basis, using the parameters noted above to provide a more consistent daily mixed ration. The Feed System is being designed to also make use of data on herd health & milk production quality as feedback to further refine the TMR on an ongoing basis. Ultimately, the system will provide the means to facilitate delivery of prescribed TMRs tailored to the needs of the individual cow. Collectively, these concepts lend themselves to enhanced operational cost savings through a reduction in the quantity of feed spoilage/waste, optimised use of nutrients in protein production and enhanced nutrient management plans to protect the environment. The presentation will focus on preliminary results from the research into feed preservation and monitoring feed quality.