



BEST MANAGEMENT STRATEGIES TO IMPROVE THE PRODUCTIVITY AND ENVIRONMENTAL SUSTAINABILITY OF GRASSLAND PASTURE SYSTEMS

As part of NCLE, this unique multidisciplinary project has brought together university researchers, three levels of government and numerous sectors of the industry to establish a research and demonstration site to explore the impact of hog manure on forage yield, forage quality, animal performance, soil and water quality, as well as greenhouse gas production

Expansion in the hog sector has created opportunities for both the beef and dairy cattle industries to economically improve forage productivity through the application of hog manure.

Although the application of hog manure may be mutually beneficial to hog and cattle producers, there are still many aspects of this practice that require further study.

To address some of these questions, a research/demonstration site has been located on 160 acres of land owned and operated by Hytek

Limited, located near La Broquerie, Manitoba. This site has given scientists, extension personnel and university researchers the opportunity to:

1. Identify a series of best management practices associated with the application of hog manure and its effect on: forage yield, forage quality, animal performance, soil and water quality, greenhouse gas production.

2. Improve economic and environmental sustainability for the livestock sector by:

- increasing forage/cattle productivity
- reducing farm input costs
- improving nutrient utilization
- minimize cycling of potentially harmful bacteria
- reducing greenhouse gas emissions
- increasing the potential opportunity to benefit from greenhouse gas credits.

3. Provide an opportunity for all sectors of the industry to work together to establish a coordinated approach to land and nutrient utilization.

4. Train students who will possess the skills necessary to help the agricultural industry grow in a sustainable fashion.

Parameters Examined

Duplicate plots with six different manure management and forage harvesting techniques are being utilized at the site. To accomplish this, the site is divided in half, each half consisting of six separate paddocks.

- 20 acres grazed, no manure
- 3 acres harvested, no manure
- 10 acres grazed, manure applied in the fall and spring, 55 lbs of available N at each application
- 3 acres harvested, manure applied in the fall and spring, 55 lbs of available N at each application
- 10 acres grazed, manure applied in the spring, 110 lbs of available N
- 3 acres harvested, manure applied in the spring

Techniques used:

Forage yield –
Quadrats/grazing cages

Forage quality – Hand plucked to mimic grazing and analyzed for crude protein, fibre and minerals

Animal performance –
Weighed every 28 days to determine average daily gain

With this information, live-weight gain/acre and grazing days per acre can be calculated

Soil quality – Soil samples taken at 1-foot increments to 4-feet for tracking soil properties and nutrient concentrations. In addition soil samples taken to 2 inches and 2 feet for plant available nutrients.

Water quality – Wells have been installed by Manitoba Water Stewardship in each of the 12 paddocks at the site. Water samples are collected and analyzed for nutrients.

Greenhouse gases
The greenhouse gases of greatest concern in the agricultural sector are:
-nitrous oxide
-methane
-carbon dioxide

In the cattle industry, methane and nitrous oxide result from natural biological processes:
- bacteria produce methane during feed fermentation in the cattle's digestive tract.
- soil bacteria are responsible for nitrous oxide gas emissions from manure.

Nitrous oxide – Nitrous oxide and methane from soil, dung, and urine patches is measured using vented static chambers.

Methane – Methane is measured from cattle using the sulfur hexafluoride technique.

Pathogen movement -
The presence of potentially pathogenic bacteria, including *Salmonella*, *E. coli* and *Yersinia* is being measured in the manure, soil, forage and water using standard culture, as well as DNA techniques. An examination of antibiotic resistance for seven major classes of organisms is also being explored.

What Have We Found?

Results:

Forage and Animal Productivity

- Hog manure improved forage yield and quality
- Crude protein content doubled in pastures receiving manure
- Pasture carrying capacity and liveweight gain per acre each increased by more than 3-fold compared to unmanured pastures

Nutrients

- Analysis of soil samples have shown that chloride is moving down through the soil profile
- With low removal rates, phosphorus concentrations are increasing within the soil surface, but not beyond
- Although phosphorus concentrations are different in wells located in manured vs unmanured plots, trends associated

with manuring are not apparent

- Nitrate is not moving into the groundwater

Pathogens

- Salmonella and E. Coli were detected in hog manure, but pathogen numbers were low in all forage and soil samples and were not transferred to grazing cattle
- Organisms, including antibiotic resistant organisms, were present in groundwater, but the source of these organisms is not known

Greenhouse Gases

- Soil greenhouse gas emissions increased with manure application, but the carbon incorporated into plant root growth more than offset those emissions over the short term
- Enteric methane emissions

produced from feed fermentation in the rumen were not affected by manure application on pastures

Economic Value

- As a consequence of manure application, the value of increased harvested forage yield was estimated to be \$84-92 per acre
- Increased liveweight gain on pastures receiving manure resulted in an estimated improvement of \$175-191 per acre

Energy Efficiency

- Beef production on manured land is less energy efficient than beef production on unmanured land, but more efficient than beef production on land where synthetic fertilizer is applied

Participating Organizations:

- University of Manitoba
- Hytek Limited
- Manitoba Agriculture, Food and Rural Initiatives
- Manitoba Cattle Producers Association
- Manitoba Pork Council
- Manitoba Livestock Manure Management Initiative
- Greenhouse Gas Mitigation Fund (Dairy Farmers of Canada, Canadian Cattlemen's Association and Canadian Pork Council)
- Beef Cattle Research Council
- University of Saskatchewan
- Dairy Farmers of Manitoba
- Canadian Agri-Food Research Council
- Manitoba Rural Adaptation Council
- Sustainable Development Innovations Fund
- HiQual Manufacturing Limited
- Water Stewardship
- Manitoba Conservation
- Prairie Farm Rehabilitation Association
- Agri-Food Research Development Initiative
- Seine Rat River Conservation District
- Deep River Science Academy
- Palmlite
- Southeast Farm Equipment
- Hanover Doors
- Staff in the Department of Animal Science at the University of Manitoba.



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