OVERVIEW

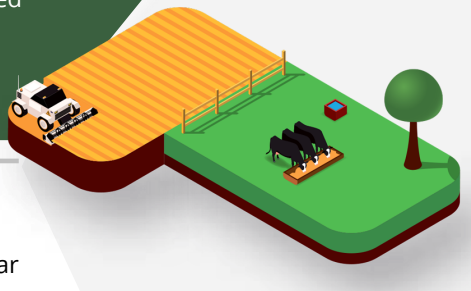
Five-Year Canadian Beef Research & Technology Transfer Strategy 2021

Canada is a world leader in meeting beef demand in an environmentally, socially and economically sustainable manner. Through investments in research and technology transfer, the Canadian beef industry is poised to play a leading role in responsibly meeting global food production needs.

The Beef Cattle Research Council, in consultation with the Canadian Beef Advisors — a diverse group representing Canada's seven national beef organizations responsible for policy, marketing, research and sustainability — has developed the Five-Year Canadian Beef Research and Technology Transfer Strategy as a framework for coordinating beef research, priorities, funding and technology transfer activities nationally. The Strategy focuses on innovation to increase productivity and improve the efficiency of cattle and feed production to meet the nutritional needs of a growing world population, while ensuring consumers are provided with a safe, high-quality product raised in an ethically, environmentally and economically sustainable manner.

Developing and implementing the Canadian Beef Research and Technology Transfer Strategy is a collaborative effort between provincial and national industry and government funding agencies, research institutions and extension agents. This collaboration is critical to ensuring priority industry outcomes are addressed and progress is made in achieving the industry's 10-year goals.

TECHNOLOGY TRANSFER is a core component of the Strategy. Key to the success of innovation is encouraging greater awareness and adoption of new technologies and beneficial practices. Coordinated research and technology transfer facilitates cost-effective innovation in productivity, quality and safety by the beef industry.



REDUCE PRIMARY PRODUCTION GHG EMISSION INTENSITY BY

33%

BY 2030

One of the 10-year industry goals is 33% reduction in the greenhouse gas emission intensity of primary production. This will require research that improves production efficiencies at all stages of the cattle production chain and the transfer of those results into application.

The Canadian Beef Research and Technology Transfer Strategy aligns with the National Beef Strategy, which provides a set of ambitious 10-year industry goals and targets in the areas of:

- greenhouse gas and carbon sequestration,
- animal health and welfare,
- land use and biodiversity,
- water,
- beef quality and food safety,
- human health and safety, and
- technology

RESEARCH AND TECHNOLOGY TRANSFER CORE PRINCIPLES

The beef industry has defined several overarching core principles for the renewed Canadian Beef Research and Technology Transfer Strategy under which more specific outcomes are established:

1. Increase producer profitability by increasing productivity or decreasing costs of production and risks.
2. Develop, enhance and encourage adoption of beneficial practices and innovations that maximize the environmental benefits industry provides and continue to reduce our environmental footprint, while supporting industry competitiveness.
3. Support continuous improvements in Canadian beef demand through advancements in the quality and safety of Canadian beef.
4. Generate science to inform decision makers, policy and best management practices and to support consumer confidence and public trust.
5. Develop, enhance and encourage adoption of leading-edge technologies that support industry competitiveness, automation and sustainability.
6. Ensure the maintenance and rejuvenation of critical research capacity and infrastructure that facilitate proactive inquiry and innovation to support industry advancement.

"Science and technology transfer are critical to achieve the Canadian beef industry's long-term goals, as well as to guide policy and communicate on issues of shared importance with the public, consumers and governments."

— Matt Bowman, BCRC Chair

PROGRAM AREAS

- Feed Efficiency & Utilization
- Forage and Grassland Productivity
- Environmental Sustainability
- Animal Health, Welfare and Antimicrobial Resistance
- Beef Quality
- Food Safety
- Extension

The Beef Cattle Research Council is Canada's national industry-led funding agency, funding research and technology transfer to position the Canadian beef industry as a global leader in beef quality, animal health, food safety and environmental stewardship. The BCRC and other members of the Canadian Beef Advisors are leading the industry to continually improve practices, elevate product quality, enhance natural environments and utilize technologies to benefit human health, safety and profitability.

SEQUESTER AN ADDITIONAL **3.4 MILLION TONNES** OF CARBON EVERY YEAR

One of the 10-year beef industry goals is to sequester an additional 3.4 million tonnes of carbon annually. Achieving this will require science-based improvements in forage and grazing productivity, soil health and environmental sustainability.

BCRC BEEF CATTLE RESEARCH COUNCIL · CBBC CANADIAN BEEF BREEDS COUNCIL · CCA CANADIAN CATTLEMEN'S ASSOCIATION · CANADA BEEF · CMC CANADIAN MEAT COUNCIL CONSEIL DES VIANDES DU CANADA · CRSB CANADIAN ROUNDTABLE FOR SUSTAINABLE BEEF · NATIONAL CATTLE FEEDERS' ASSOCIATION ASSOCIATION NATIONALE DES ENGRAISSEURS DE BOVINS

2021 Research Priorities and Detailed Outcomes

Feed Efficiency & Utilization

Outcome 1: Improve feed grain and silage yields through plant breeding, agronomic practices, and harvest strategies

Research Priorities:

- Develop new, high-yielding feed grain and silage varieties with superior agronomic performance and nutritional quality
- Investigate agronomic, harvest and ensiling practices to optimize feed and silage yield, nutritional quality and animal health and performance

Extension Priorities:

- Improve producer awareness and adoption of regionally appropriate varieties for feed grain and silage
- Improve producer awareness and adoption of optimal agronomic, harvest and storage practices for feed grains and silage production

Outcome 2: Investigate feed processing, by-products, additives, supplements or other feeding strategies that optimize productivity and profitability

Research Priorities:

- Develop rapid and cost-effective ways to assess nutritional value, digestibility, and optimal processing of feedstuffs and by-products
- Develop cost-effective methods to measure, and feeding strategies to ensure, uniform supplement intake on pasture
- Re-investigate and update nutritional recommendations to maintain optimal animal health and performance
- Investigate feed processing methods and practices, additives and management systems to improve digestibility, animal maintenance costs and cost of gain
- Quantify the role and identify opportunities to further use cattle to upcycle and reduce food loss and waste

Extension Priorities:

- Promote the adoption of best management practices for utilizing by-products, additives, supplements, and other feed processing and feeding strategies
- Evaluate the economic feasibility of feed processing, by-products, additives, supplements or other feeding strategies

Outcome 3: Improved feed efficiency through identification of genetic differences and animal breeding

Research Priorities:

- Develop and validate practical, accurate and cost-effective ways to quantify forage intake in grazing cattle and feed efficiency in the cow herd and the feedlot
- Validate genetic markers for feed efficiency in commercial crossbred cattle
- Identify genes with functional roles in microbiological and physiological processes affecting feed intake and efficiency in feedlot and cow-calf production
- Determine the impact of genetics, management, and environmental interactions on growth and reproductive efficiency

Extension Priorities:

- Identify barriers to the adoption of genetic tools
- Improve feed efficiency through genetic selection in breeds for which breeding values for feed efficiency exist

Forage & Grassland Productivity

Outcome 1: Improve the management and productivity of native/naturalized pastures to enhance profitability and discourage land conversion

Research Priorities:

- Identify practices that optimize utilization and resilience of pastures which may include indicators of appropriate recovery times
- Identify or develop cost-effective management strategies to control the spread of invasive plant species on rangeland

Extension Priorities:

- Promote grazing management practices that optimize the productivity of native plant species
- Promote best management practices to help producers control invasive plants

Outcome 2: Better understand the impact of grazing management on plant, animal and soil interactions and how the overall system contributes to plant and animal health and productivity

Research Priorities:

- Quantify the impact of agronomic and grazing management practices on economic and environmental outcomes such as plant health, forage yields and quality, animal health and performance, soil carbon sequestration and organic matter, soil health and quality, water infiltration and nutrient cycling in different ecoregions of Canada
- Identify and validate technology to simply and cost-effectively manage grazing systems and quantify improvements in forage productivity
- Identify simple, practical, cost-effective indicators of soil quality that have impacts on forage quality and productivity

Forage & Grassland Productivity, cont.

- Evaluate long-term effects of incorporating grazing on crop production land

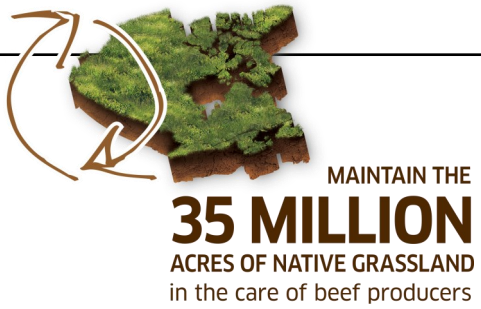
Extension Priorities:

- Encourage the development and adoption of forage and grazing management plans and practices that encourage long term plant, soil and animal health and productivity
- Encourage the adoption of cost of production analysis to assist in decision making
- Promote the use of resources and tools to evaluate grazing management practices
- Encourage the adoption of management practices that extend the grazing season
- Identify and promote best management practices for incorporating grazing on cropland

Outcome 3: Cost-effectively improve the agronomic performance, yields, nutritional quality and palatability of annual and perennial tame species for grazing or stored forages

Research Priorities:

- Develop strategies and best management practices to promote stand productivity and longevity, preserve forage quality and prevent waste in stored forages
- Develop and evaluate new varieties with improved germination, emergence, yield, digestibility, salinity, drought and flood tolerance, reduced fall dormancy, and improved winter hardiness and plant persistence
- Independent comparisons of promising international and domestic forage varieties and mixtures on a meaningful scale to determine varietal and mixture adaptation under a range of environmental conditions and soil types



Extension Priorities:

- Promote regionally appropriate management practices that encourage long-term stand maintenance and profitability
- Identify simple, cost-effective strategies to rejuvenate tame pastures when required
- Communicate the potential forage yield and animal carrying capacity improvements that can be cost-effectively achieved under different management systems
- Promote management practices that maintain legumes in mixed grass stands and provide producers with information on safe and effective ways to graze legumes in pastures
- Communicate variety testing trial results to help producers make informed variety and seed selection decisions
- Develop and communicate cost-benefit analysis of different harvest strategies
- Promote best practices for irrigation for forage and feed production

Environmental Sustainability

Outcome 1: Develop cost-effective ways to reduce greenhouse gas emissions, maintain or improve biodiversity, increase soil carbon or improve water infiltration on pastures and range

Research Priorities:

- Validate grazing practices that improve water infiltration, forage yield and soil organic matter in Canadian conditions across a variety of ecoregions
- Evaluate the roles of the soil microbiome and plant-soil interactions in short-, medium- and long-term soil carbon storage and sequestration, plant yield and water holding capacity
- Develop simple outcomes- and systems-based approaches for producers to understand and quantify the costs and benefits of environmental best management practices
- Investigate cost-effective ways to reduce greenhouse gas emissions on pasture- or forage-based systems
- Quantify N and P excretion rates in grazing animals, N impacts on GHG emissions and P runoff and leaching impacts on water quality/eutrophication in central and eastern Canada
- Develop or repurpose materials with the potential to reduce the amount of single-use plastics along the forage, cattle and beef production and supply chains

Extension Priorities:

- Develop and promote best management practices for improved environmental sustainability
- Encourage the adoption of best management practices that support biodiversity and species-at-risk habitat preservation

Outcome 2: Develop cost-effective ways to reduce feedlot greenhouse gas emissions and evaluate the impacts of manure nutrients on pasture and cropping systems

Research Priorities:

- Evaluate supplements, strategies and practices used to reduce greenhouse gas emissions in the feedlot using a systems approach
- Quantify the effectiveness of forages to mitigate the nutrient mobility associated with extended winter grazing practices
- Develop manure handling and processing technologies and strategies that enable manure to be transported and spread more cost-effectively

Extension Priorities:

- Determine the cost benefit of utilizing manure on crop land

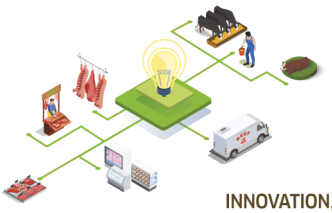
Environmental Sustainability, cont.

- Promote best manure and odour management practices

Outcome 3: Identify cost-effective ways to improve air, water and soil outcomes associated with beef packing and processing facilities

Research Priorities:

- Develop and validate cost effective cleaning technologies that reduce water and sanitizer use in packing plants
- Identify and develop new revenue streams that also reduce environmental impacts by utilizing carcass by-products
- Develop technologies that reduce odors associated with packing plants
- Develop strategies and technologies that reduce food waste in the packing plant



SUPPORT INNOVATION, RESEARCH, AND COMMERCIALIZATION OF **TECHNOLOGY** THROUGHOUT THE SUPPLY CHAIN

Extension Priorities:

- Encourage the adoption of cost-effective technologies that have known environmental benefits

Animal Health, Welfare & Antimicrobial Resistance

Outcome 1: 92% of cows wean a calf each year through cost-effective improvements in nutritional and overall management

Research Priorities:

- Refine nutritional and related management strategies to improve rebreeding success, calf survival and herd retention in replacement females
- More precisely define micronutrient requirements and develop regionally-appropriate supplementation recommendations for breeding cattle of different ages throughout the production cycle
- Assess the impacts of water quality on reproductive performance, health and calf growth performance
- Clarify how management practices impact reproductive performance in cattle that differ in their genetic potential for growth, efficiency and carcass traits

Extension Priorities:

- Identify and promote the suite of production practices that, when utilized together, provide consistent and cost-effective improvements in reproductive performance and longevity and reduced preweaning mortality
- Encourage producers to participate in training and/or record-keeping programs requiring the collection of on-farm food safety, animal welfare, biosecurity and production records (e.g. VBP+) allowing them to compare their operations to industry benchmarks
- Develop and promote best management practices to ensure breeding bull fertility and reproductive soundness
- Promote the benefits of crossbreeding on reproductive performance, herd retention and longevity of the cow herd

Outcome 2: Develop and promote the adoption of cost-effective management practices and technologies that reduce the need for and preserve the effectiveness of antibiotics

Research Priorities:

- Continued development of alternative health products and management practices to maintain animal health and reduce the need for antibiotic treatment
- Controlled trials to independently assess or validate the cost-effectiveness of promising traditional or alternative animal health products and/or management strategies
- Identify key management practices and preconditioning program component(s) that are most critical to reducing respiratory disease in the feedlot
- Understand how stress (e.g. transportation, marketing, commingling, social dynamics) impacts the ability of cattle to acclimate to new environments
- Assess how nutritional and health management (e.g. vaccination) of the cow herd impacts calf health pre- and post-weaning

Extension Priorities:

- Promote the adoption of production and health practices that have been shown to effectively reduce the need to use antimicrobials in cattle

Outcome 3: Effective surveillance of production-limiting diseases, production practices, antimicrobial use and antimicrobial resistance

Research Priorities:

- Support the ongoing collection of antimicrobial use and resistance information in beef production systems and environments
- Support ongoing surveillance of management practices and animal health and productivity information at the cow-calf and feedlot levels across Canada

Extension Priorities:

- Use information collected by surveillance programs to inform extension, communication, future research needs and the impact of interventions or changes in management practices
- Encourage surveillance and/or recordkeeping/ benchmarking initiatives to communicate, collaborate and share data to inform veterinary and producer benchmarking comparisons and practice change
- Investigate information needs and opportunities to encourage telemedicine, enhanced veterinarian-client-patient relationships and skills to support accurate diagnosis and sampling and to inform surveillance efforts on cow-calf operations
- Encourage veterinarians and producers to participate in and submit data to ongoing surveillance and/or recordkeeping/benchmarking initiatives

Outcome 4: Improved prevention and mitigation of animal disease issues

Research Priorities:

- Develop vaccines and delivery systems to cost-effectively prevent economically important production-limiting diseases
- Develop management strategies and approaches to cost-effectively maintain calf health through the weaning process into the feedlot
- Develop point-of-care and other diagnostic tools that rapidly, accurately and cost-effectively identify infectious disease, immune/vaccination status, antimicrobial susceptibility/resistance or nutritional status
- Improved understanding of the etiology and pathophysiology of common production-limiting diseases that lack effective vaccines or treatment
- Use new techniques and traditional microbiology to understand the role of the microbiome(s), their development and interactions and how they can be manipulated to help prevent, mitigate and manage major diseases
- Take advantage of opportunities presented by artificial intelligence and other technologies to develop cost-effective and accurate tools to predict disease in individuals or groups of animals before clinical signs become apparent
- Identify and quantify biosecurity and animal health risks associated with transport rest stops and other commingling sites

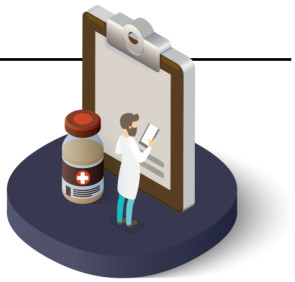
Extension Priorities:

- Promote and monitor the adoption of prevention-based herd health programs addressing a range of genetic, nutritional, vaccine, and other tools to maintain herd health, welfare and productivity
- Develop and promote tools to help veterinarians, nutritionists, other professionals and cow-calf producers design and implement appropriate and cost-effective biosecurity, vaccination, health and nutritional management programs
- Develop and promote best practices regarding the collection and sharing of individual animal health and production information between cow-calf producers and feedlot operators
- Develop and promote best practices for the transportation, storage, handling, mixing and timely administration of vaccines to improve their effectiveness
- Promote and monitor the development of veterinary-client-patient relationships among cow-calf producers
- Develop and promote cost-effective biosecurity protocols to minimize the introduction and spread of disease in cow-calf and cattle feeding operations

Outcome 5: Improved prevention and mitigation of animal welfare issues

Research Priorities:

- Improved understanding of the physiological and economic impacts of stresses associated with weaning and acclimation to the feedlot, and develop cost-effective strategies to improve behavioral, health and productivity outcomes
- Develop cost-effective and easily administered options to alleviate procedural pain associated with castration, branding and dehorning
- Develop cost-effective chronic pain management strategies
- Identify factors contributing to lameness, develop cost-effective preventions, treatment options, and methods to control or limit environmental spread of the pathogens involved



LEADING EXCELLENCE IN
BEST PRACTICES
REGARDING ANTI-MICROBIAL USE

Extension Priorities:

- Encourage and empower producers to understand and comply with the requirements and recommendations in The Code of Practice for the Care and Handling of Beef Cattle, including:
  - timely euthanasia
  - nutritional management
  - confirming death immediately after euthanizing
  - avoiding and minimizing acute and chronic pain
  - minimizing stress during weaning
  - optimizing transportation decisions to prevent injury and stress
- Promote and monitor the adoption of cost-effective pain mitigation strategies
- Develop, promote and monitor the adoption of tools to help producers accurately differentiate, diagnose and treat different causes of lameness
- Promote and monitor the adoption of polled genetics and early and proper dehorning and castration
- Promote and monitor awareness of the Code of Practice for the Care and Handling of Beef Cattle among veterinarians, producers and industry employees

Beef Quality

Outcome 1: Improved customer satisfaction with Canadian beef

Research Priorities:

- Modernize and conduct a National Beef Quality Audit that reflects the industry's evolution from carcass-based to cut-based marketing
- Develop and implement processes and technology to capture carcass quality defect data at processing plants in real-time
- Demonstrate the effectiveness of genetic markers to improve the uniformity and profitability of fed cattle
- Develop and/or independently validate packaging technologies to extend and improve shelf life of beef

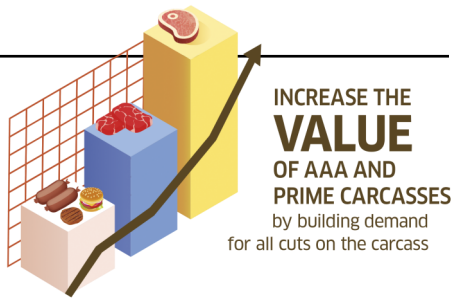
Extension Priorities:

- Communicate National Beef Quality Audit results pertaining to production-related issues to producers in a timely and effective manner to drive practice change
- Producer communication and awareness regarding the use of genetic tools to improve carcass and beef quality
- Data from individual animal carcass and offal images collected at processing plants are available to inform improvements in feedlot, transportation, cow-calf and seedstock management/selection

Outcome 2: Define, validate and enhance the emotional and functional attributes of Canadian beef in domestic and international markets

Research Priorities:

- Develop objective measures to assess the eating quality of specific primals / cuts desired in high-value export markets
- Develop and conduct industry-led domestic and international surveys to audit customer/consumer preferences and perceptions of Canadian beef quality attributes and track changes relative to previous studies



- Develop and conduct consumer sensory comparisons and cut performance of equivalent Canadian and competitors' products in domestic and international markets
- Identify critical control points and develop best practices enabling processors, customers and importers to ensure maximum shelf life of Canadian beef to ensure food safety and quality and reduce food waste
- Compare the shelf life of Canadian vs. competing beef in key export markets
- Quantify the value difference between fresh and frozen beef for Canadian retailers, considering differences in wholesale price and cutting performance

Extension Priorities:

- Communicate fact-based information regarding the equivalence or superiority of Canadian beef to comparable U.S. and Australian grades among domestic and international customers
- Use the results of domestic and international benchmarking surveys to increase the quantity of Canadian product that meets domestic and international customer/consumer preferences
- Encourage adoption of best practices by processors and domestic and international customers to ensure

Food Safety

Outcome 1: Ensured food safety along the beef supply chain

Research Priorities:

- Develop and implement cost-effective technologies targeting multiple pathogens in cattle and beef production and processing facilities, including heat- and acid-resistant *E. coli* and biofilm forming bacteria
- Identify key spots in processing plants that are prone to contamination and difficult to clean, and develop alternative designs, surfaces and cleaning strategies to facilitate effective cleaning
- Proactively (re)assess the prevalence of *Salmonella* in Canadian slaughter cattle, carcasses and beef, and develop strategies to effectively reduce food safety risks

Extension Priorities:

- Educate retail and foodservice meat cutters about the importance of temperature and appropriate cleaning (knives, gloves, equipment) in ensuring food safety for consumers
- Encourage the consistent adoption of known best practices to minimize the risk of pathogen contamination in beef processing plants related to the proper and thorough cleaning of conveyor belts, personal equipment, processing and grinding equipment, etc.

Outcome 2: Validate the efficacy and safety of new technologies in support of the rational regulatory approval and adoption of improved food safety interventions throughout the supply chain

Research Priorities:

- Develop cost-effective cleaning technologies that reduce the need for (hot) water, sanitizers and labor in large and small processing facilities
- Conduct research to proactively identify and resolve potential market access concerns for Canadian beef

Extension Priorities:

- Proactively identify likely regulatory barriers / concerns in key beef markets so they can be resolved before market access is impaired