CANADIAN BEEF RESEARCH & TECHNOLOGY TRANSFER STRATEGY 2018-2023

Developed by the Beef Cattle Research Council (BCRC) and the national Beef Value Chain Roundtable (BVCRT), the five-year Canadian Beef Research and Technology Transfer Strategy provides a framework to coordinate beef research priorities, funding and technology transfer nationally. The Strategy focuses on innovation and production efficiency in beef, cattle and feed to sustainably meet the nutritional needs of the growing world population.
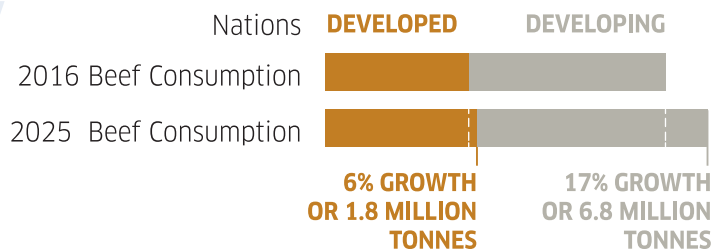
Developing and implementing the Canadian Beef Research and Technology Transfer Strategy is a collaborative effort between provincial and national industry and government funding agencies and research institutions. This collaboration identifies gaps in research needs, research capacity, and programming to ensure priority industry outcomes are addressed.

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

Sustainably meeting the nutritional needs of the growing global population requires producing more food using less resources by improving beef cattle and feed production efficiencies. Canada has an opportunity to play a leading role in meeting global food production needs through investments in agricultural research across a variety of disciplines over the next twenty years.

Nations **DEVELOPED** | DEVELOPING

2016 Beef Consumption

2025 Beef Consumption

6% GROWTH OR 1.8 MILLION TONNES | 17% GROWTH OR 6.8 MILLION TONNES

BEEF INDUSTRY CORE RESEARCH OBJECTIVES

1. To enhance industry sustainability and improve production efficiencies
2. To improve consumer confidence and beef demand
3. To improve public confidence in Canadian beef

> Feeding a growing world population against the backdrop of the intensifying pressures of climate change, food safety issues and other factors needs to be informed by a strong scientific base.
>
> *Agricultural Institute of Canada*

Overarching Aims for Research Priority Areas

1. Improved communication, collaboration and understanding between researchers and industry
2. Continued industry mentorship of new scientists
3. Cost-benefit analysis completed to support recommendations and technology transfer
4. Encouragement of interdisciplinary teams integrating the entire value chain where appropriate
5. Ensured maintenance, transition and mentorship of key research and extension capacity

Priority Areas

- Beef Quality
- Food Safety
- Animal Health and Welfare
- Antimicrobial Use, Resistance and Alternatives
- Feed Grains and Feed Efficiency
- Forage and Grassland Productivity
- Environmental Sustainability
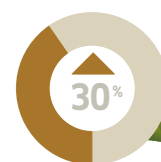- Technology Transfer

The Beef Cattle Research Council is Canada's national industry-led funding agency, funding research to position the Canadian beef industry as a global leader in beef quality, animal health, food safety and environmental stewardship.

BCRC
BEEF CATTLE RESEARCH COUNCIL

Agriculture and Agri-Food Canada

In Canada, producing 1 kg of beef in **2011** created

15% LESS greenhouse gases

than in **1981**, due to improved production practices

30% Increase in forage production

15% Decrease in cost of production at cow-calf level

CANADIAN BEEF RESEARCH & TECHNOLOGY TRANSFER STRATEGY RESEARCH PRIORITIES AND DETAILED OUTCOMES, 2018 - 2023

Beef Quality Research

Outcome 1: Improve customer satisfaction with Canadian beef

- Beef Quality Audit demonstrates a reduction in carcass defects below 2016 levels and maintained or improved consumer satisfaction for tenderness, juiciness and flavor of inside round, cross-rib, top sirloin and strip-loin steaks
- Develop and implement processes that facilitate the automated collection, recording, evaluation and communication of desirable (e.g. high lean yield/high marbling/healthy livers) and undesirable (e.g. low lean yield/low marbling/ abscessed livers) characteristics to enhance the Beef Quality Audit
- Re-evaluate electrical stimulation recommendations in commercial environments to reflect increased carcass weights
- Validate objective in-plant measures of tenderness that can be used at line speed
- Demonstrate the cost-effectiveness and value of genetic markers for tenderness in commercial cattle
- Identify potential interactions between tenderness genotype and animal management (e.g. implants, backgrounding, grassing, finishing, etc.) and develop appropriate breeding and management recommendations

Outcome 2: Validate and support the Canadian Beef Advantage

- Improved algorithms for predicting lean meat yield and / or retail product percentage

- Implement genomic and grading technologies that allow for market segmentation according to carcass quality and/or yield
- Develop packaging and other technologies to improve shelf life and appearance for export
- Complete a systematic literature review on the nutritional attributes of beef relative to other foods to address consumer concerns, inform consumer education programs, and identify appropriate research directions and applications
- Collect data regarding the nutrient density (per g) and value (cost per unit nutrient) of beef relative to other foods, including protein, mineral, vitamin, and lipid components

Outcome 3: Extension, outreach and policy

- Conduct demographic (young adults, parents, retirees) research addressing consumer perceptions, attitudes, stated preferences and buying behavior with respect to Canadian beef and offal products (e.g. importance of price, cultural factors, production methods, convenience, quality, nutritional attributes, healthfulness and enjoyment)
- Enhance consumer education regarding their role and responsibility in ensuring beef quality through selection of appropriate cut-specific preparation and cooking methods
- Increase information exchange between sectors along the supply chain to help inform production decisions that ultimately improve carcass value and consumer satisfaction

Food Safety Research

Outcome 1: Improved food safety along the beef supply chain

- 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
- Develop and implement cost-effective technologies to rapidly and effectively detect STEC (e.g. *E. coli* O157) contamination in beef and trim
- Develop objective, cost-effective approaches for verifying effectiveness of packing plant equipment cleaning processes, and adopt them for 85% of processed cattle
- Increase surveillance to detect, characterize and quantify the relative human health risk of (re)emerging pathogens

Outcome 2: Improved beef quality and food safety research and training capacity

- Establish an industry meat science research chair to address issues facing the beef packing and processing sectors, and reinvigorate food safety research program capacity
- Establish a meat science program at a Canadian university with educational and research components to produce highly

qualified personnel serving Canada's beef industry

Outcome 3: Extension, outreach and policy

- Encourage the consistent adoption of known best practices to minimize the risk of pathogen contamination in beef processing plants through enhanced processor education encouraging the consistent adoption of proper and thorough cleaning of conveyor belts, personal equipment, processing and grinding equipment, etc.
- Enhance consumer education regarding their role and responsibility in ensuring food safety in the home, including the relative efficacy of alternative in-plant interventions and at-home food handling and storage practices to ensure food safety
- Generate science-based information to inform the regulatory approval of trim and ground beef irradiation in Canada
- Generate science-based information to inform the regulatory approval of effective food safety interventions in key international markets (e.g. European Food Safety Authority approval of peroxyacetic and citric acid interventions for beef)
- Generate science-based information to inform regulatory approval of cost-effective methods of separating specified risk material (SRM) from non-SRM in order to reduce SRM disposal costs and the amount of material directed to landfill

Animal Health and Welfare Research

Outcome 1: Improved surveillance of production limiting disease and welfare issues

- Expand the Western Canadian benchmarking initiative to a national survey of the incidence and economic impact of production limiting diseases, nutritional and health management, biosecurity practices, and welfare practices in cow-calf, backgrounding and feedlot operations
- Develop a national production limiting disease surveillance program, identifying opportunities to collaborate with wildlife disease surveillance programs
- Establish a national surveillance system to monitor the incidence of and etiology of (re)emerging production limiting diseases

Outcome 2: Improved prevention of animal disease and welfare issues

- Conduct clinical trials to identify commercially available vaccines that stimulate an effective immune response and reduce the incidence of disease in calves pre- and post-weaning
- Develop and promote cost-effective vaccination and management strategies that can be widely adopted throughout the beef production system to improve health, reproductive and performance outcomes
- Identify or develop cost-effective management or treatment options that lead to improved control of internal and external parasites
- Develop revised feed mycotoxin levels to avoid adverse animal health and welfare impacts
- Develop and maintain a prioritized list of the 10 best animal health management practices to improve cow-calf sector profitability (e.g. vaccine timing, mineral nutrition, parasite control, etc.)
- Evaluate the cost-effectiveness of pain control products and strategies for avoiding or mitigating acute and chronic pain
- Define appropriate feed, water and rest intervals that optimize transport outcomes for different classes of long-haul beef cattle

transported across Canada
- Identify potential trailer design modifications to minimize bruising and injury

Outcome 3: Improved animal health and welfare research and training capacity

- Ensure maintenance and transition of key animal health and welfare research, diagnostic and extension expertise and facilities

Outcome 4: Extension, outreach and policy

- Encourage producers to continually update and implement a herd health program developed in partnership with a veterinarian, which consider the following:
  - vaccination
  - utilization of feed and water testing, and proper formulation of feed and supplement rations to ensure animal nutrition and prevent exposure to toxins
  - prompt and accurate diagnosis of animal illness and injury to inform appropriate treatment methods
  - necropsies
- Encourage producers to understand and comply with the requirements and recommendations in The Code of Practice for the Care and Handling of Beef Cattle, including:
  - confirming death immediately after euthanizing
  - avoiding and minimizing acute and chronic pain
  - minimizing stress during weaning
  - optimizing transportation decisions to prevent injury and stress
- Develop an on-farm decision making tool to determine the reproductive rate of highest profitability with recommendations of known best practices to optimize reproduction and longevity, including consideration of
  - selection and breeding of heifers
  - accurate measurement of fat cover on animals to inform feeding strategies and maintain animals in ideal body condition

Antimicrobial Use, Resistance and Alternatives Research

Outcome 1: Evidence-based antimicrobial resistance decision making and communication to the veterinary, producer and medical communities

- Increase CIPARS activities to encompass on-farm, abattoir and retail beef antimicrobial resistance surveillance, including *Enterococcus hirae* or other indicator organisms that are informative with regard to macrolide resistance
- Conduct pilot projects to identify whether the prevalence of antimicrobial resistance in market beef cows, dairy cows and bob/veal calves differ from fed cattle, and include any found to have concerning levels of antimicrobial resistance into ongoing CIPARS surveillance
- Develop methodology to evaluate and monitor the potential movement of antimicrobial resistant genes from cattle

associated environments to human environments via manure, soil, food and water
- Implement ongoing surveillance of antimicrobial resistance through sampling of live animals at feedyards, focusing on BRD pathogens and enteric bacteria
- Conduct clinical trials to confirm best antimicrobial treatment options to minimize antimicrobial resistance throughout the cattle production cycle
- Develop rapid, accurate, cost-effective technology to detect antimicrobial resistance in production environments
- Develop and verify best practices at the farm level to reduce antimicrobial resistance in bacterial isolates from both healthy animals and clinical cases

Outcome 2: Develop a broader toolbox for disease management

- Conduct an evidence-based risk-assessment of the effectiveness of alternative production practices (e.g. preconditioning, methods of reducing stress in weaned calves)
- Develop cost-effective nutritional and other management strategies to effectively reduce the need for antimicrobials to control liver abscesses
- Re-invest in vaccine development, with a specific focus on pathogens associated with bovine respiratory disease in Canada (e.g. *Mycoplasma spp, Mannheimia haemolytica, Histophilus somni, Pasteurella multocida,* bovine herpesvirus, bovine respiratory syncytial virus, bovine viral diarrhea virus, bovine coronavirus), liver abscesses (e.g. *Fusobacterium necrophorum, Trueperella pyogenes*), footrot (e.g. *F. necrophorum*) and digital dermatitis (e.g. *Treponema spp.*)
- Investigate and develop simple, cost-effective alternative vaccine delivery methods to improve vaccination rates in the cow-calf sector
- Develop rapid, accurate, cost-effective chute-side diagnostic tests to evaluate whether cattle have been effectively vaccinated against specific pathogens
- Develop rapid, accurate, cost-effective diagnostic tools to detect disease before symptoms become apparent
- Develop a better understanding of the respiratory and gut microbiomes, their establishment and development in the neonate, and their relation to immunity and disease
- Investigate the impact of animal genetics on disease susceptibility and resistance
- Develop cost-effective non-antimicrobial products to prevent, treat and control disease

Outcome 3: Ensure that Canada's beef industry continues to have access to antimicrobials to protect animal health and welfare by developing a database to quantify and validate responsible antimicrobial use in beef production

- Establish a working group to determine the governance, structure, potential data sources (veterinary, farm and feedlot data, CgFARAD, VBP, etc.), data collection methodology (e.g. sentinel vs. random sampling), data reporting (e.g. kg active ingredient, animal defined daily doses, population corrected unit, etc.) and resources required to develop an antimicrobial use database for the beef industry
- Conduct pilot projects to identify which sectors of the beef and veal industries (cow-calf, feedlot, dairy, bob/veal) pose the greatest antimicrobial use risk (classes of antimicrobials used, treatment rates, etc.)
- Develop a database to track antimicrobial use in sectors deemed to be highest risk
- Use the database to monitor changes in antimicrobial use over time and relate changes in antimicrobial use practices to changes in antimicrobial resistance in cattle pathogens and indicator organisms isolated from cattle, beef and cattle-associated environments

Outcome 4: Extension, outreach and policy

- Encourage producers to proactively work with their veterinarian to adopt management practices that reduce the need to use antimicrobials, to use antimicrobials responsibly when needed, and to have a thorough understanding of how and when to use particular antimicrobials for effective treatment

Feed Grains and Feed Efficiency Research

Outcome 1: Improved feed efficiency through animal breeding

- Quantify the genetic relationships between feed intake and efficiency in cow-calf and feedlot production, and their relationships with other economically relevant beef production traits (longevity, fertility, weaning weight, wintering costs, carcass weight, yield and quality grades, tenderness, etc.)
- Identify genes with functional roles in microbiological and physiological processes that affect feed intake and efficiency in feedlot and cow-calf production
- Determine the impact of cow-calf management practices on feed intake and efficiency in feedlot calves
- Develop a cost-effective method to easily and accurately quantify forage intake in grazing cattle

Outcome 2: Improved feed supply and utilization

- Identify cost-effective agronomic strategies to increase feed grain energy yield per acre
- Develop new feed grain varieties with improved feed grain energy yield per acre, N and water use efficiency
- Identify, evaluate and calculate the cost-effectiveness of alternative / by-product energy feeds, considering impacts on animal performance, health, product quality, and nutrient management
- Develop feeding strategies to optimize animal performance, nutritional value and cost of gain (e.g. ideal forage inclusion rates, grain processing/blending, high moisture corn, wheat, etc.)

Outcome 3: Maintained feed grains and feed efficiency research and training capacity

- Ensure maintenance and transition of key feed efficiency research and extension expertise and facilities

Outcome 4: Extension, outreach and policy

- Enhance producer education to improve feed efficiency through management techniques to the point of highest profitability while responsibly maintaining animal welfare and environmental stewardship
- Improve feed efficiency through genetic selection, in breeds for which EPDs for feed efficiency exist

Forage and Grassland Productivity Research

Outcome 1: 15% Improvement in yields and nutritional quality of tame, native and annual species through improved pasture, forage and grazing management and plant breeding

- Develop new annual and perennial grass and legume varieties with improved stand longevity, quality, yield, and adaptability (e.g. flood and drought resistance) through traditional and/or advanced plant breeding techniques
- Characterize corn and cereal forage variety differences in nutrient profile and ensiling potential
- Quantify varietal and species differences in the ability of grasses, legumes and annual forages to maintain nutritional quality throughout the grazing season and in extended stockpiled or swath grazing systems to help inform producers' seed selection decisions
- Identify or develop improved grazing and range management strategies that optimize forage and beef production from native range and tame perennial pastures
- Investigate and refine regionally-appropriate methods of combining native, tame (annual and perennial) species and extended winter grazing practices to lengthen the grazing season and reduce winter feed costs, while meeting animal requirements
- Quantify the economic and agronomic benefits of integrated annual crop, forage and beef production systems

Outcome 2: Maintained forage research and training capacity

- Establish industry research chairs focused on forage and grazing management and economics established to serve Central and Eastern Canada and in the Prairies and B.C.
- Reinvigorate and enhance long-term breeding programs, while capturing near-term opportunities that are currently under development

Outcome 3: Extension, outreach and policy

- Producer extension programs used to foster collaboration between producers and researchers and the adoption of cost-effective, sustainable production and management practices
- Improve native and tame pasture management for optimum yields and forage quality and responsible environmental stewardship, including species establishment, fertilization, weed control and grazing management or harvesting techniques that have the highest and longest lasting return on investment for the regional conditions
- Increase information exchange between forage producers and forage seed growers to help inform decisions to improve forage production and minimize weeds
- Increase understanding of the costs, risks and benefits (economic and environmental) of pasture rejuvenation, weed control, fertilization, and the incorporation of forages into cash crop rotations and the development of on-farm decision making tools to quantify the return on investment of these various strategies

Environmental Sustainability Research

Outcome 1: Science-based information to inform the development of effective public communication and policy development regarding environmental goods and services provided by the beef industry

- Develop cost-effective methods of reducing GHG emissions in forage-based diets
- Quantify factors impacting the rate and extent of C sequestration in tame and native pastures across Canada
- Quantify the impacts of native and tame pasture management on plant, animal, bird and insect biodiversity across Canada
- Quantify the impacts of native and tame pasture management on water use, cycles and watersheds across Canada

- Identify cost-effective cleaning technologies to reduce water use in beef packing and processing facilities
- Quantify N and P excretion rates in grazing animals, and N impacts on GHG emissions and P runoff and leaching impacts on water quality / eutrophication
- Develop feedlot manure management best practices to reduce the risk of phosphorus overload in soils

Outcome 2: Extension, outreach and policy

- Increase the uptake of manure management practices that protect soil and water resources, including handling systems which minimize nutrient emission to air and leaching or run-off during storage or use
- Enhance public education regarding the impact of Canada's forage and beef industry on Canada's environment and economy

Technology Transfer

Outcome 1: Improved efficiency and effectiveness of technology transfer in the Canadian beef industry through greater collaboration and empowerment of technology transfer agents

Outcome 2: Increased producer adoption of relevant technologies and production practices through improved information management