July 23, 2019

BACKGROUNDER

Results of the 2018 Large-Scale Applied Research Project Competition: *Genomic Solutions for Agriculture, Agri-Food, Fisheries and Aquaculture*

Genome Canada, and in partnership with Agriculture and Agri-food Canada (AAFC), is pleased to announce an investment of approximately $76.7 million over four years in eight new projects from its 2018 Large-Scale Applied Research Project competition. These projects demonstrate how genomics research can be translated into solutions that advance the sustainability and productive capacity of the Canadian agriculture/agri-food and fisheries/aquaculture sectors. The funding includes $29.2 million from Genome Canada and $47.5 million from co-funding partners, including AAFC.

Building upon regional stakeholder consultations across Canada to renew a genomic strategy in agriculture, agri-food and aquaculture for Canada, Genome Canada and AAFC launched a competition for large-scale research projects that focus on the application of genomics to address challenges and opportunities of importance to Canada in these sectors. The role of the agriculture and its related sectors are recognized as critical for Canada's economic growth and can make significant contributions to improving food security and safety both at home and abroad.

The results of this competition bring together the complementary mandates of Genome Canada and AAFC and provide an opportunity to maximize the effectiveness of their research networks, infrastructure and resources. This funding makes it possible to collaboratively carry out joint projects with AAFC researchers, where Genome Canada funds will support the Genome Canada eligible researchers and AAFC funds will support the AAFC researchers.

BRITISH COLUMBIA

Title: PeptAid – Antimicrobial Peptides to Replace Antibiotics in Farm Veterinary Practice
Project Leaders and Institutions: Inanc Birol (University of British Columbia)
Genome Centre(s): Genome British Columbia
Total funding: $6.9 million

Antibiotic drugs are routinely used in agriculture. However, in the past, overuse of antibiotics has caused some bacteria to become resistant to these drugs, contributing to a looming crisis of antimicrobial resistance. The project aims to use genomic tools to develop antibiotic alternatives based on naturally occurring proteins, called antimicrobial peptides (AMPs), that are produced by a number of species to fight bacterial infections. There is evidence that AMPs are effective and that bacteria are less likely to

develop resistance to AMPs than to conventional antibiotics. The team aims to identify 10 effective and safe AMPs that will be tested in chicken eggs for protection from major infectious diseases that are of current concern to the poultry production industry. The team will also conduct an in-depth analysis of the economic, ethical, and regulatory issues related to using AMPs in agriculture, and will assess the opinions of stakeholders from the farming and food industries as well as the general public.

ALBERTA

Title: Integrating genomic approaches to improve dairy cattle resilience: A comprehensive goal to enhance Canadian dairy industry sustainability
Project Leaders and Institutions: Christine Baes (University of Guelph), Paul Stothard (University of Alberta), Ronaldo Cerri (University of British Columbia) and Marc-André Sirard (Université Laval)
Genome Centre(s): Genome Alberta, Ontario Genomics, Genome British Columbia and Génome Québec
Total funding: $12.1 million

Dairy is one of Canada's most important and dynamic industries. In 2015, the dairy sector contributed roughly $19.9 billion to Canada's gross domestic product (GDP). This project aims to use genomic tools to develop new datasets and genomic tools in order to develop a more 'resilient' cow, i.e. an animal able to adapt rapidly to changing environmental conditions, without compromising its productivity, health or fertility. A set of new genomic breeding tools for the dairy producers and the artificial insemination industry will be implemented based on a novel selection index for resilience, which will include novel traits related to fertility, health and environmental efficiency (feed efficiency and methane emission). The new index for resilience will allow farmers to reduce costs related to poor cow fertility, diseases and animal feed, and a more accurate selection for increased fertility, broader disease resistance and environmental efficiency. This will result in benefits, not only to Canada's dairy industry, but will help address global food security and sustainability.

PRAIRIE

Title: Enhancing the Value of Lentil Variation for Ecosystem Survival (EVOLVES)
Project Leaders and Institutions: Kirstin Bett (University of Saskatchewan) and Albert Vandenberg (University of Saskatchewan)
Genome Centre(s): Genome Prairie
Total funding: $7.4 million

Canada is the largest lentil producer and exporter in the world. In 2015, Canadian lentils generated $2.5 billion in export revenue. The industry is seeking to enter the high-value food and ingredients sector and expects future lentil varieties will support this new venture. The goals of EVOLVES are to: i) accelerate the deployment of specific quality traits through strategic use of genetic variability, and ii) improve the capability and agility of the breeding program so Canada can rapidly capture emerging market opportunities. Project outputs from EVOLVES will contribute to the Canadian pulse industry's goal of diversifying market outlets and creating price stability. It will also secure Canada as the global leader in all aspects of lentil innovation, and as a preferred supplier of high-quality lentils to the world.

Title: 4DWheat: Diversity, Discovery, Design and Delivery
Project Leaders and Institutions: Curtis Pozniak (University of Saskatchewan) and Sylvie Cloutier (Agriculture and Agri-Food Canada)
Genome Centre(s): Genome Prairie and Ontario Genomics

Total funding: $11.2 million

Wheat is the most important crop for current and future global food security, as it supplies the most calories and proteins to the global population. Wheat is grown on more land area than any other commercial crop. Meeting the challenge of increasing wheat production to match the growing demand for food over the next 20–30 years is of paramount importance. Current yield gains (~0.67% per year) are impressive but will not meet the need (1.6-1.8%) of a growing global population and may become unsustainable due to lack of new genetic diversity. 4DWheat will apply the very latest in genomic strategies to address this gap by focusing on two major challenges: enhancing yield and managing producer risk to important diseases. 4DWheat will apply cutting-edge genomics for "harnessing Diversity, advancing Domestication, enabling Discovery, and expediting Delivery" of new sources of genetic variation. Applying genomic tools will result in strategies to fully capture diversity in wheat breeding. The project will also quantify the current and future value of wheat genetic resources and examine regulatory networks to promote their utilization using new breeding technologies.

Title: Genomic ASSETS (Antimicrobial Stewardship Systems from Evidence-based Treatment Strategies) for Livestock
Project Leaders and Institutions: Cheryl Waldner (University of Saskatchewan) and Simon Otto (University of Alberta)
Genome Centre(s): Genome Prairie and Genome Alberta
Total funding: $5.6 million

Bacteria are increasingly resistant to antibiotics used for treatment, creating an unprecedented and growing global threat to human and animal health. Furthermore, animal agriculture is also facing pressure to reduce its use of antibiotics and use antibiotics more prudently. To meet this challenge, veterinarians and livestock producers need fast and precise information about disease in their animals. This project will use genomic tools and strategies to develop a pen-level precision diagnostic support network and cutting-edge computing tools for the livestock industry to manage genomic test data, assess risk and inform therapy decisions. These tools will give rapid practical support for prudent decisions on using antibiotics in food animals and have direct and immediate benefits to the livestock industry, animal health, consumers and public health.

ONTARIO

Title: BeeCSI: 'omic tools for assessing bee health
Project Leaders and Institutions: Amro Zayed (York University) and Leonard Foster (University of British Columbia)
Genome Centre(s): Ontario Genomics and Genome British Columbia
Total funding: $10 million

Honey bees are crucial to Canada's agriculture and contribute up to $5.5 billion a year to our economy by pollinating valuable Canadian crops. However, the health of honey bees has been declining over the past decade, with Canadian beekeepers losing more than a quarter of their colonies each winter since 2006-07. The causes of bee declines are complex, variable over space and time, and often difficult to identify. This project aims to use genomic tools to develop BeeCSI – a new health assessment and diagnosis platform powered by stressor-specific markers. Working with beekeepers, industry technology-transfer teams, and diagnostic labs, in consultation with federal and provincial regulatory

entities to ensure that the tools are implemented and accessible to the beekeeping industry by the end of the project.

Title: Environmental DNA ("eDNA"), meta-barcoding and transcriptional profiling to improve sustainability of freshwater fisheries and fish culture
Project Leaders and Institutions: Daniel Heath (University of Windsor), Margaret Docker (University of Manitoba) and Stephan Cooke (Carleton University)
Genome Centre(s): Ontario Genomics and Genome Prairie
Total funding: $9.1 million

Freshwater fish resources contribute to Canada's economy both directly and indirectly. Thriving freshwater fish resources are the lifeblood of many rural, northern and Indigenous communities and are central to the social and cultural lives of millions of Canadians. Yet, freshwater fish stocks are under threat. Canadian freshwater fish stocks need science-based monitoring and management. The logistical difficulties of monitoring fish stocks in Canada's 2+ million lakes and countless rivers are compounded by the limitations of conventional sampling methods, which provide only a snapshot. The project will use genomic approaches to develop a Fish Survey Toolkit based on environmental DNA from water samples and a Fish Health Toolkit that will provide quantitative assessments of the health of fish and the stressors they face. Collectively, these toolkits will enable a complete and accurate assessment of the status of Canada's freshwater fish resources and save millions of dollars for government, NGOs, fish culture facilities, and environmental consultants in fish survey costs, and will result in additional indirect savings through more effective and directed management actions. Furthermore, and most importantly, the project will ensure sustainability of Canada's freshwater fish resources for generations to come.

QUEBEC

Title: FISHES: Fostering Indigenous Small-scale fisheries for Health, Economy, and food Security
Project Leaders and Institutions: Louis Bernatchez (Université Laval), Jean-Paul Moore (Université Laval), Dylan J. Fraser (Concordia University) and Stephan Schott (Carleton University)
Genome Centre(s): Génome Québec and Ontario Genomics
Total funding: $14.4 million

The FISHES project will develop and apply genomic approaches in concert with Traditional Ecological Knowledge to address critical challenges and opportunities related to food security and commercial, recreational and subsistence fisheries of northern Indigenous Peoples in Canada (Inuit, Cree and Dené communities). The project will develop genomic resources for six species important to northern communities and use these resources to identify genetically distinct populations, assess their vulnerability to future climatic conditions, quantify their contributions to mixed-population harvests, and measure the contribution of fish from developing hatchery programs to subsistence harvests. FISHES will support the co-generation of knowledge to foster the development and co-management of sustainable fisheries and will also contribute to our ability to forecast the response of key fisheries to rapid global and socio-economic changes in northern Indigenous communities.