Innovations from the Agricultural Bioproducts Innovation Program

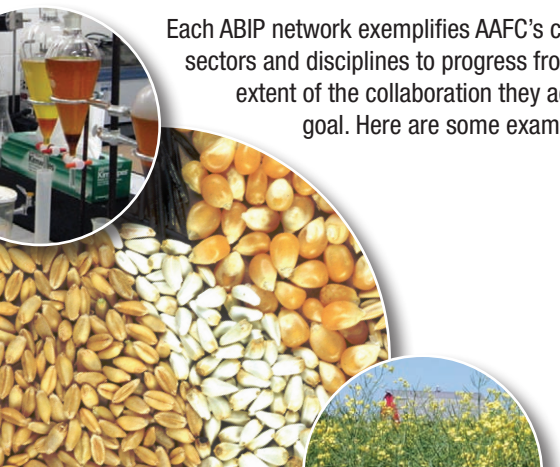
The multi-year Agricultural Bioproducts Innovation Program (ABIP) creates networks of talent, creativity and resources from academia, industry and governments to build greater research capacity in agricultural bioproducts and bioprocesses in Canada.

The program promotes research, development, technology transfer and commercialization in areas such as biofuels, other forms of bioenergy, industrial chemicals, biomaterials, and health products. This work will help bring new products and processes to the marketplace, and open the door to greater opportunities for Canadian producers.

ABIP's nine networks, listed below, currently involve 36 universities, 52 industry groups, and 19 government organizations.

- Industrial Oil Seed Network (IOSN)
- Cellulosic Biofuel Network (CBioN)
- Canadian Triticale Biorefinery Initiative (CTBI)
- Sustainable Cropping System Platforms for Biodiesel Feedstock Quantity and Quality (SBQQ)
- Agricultural Biorefinery Innovation Network for Green Energy, Fuels and Chemicals (ABIN)
- Feed Opportunities from the Biofuels Industries (FOBI)
- Natural Fibres for the Green Economy Network (NAFGEN)
- Pulse Research Network (PURENet)
- BioPotato Network

Each ABIP network exemplifies AAFC's commitment to encourage and facilitate collaboration and partnerships across sectors and disciplines to progress from basic research to application. Many of the networks are groundbreaking in the extent of the collaboration they achieve, harnessing strengths from diverse partners to work toward a common goal. Here are some examples of the progress being made by the network partners.



Canada

Research Paints a Colourful Future for Potato Products

The BioPotato Network combines the expertise of plant breeders, food scientists, molecular biologists, and plant production specialists to commercialize potato extracts, develop healthier potato varieties, and discover new uses for potatoes. One of the four areas of focus for the network is the development of potato functional foods and nutraceuticals. This research involves the investigation of potato bioactives and their health interactions at the University of Prince Edward Island, the National Research Council's Institute of Nutrisciences and Health in Charlottetown, Dalhousie University in Halifax and AAFC's Potato Research Centre in Fredericton.

In one research project, scientists at the Food Technology Centre adapted the potato granulation process used to make dehydrated instant mashed potatoes to include anthocyanin-rich colourful potatoes bred at AAFC's Potato Research Centre.

Anthocyanins, the natural colourants found in fruits and vegetables, have recently been studied for their nutritional aspects and anti-oxidant activities. The research chefs at Holland College, Canada's Smartest Kitchen, are using the anthocyanin-rich potato granules to develop new functional food product concepts for commercialization such as colourful mashed potatoes.

Triticale Poised to Become Canada's Bio-Industrial Cereal

Triticale may never displace wheat as Canada's number one cereal but research through the Canadian Triticale Biorefinery Initiative (CTBI) is bringing the crop closer to being recognized as Canada's bio-industrial cereal.

Triticale, a hybrid of wheat and rye, is a source of carbohydrates including starch, cellulose and hemicellulose that can be used to produce chemicals and fuels derived from simple sugar chemistry, and a competitive source of fibre and raw biomass. The development of new specialty lines of triticale and advanced processing technologies will enable triticale to become a valuable renewable resource for chemicals, fuels and biomaterials such as natural fibre reinforced composites, and thermoplastic starch based polymers and composites.

To track the genetic purity of new lines, scientists at AAFC's Lethbridge Research Centre in Alberta have introduced a blue-coloured seed which will be incorporated into future bio-industrial varieties of triticale. The blue seed colour will be used as a marker by scientists at the University of Alberta to indicate gene transfer to help determine if genes from triticale are transferred to wheat or other triticale crops via pollen. This research will help ensure that new triticale varieties can be grown without adverse effects on existing markets.

Initial results suggest that triticale has a low frequency of crossing with common and durum wheat. Best management practices, however, such as careful seed handling and certified seed production should maintain variety purity while the blue triticale seed for bioproducts will help ensure that mixing of seed is minimized. As genes to improve the bio-industrial properties of triticale are introduced, the blue seed and completion of biosafety work will provide CTBI with the necessary information to deliver new varieties to producers as quickly as possible.

Wheat Distillers' Grains May Benefit Bottom Line for Livestock Producers

With the recent expansion of the wheat-ethanol industry in western Canada, wheat dried distillers' grains with solubles (wheat-DDGS) have become a readily available, low-cost ingredient for livestock producers. Despite their availability, wheat-DDGS are currently used infrequently and at relatively low inclusion rates in feedlot rations due to the limited information on nutrient/feed quality, composition and impact on animal performance.

To address these concerns, researchers with the Feeds Opportunities from Biofuels Industries (FOBI) Network have examined various nutritional aspects and produced a comprehensive set of information on nutrient characteristics of wheat-DDGS, valid for a wide array of livestock operations including beef, dairy, swine, poultry and fish.

The results from animal trials have shown that wheat-DDGS can be used as sources of both energy and protein depending on the type of livestock and, at a significantly higher inclusion rates than previously recommended. For instance, wheat-DDGS can replace 50 per cent of the barley normally used in diets given to back-grounding cattle, while in feedlot animals it can be included as high as 40 per cent of the diet without affecting health, meat quality or performance. Similarly, wheat DDGS can be successfully included in the diets of grower-finisher pigs by up to 25 per cent and 10 per cent in broiler chicken diets.

Inclusion of DDGS means a significant cost savings to livestock farmers while creating a ready market for the wheat-DDGS, a win-win situation leading to a synergetic integration of the wheat-ethanol and livestock industries.

NAFGEN Member Expands both Capacity and Capability

The key focus of the Natural Fibres for the Green Economy Network (NAFGEN) is on developing the full potential of currently underutilized natural fibre crops, such as flax and hemp, and facilitating their entrance into new and expanding fibre markets. This research examines feedstock production, crop management (with emphasis on straw harvesting techniques) and product development.

Schweitzer-Mauduit Canada (SMC), a key member of NAFGEN, processes approximately 100,000 tons of flax straw annually from Manitoba, Saskatchewan and North Dakota to create bast fibre for paper and flax shives for horse bedding, soil erosion control and biofuels. The flax fibre can also be substituted for fibreglass and other petroleum based products to produce superior products and help manufacturers lower their carbon footprint.

Schweitzer-Mauduit has been working closely with other NAFGEN scientists at the Composites Innovation Centre in Winnipeg, Manitoba, Tekle Technical Services in Edmonton, Alberta and AAFC in Morden, Manitoba, to assess fibre quality and its suitability for processing and have produced test scale batches for marketplace assessment. This research has helped generate the technical knowledge and the business case to proceed with a $1,120,000 expansion of SMC's plants in Carman and Winkler, Manitoba.

With the new equipment, SMC will develop and produce a line of renewable and sustainable biomaterials to serve the growing bio-economy throughout North America. Completion of the expansion will allow the company to access new markets, which in turn will provide additional revenue, value chain businesses and jobs on the prairies.

Funding for the expansion came from the Canada/Manitoba Growing Forward initiative, Manitoba's Entrepreneurship, Training and Trade's Technology Commercialization Program, matching funds from SMC and the National Research Council.

‘Eco-pactor’ Helps Make Toronto Green

Canada’s largest landlord has begun using technologically “smart” Eco-pactors containing specially formulated, environmentally-friendly bio-oil as a substitute for petroleum-based hydraulic fluid in trash compactors across Metro Toronto.

The Eco-pactor pilot project was initiated by Linnaeus Plant Sciences Inc., the network lead of the Industrial Oilseed Network (IOSN), in partnership with the Toronto Community Housing Corp. and equipment-maker Metro Compactor Service Inc. Linnaeus has been working with the housing corporation and the compactor-maker to begin roll out of this next generation of garbage compactors.

The Toronto Community Housing Corp., with almost 60,000 units and 160,000 tenants, predicts it could save between $1-million and $2-million a year in waste removal costs by using this next-generation of compactors that feature renewable plant-based fluids and electronic sensors to reduce garbage truck fuel consumption.

The old petroleum-based hydraulic fluid in the garbage compactors has been replaced with a high-performing bio-based lubricant formulated from canola oil grown on farms in western Canada. This new oilseed-based fluid is totally renewable, bio-degradable, and is far less toxic than traditional petroleum-based oil. It reduces greenhouse gas emissions while offering better lubricating qualities and higher viscosity than traditional petroleum-based oil.

Linnaeus Plant Sciences Inc. expects to see wider public use of its innovative, homegrown, 100 per cent renewable bio-friendly vegetable oils – products that can be used as a petro-chemical substitute – to make industrial and household lubricants, motor oils, plastics, nylon and greases. With interest from major end-users such as the Toronto Community Housing Corp., Linnaeus hopes to leverage its flexibility and take this to the next step, making a variety of bio-based oils that will benefit consumers, farmers, and all Canadians while helping protect the environment for future generations.

Agri-Therm Inc. Posts Gains in Technology Transfer and Commercialization

New legislation in Europe and the United States now requires that a sizeable and increasing percentage of domestic energy be derived from renewable sources, yet neither market has the resources or technology to meet this demand. With funding from the Agricultural Biorefinery Innovation Network (ABIN), a Canadian company has created a mobile unit that turns waste from agriculture, forestry and food processing into renewable fuel products.

Agri-Therm Inc., a spin-off company from the University of Western Ontario, has developed the first mobile pyrolysis process to rapidly convert low value bio-residue into higher-value bio-oil and bio-char and decrease the costs of transporting the raw material to conventional fixed pyrolysis plants. For example, the mobile unit can be brought directly to a logging operation where it converts low value wood chips into higher value, low volume bio-oil and bio-char with a much greater energy density than the original feedstock. Pyrolysis breaks down organic matter by using high heat in the absence of oxygen.

The Agri-Therm technology is being tested with a variety of feedstocks including agricultural residues (such as tomato and grape residues from juicing) and co-products of other energy industries (dry distiller’s grains and sugar cane residues). The versatile unit has a capacity of 10 tons of dry feedstock per day, and also produces a co-product gas which is recycled as an energy source back into the process. The operating conditions of the unit can also be adjusted, depending on the feedstock, to maximize either the bio-oil or the bio-char products to achieve liquid bio-oil yields of up to 70 per cent of the original feedstock mass.

Agri-Therm is presently designing and manufacturing the second generation mobile pyrolysis pre-commercial demonstration unit and is collaborating with ABIN researchers on bio-oil upgrading, utilization and technology transfer. This allows Agri-Therm to anticipate technological advances and future market needs and improve their mobile technology as they develop new generations of the unit. Agri-Therm will soon launch a pilot study to test their unit in the field and transfer the technology to a commercial industrial scale.

Research Spurs Biofuel Production from Agricultural Cellulosic Biomass

The most abundant biomass feedstock available for renewable bio-energy production is fibre readily found in agricultural food-crop residues such as stalks, straws and chaff, and forestry residues including wood chips and unusable damaged trees, renewable land cover like grasses and trees, plant-based garbage, and waste paper products.

The starch in wheat and corn grains is currently used as a source of fermentable sugar to make bio-ethanol in Canada. But starch is an energy-producing food product, and as a biomass feedstock, it can produce only a small fraction of the ethanol needed on a national and global scale. Cellulosic biofuels are primarily derived from the cellulose, which comes from the fibre in stalks and straws, leaving grains for human and animal consumption. The huge amount of potential energy available from plant fibre is attracting attention and investment worldwide.

In Canada, the Cellulosic Biofuels Network is helping overcome current technological and economic barriers that limit the formation of a Canadian fibre-based biofuel by investigating sustainable low-cost agricultural biomass production and working to decrease reliance on expensive physical and chemical pre-treatments. Researchers are also studying and modifying plant cell-wall composition and developing better enzymatic and fermentation tools to transform fibre efficiently into the fermentable sugars needed to produce bio-ethanol.

The breadth of the Canadian land mass with its vast agricultural and forestry base offers a tremendous advantage for the production of biomass and biofuels. The creation of a cellulosic bio-ethanol industry will also help sustain two viable domains by providing a new source of revenue for farmers, while maintaining food production capacity.

Pulse-based Diets Show Potential Health Benefits

Over the past 20 years, Canada's production of eight major pulses and specialty crops -- pea, lentil, bean, chickpea, mustard, sunflower, canary seed, and buckwheat -- has increased fivefold from 1 million to 5.6 million tonnes per year (http://www.pulsecanada.com/pulse-industry). Canadian pulse exports generated $2.2 billion and accounted for about 35 per cent of the global pulse trade in 2009. Globally, pulse consumption has continued to decline on a per capita basis but this is being offset by an ever-growing population.

With an eye toward protecting a valuable Canadian industry, pulse producers and processors are focused on firmly establishing the health and wellness benefits of pulses, creating high-value novel foods and ingredients for a larger number of food formulations, and nutraceuticals, and proving the environmental benefits of growing pulse crops. Research through the Pulse Research Network (PURENET) is significantly advancing scientists' understanding of how pulse-based diets of peas, lentils, beans, and chickpeas impact human health and has successfully developed new pulse-based food concepts and pilot products.

For example, scientists at the University of Saskatchewan are studying the effects of a pulse-based diet on cholesterol and blood glucose levels in people 50-years and older, a demographic at increased risk of diabetes and heart disease. Eighty people participated in the study and consumed a pulse-based diet twice per day for two months. A comparison of blood chemistry before and after the study period showed that the participants' fasting glucose and cholesterol levels were significantly reduced.

The Sustainable Cropping System Platforms for Biodiesel Feedstock Quantity and Quality (SBQQ) network has developed a strong field-based program for key crop species (e.g., canola, mustard, camelina, flax, soybean) and is working together to achieve their goal of ensuring an adequate supply of Canadian-grown, oil crop feedstock for use by the biodiesel industry in Canada and abroad to produce high-quality biodiesel. The network has made progress in determining how biodiesel quantity and quality are influenced by agronomic and environmental factors and is currently involved in extensive work in profiling oils, determining biodiesel sample adherence to biodiesel standards, and identifying compounds that influence biodiesel quality. They are also determining the pest management and sustainability implications of growing canola in rotations that do not have recommended levels of diversity.

ABIP Secretariat

1-866-912-2247

abip-piba@agr.gc.ca

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