

Discovering the potential of barley

“BBOP offers the potential for increased market opportunities . . . and the opportunity to put barley farmers in greater control of their product.”

Behind the Barley Bioproducts Opportunities Project (BBOP) is a belief that barley, already one of the prairies' major crops, has infinitely more potential.

The three-phase, research-based BBOP was launched in May 2007 to evaluate barley's potential in Canada's rapidly evolving biofuel, biorefining and bioproducts industries. Specifically, researchers will study the opportunities and challenges growers face to establish regional barley-based ethanol production facilities that take full advantage of barley co-products and ethanol byproducts.

This will include looking at removing valuable fractions and compounds from barley prior to ethanol production and using a major byproduct of barley ethanol production – distillers grains – in commercial applications, including various classes of livestock feeding.

Doug McBain, a Cremona barley producer and a director of the Western Barley Growers Association, says BBOP “brings barley into the energy picture. In the past, it's been dismissed out of hand [for ethanol production] because it was assumed it wouldn't work. This is an opportunity to prove barley's viability for ethanol production.”

Brian Kelly of Kelwin Management Consulting, a Manitoba-based firm evaluating the business case for barley in BBOP, describes the project as “really, really timely. Two years earlier, the enzymes [to break down barley beta-glucans and viscosity for ethanol production] were not available. And if this project was to begin two years from now, there would be lost opportunities.”

Despite recent technological developments, Carman Read, BBOP's project manager, cautions that more comprehensive research and business planning is essential to determining barley's suitability for sustainable energy and new bioproducts in Western Canada.

“That is our focus and that is what we will deliver to producers,” says Read.



Terry Young, a Lacombe barley producer and chairman of the Alberta Barley Commission, says his organization's 17,000 member/producers are eager for those answers.

“BBOP is all about giving our members and their customers a good base of regional technical and business information to assess their options for investing in barley,” says Young. “BBOP offers the potential for increased market opportunities . . . and the opportunity to put barley farmers in greater control of their product.”

Western Canadian barley producers who sell their grain in Canada for domestic uses other than human

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consumption are not required to make the transaction through the Canadian Wheat Board.

The \$380,000-project has received more than 70 per cent of its funding (\$262,000) from the Government of Canada's Biofuels Opportunities for Producers Initiative (BOPI); BOPI funding is made available



Doug McBain

through Alberta's Agriculture and Food Council, which administers Agriculture and Agri-Food Canada's Advancing Canadian Agriculture and Agri-Food Program in the province.

BBOP is jointly funded and managed by the Western Barley Growers Association and the Alberta Barley



Terry Young

Commission, and is supported by industry partners Syngenta (\$45,000), Ceapro (\$10,000), Wilbur-Ellis Canada (\$2,000) and Parkland Agri Services (\$1,000).

"Barley is already one of Western Canada's most important crops due to its role in Canada's beef industry, domestic and international malting and brewing, and agronomic rotational management," says McBain. "Our goal is to determine how Western Canada's barley producers and their customers can capitalize on the crop in new, profitable and sustainable ways."

"Our view is not 'if' but 'when' and 'how' we can tap into barley," says Read. "Barley has tremendous genetic diversity and processing technology and systems are rapidly advancing. These advancements will, in our view, make barley an important crop for biofuel production and biorefining."



Carman Read

Read leads BBOP

A former farmer and a retired executive with Monsanto Canada Inc., Carman Read is the project manager of the Barley Bioproducts Opportunities Project.

Currently president of C & N Partners, Read works with a number of agricultural agencies, associations and businesses, consulting on business development and management as well as integrated product and market strategy. His recent projects include managing the Western Barley Growers Association's cash commodity clearinghouse and assessing and developing an imple-

mentation strategy for bioproducts in Alberta for the provincial government.

During his 30-year career with Monsanto, Read developed and executed the Canadian Roundup brand strategy; played a significant role in restructuring the company's Canadian business unit; and was the company's government, farm, industry and media representative on numerous issues.

For many years, Read also ran a successful grain and oilseed farm in southeast Saskatchewan. He currently lives in Sylvan Lake.

Biodefinitions

Biofuel – solid, liquid or gas fuel consisting of, or derived from renewable biological resources such as biomass (plant or animal). Typically, biofuels are used for transportation.

Biorefining – definitions vary, but the concept of biorefining is to discover, extract and profitably use every possible element of a renewable biological resource. For example barley could be biorefined to produce starch, fibre, protein, sugar, beta-glucans and a host of other compounds.

Bioproduct – any renewable biological resource (in whole or in part) used, traded or sold in the marketplace.

Research the key to BBOP

“The project will document – in great detail – the ethanol potential and chemical composition of three barley varieties.”

The Alberta Barley Commission’s and the Western Barley Growers’ joint Barley Bioproducts Opportunities Project (BBOP) is exploring the potential of increasing barley acreage and/or production, or directing part of Western Canada’s current barley acreage for use in emerging industrial markets.

Using barley as a feedstock for ethanol production can provide significant new value-added opportunities while also continuing to provide significant feedstock to established feed and malt markets, says Terry Young, chairman of the Alberta Barley Commission and a barley farmer in Lacombe, Alberta.

For example, when whole-grain barley is used as a feedstock in ethanol production, a byproduct of the process – distillers grains – could be a source of high-value feed for certain livestock rations. As well, fractionation of whole-grain barley (coupled with innovative extraction technologies) could produce high-value compounds for a wide range of human health, nutrition and consumer products.

BBOP will also examine the potential for producers to increase their barley revenue through biorefining technologies and processes that use barley’s entire biomass.

BBOP researcher Dr. David Bressler, an assistant professor with the University of Alberta’s department of Agricultural, Food & Nutritional Science, says BBOP is focusing on three varieties of hulled and hullless barley. The project team chose the varieties because they are high-yielding and agronomically accepted.

Bressler says BBOP will document – in great detail – the ethanol potential and chemical composition of the barley varieties and how various pretreatment regimes currently used in the industry (including high temperature jet cooking and commercial enzyme “recipes”) break down the starch (the building block of ethanol) content in each variety.

“Ethanol production is similar to malting – it’s about breaking down the starch, but instead of using the grain’s own enzymes to break down starch over a period of days, we’re adding commercial enzymes to break down the starch in a matter of hours,” says Bressler.

On the feed side of BBOP, researcher Dr. Ruurd Zijlstra, also with the U of A’s department of Agricultural, Food & Nutritional Science, is analysing the distillers grains that are produced during the barley-to-ethanol process. He says the nutritional value of distillers grains vary by variety, biofuel production method and how and if beta-glucans are removed.

“Right now we want to find the least harmful production method to keep as much of the grain’s nutritional value intact as possible,” says Zijlstra. “Barley’s amino acid is very volatile to heat and the starch can cross link, making it unavailable to an animal and affecting the protein content, which is incredibly important in the nutritional value of livestock feed.”

Other potential co-products include fractionated or chemical components of barley such as beta-glucans, phenolic components and anti-oxidants.

These components could be used in everything from functional foods such as high-performance sports drinks and nutritional supplements to ingredients in anti-aging cosmetics and sun-screen lotions, says Dr. Mark Redmond, president, CEO and chief scientific officer for Ceapro Inc., one of BBOP’s industry partners.

“We’re talking about using barley as an ingredient that is measured in parts per million or about 1/1,000th of a kernel. It could be that we only need a tonne a year of it, but it will have significant value,” says Redmond.

Redmond likens the process to looking for a needle in a haystack – with two major advantages. “We know where the needle is and we have a magnet.”

What’s exciting for the barley industry is this research will demonstrate the feasibility of improving the value of barley to both producers and downstream customers.

“This is where we need to go as an industry,” says Doug McBain, a director with the Western Barley Growers Association and a barley producer in Cremona, Alberta. “Our industry has largely focused on breeding barley for the malt industry, and while important, we also need to develop – and produce – varieties that can add more value and increase barley’s domestic use. It’s how we’ll stay competitive”



Why barley hasn't been used extensively for ethanol production in North America

- Ethanol production has largely been focused on corn and wheat, two of North America's largest crops and crops with high starch percentages. In contrast to regions elsewhere in the world that don't have large corn or wheat crops, other crops – including barley – are used for ethanol production.
- Previous studies on using barley for biofuel production have shown that hulled barley plays havoc on equipment in conventional ethanol production facilities due to the abrasive nature of the hulls. Plus, hulls take up space in tanks and pipes in ethanol production, says Brian Kelly of Kelwin Management Consulting, a Manitoba-based firm advising the Barley Bioproducts Opportunities Project. "And hulls result in less starch so you get less ethanol production."
- The hull issue could be addressed by hullless barley, but currently hullless barley accounts for a relatively small percentage of North America's barley production.
- Barley's starch content (about 50 to 55 per cent) results in lower yields compared to North America's main ethanol feedstock, corn, which has a starch content of about 70 per cent.
- The high viscosity of barley mash (due to beta-glucans) increases costs, complicates production and limits co-product uses (distiller grains containing beta-glucans can't be used for non-ruminant animals). "Unfortunately in ethanol production, a sticky viscosity is like heavy oil – it's expensive to pump, slow to move and it increases costs," says Kelly.
- Studies in the U.S. have shown a relatively high number of barley varieties are grown in relatively small quantities, a drawback for ethanol facilities using barley as a feedstock.

See page 5 for "Why barley could be used extensively for ethanol production in North America."



Dr. Ruurd Zijlstra

Better feed the focus of Zijlstra's research

Dr. Ruurd Zijlstra is an associate professor of ingredient evaluation and feed processing with the Faculty of Agriculture, Forestry and Home Economics at the University of Alberta. His research focuses on evaluating the nutritional content of feed and improving feed processing to ensure livestock producers get consistent, high-quality performance from one of their most important inputs. Zijlstra's work analyses feed quality and characteristics in a variety of animals and how those characteristics vary among livestock.

Zijlstra is co-principal investigator with Dr. Jim Helm of the Alberta Field Crop Development Centre for a five-year research project establishing benchmark near infrared reflectance spectroscopy (NIRS) calibrations for major Western Canadian livestock feed. His research is giving Alberta's crop and livestock producers a better understanding of how grain varieties, including barley, and processing affect the nutritional value, digestibility and competitiveness of livestock feed.



Dr. David Bressler

Researcher focused on new uses for ag products

Dr. David Bressler is an assistant professor with the Faculty of Agriculture, Forestry and Home Economics at the University of Alberta. His research focuses on industrial applications of chemical, thermal and biological systems for the conversion of conventional agricultural products to platform chemicals, fuels and value-added commodities. He is particularly interested in developing new and better ways of converting these products. His research often takes a multidisciplinary approach, combining industrial microbiology, biotechnology and analytical chemistry with his previous experience in petrochemical conversions and upgrading. Several of his projects have been in conjunction with scale-up and engineering support by the Bio-Industrial Technologies Division (BTD) of Alberta Agriculture and Food.

Bressler's university position is a joint appointment between the department and BTD, resulting in significant research collaboration between the two organizations. One example is a major initiative to develop a comprehensive ethanol and platform chemical assessment and opportunity database. Launched in 2005, the project uses various current industrial fermentation approaches and a wide variety of Western Canadian-based crop feedstocks.

As well, Bressler is currently chairman of the Management Committee of Agri-Food Discovery Place, the U of A's pilot-scale processing facility.

Why barley could be used extensively for ethanol production in North America

- Advances in equipment and technology are making it easier and cheaper to remove the hulls from hulled barley. "Removing the hull is the simple part of what we're doing in BBOP," says Kelly.
- Ethanol production could prompt more hullless barley production.
- New varieties of barley could be bred to have higher starch content; updated analysis of existing barley varieties, production costs and co-product uses could put barley ethanol on par with corn or wheat ethanol.
- New commercial enzyme preparations, along with new processes and other related technologies, are increasing ethanol yields by improving starch conversion and converting beta glucans to ethanol. These advances can reduce the viscosity of barley mash in ethanol production and some processes remove beta-glucans from barley prior to ethanol production. When beta-glucans are removed, the result is a thinner, more mobile mash and a wider use of distillers grains, also known as dry distillers grains with solubles (DDGS).
- Barley is widely adapted to all geographic areas of the prairies. Plus, in some areas with higher moisture and shorter growing seasons, barley is expected to have significant production volume advantages over wheat, the other main crop for ethanol production on the Canadian prairies.
- Demonstrating the commercial feasibility of barley-to-ethanol and co-product facilities will lead to more contract production of barley. This trend is growing in other segments of the industry, providing certainty to both growers and processors and providing consistent feedstock for ethanol and other bioproducts.
- With numerous businesses, government agencies and producer groups in Canada and the U.S. focused on finding new processes and technologies to improve the competitiveness of barley for ethanol production, advances in biorefining will benefit barley producers across North America.

Partners bring strength, diversity and perspective to BBOP

“By working together with the BBOP partners, we’ll have more focused information and a program that’s a lot stronger for the prairies’ barley producers.”

More than funders, partners in the Barley Bioproducts Opportunities Project (BBOP) come from many industry sectors and so bring a variety of interests and viewpoints to the table.

- The **Alberta Barley Commission** will jointly manage BBOP and has contributed \$30,000 in kind to support the project’s activities.

“The way I see it, the future of Canadian agriculture and barley in particular will be through more domestic use and more valued-added production within Canada,” says Terry Young, chairman of the Alberta Barley Commission and a Lacombe barley producer. “Bioproducts give us another market for our crop and the opportunity to increase farmers’ returns.”

- The **Western Barley Growers Association** will jointly manage BBOP and provide in-kind support and administration.

“The key to BBOP is integration – we have to research, develop and use a system where everything works together. In Brazil, where they use sugar cane for ethanol production, they burn the byproduct because it’s worth almost nothing,” says Doug McBain, a director of the Western Barley Growers Association and a Cremona barley producer. “Here, if you use barley you have byproducts like distillers grains, beta-glucans and other components that have real value and demand.”

- One of the world’s leading agri-businesses, **Syngenta** is committed to sustainable agriculture through innovative research and technology. Syngenta employs 21,000 people in 90 countries around the world and is renowned for its work in crop protection, and ranks third in the high-value commercial seeds market. Syngenta is supporting BBOP with a contribution of \$45,000.

“Our interest in BBOP combines our desire to support our customers and our commitment to investing in agriculture’s future,” says Norm Dreger, the Calgary-based head of Business Development for Syngenta. “This type of project brings together people, innovation and technology – and it could create opportunities to expand agricultural-based value chains. BBOP is something we want to be involved in because it could lead to some great opportunities for our grower customers and partners as well as Syngenta.”

- Edmonton-based **Ceapro Inc.** has committed \$10,000 to BBOP and is also working on a second proj-

ect funded through the Government of Canada’s Biofuels Opportunities for **Producers Initiative** (BOPI). Ceapro is an innovative formulator and advanced processor of active ingredients, botanical extracts and therapeutic products. In turn, the company creates ingredients and formulations for effective shampoos, cleansers, moisturizers and cosmetics that are licensed and marketed worldwide.

“BBOP looks at a business model that incorporates all the components of barley – we’re not just creating one product, biofuel. We’re increasing valued-added components and developing a business model that uses all those components. Look at all petrochemicals – you get many products,” says Mark Redmond, president, CEO and chief scientific officer for Ceapro Inc. “By working together with BBOP partners, we’ll have more focused information and a program that’s a lot stronger for the province’s barley producers.”

- A family-owned business with offices around the world, the **Wilbur-Ellis Company** markets and distributes agriculture commodities and is known for its ability to find the best markets for new and existing products. In Canada, the company’s feed division includes the sale of distillers grains from ethanol and alcohol producers. Through its Lethbridge office, Wilbur-Ellis Co. Canada is contributing \$2,000 to BBOP.

“As a world leader in marketing and trading feed products, we are constantly looking for innovation and developments in our industry. We’re very interested in seeing which co-products and byproducts could be developed for our customers through this project,” says Terry Odlund, a senior trader with Wilbur-Ellis Co. Canada.

- **Parkland Agri Services** operates from nine locations in central Alberta, offering independent agricultural services and inputs to producers. The company focuses on delivering quality products and services, cutting-edge technology and knowledgeable, skilled staff to help its customers succeed. Parkland Agri Services has given \$1,000 to the BBOP.

“Barley is a good, sustainable crop to grow in central Alberta. It fits the growing conditions and it fits the needs of the beef industry,” says Parkland’s Tony Overwater. “I think we can find ways to match the needs and demands of barley producers, the beef industry and bioproducts.”

Events, trends and trivia

FEDS PUT MILLIONS INTO RENEWABLE ENERGY

By 2010, the Government of Canada will require that transport fuel contain an average five per cent renewable content and heating fuel contain an average of from renewable content. To ensure these changes benefit agricultural producer, the Government of Canada launched the Biofuels Opportunities for Producers Initiative (BOPI) in 2006. Among the projects supported by the \$20 million program are:

- Kyoto Fuels Corporation of Lethbridge which received \$277,500 in June 2007 to create a comprehensive business plan, identify the best crushing technology, evaluate seed alternatives, undertake investor consultations and develop an environmental sustainability plan.
- Gartley Farm Industries Inc. of Drumheller which recently received \$93,638 to conduct a feasibility study determining the best location for a biodiesel refinery and the best feedstock to use for the operation.
- \$45,000 to Refuel Bioproducts Corporation of Coalhurst which received \$45,000 in June 2007 to develop a concept into a profitable, competitive and functioning agri-business.

Another federal government project, ecoABC, provides repayable contributions of up to \$25 million per project to help farmers overcome the challenges of raising the capital necessary for the construction or expansion of biofuel production facilities. A \$200-million program, ecoABC will be delivered nationally by Agriculture and Agri-Food Canada. For more information, visit www.agr.gc.ca/ecoabc, call 1-866-367-8506 or e-mail ecoABC@agr.gc.ca.

ETHANOL'S GROWING IMPORTANCE

The U.S. Renewable Fuels Association reports that in 2006, ethanol production reached a record high of 4.9 billion gallons (up by more than 25 per cent from 2005) at 110 biorefineries in 19 states. Since 2000, ethanol production in the United States has increased by 300 per cent. Much of the industry's growth has been in the "Corn Belt" but facilities are online, under construction or planned for Arizona, Oregon, Texas, New York and even Hawaii.

The RFA says ethanol production supported the creation of 160,231 American jobs, put an additional \$6.7 billion into the economy and added \$2.7 billion of new tax revenue for the federal government and \$2.3 billion for state and local treasuries.

"Ethanol production is also having an important impact on rural communities that cannot be quantified but is no less important. The good-paying jobs that

follow ethanol production provide young people a reason to stay in their rural communities, as well as an opportunity for those that have moved away to come home," says the association in Industry Outlook 2007.

RENEWABLE FUELS SUMMIT SET FOR QUEBEC CITY

The Fourth Annual Canadian Renewable Fuels Summit will be held Dec. 2 to 4, 2007 at the Quebec City Convention Centre. Early bird registration for members of the Canadian Renewable Fuels Association is \$415; general early bird registration is \$520. Confirmed speakers include:

- Rick Tolman, CEO, National Corn Growers Association
- David Perlman, managing director, Fieldstone Private Capital Group Inc.
- Don O'Connor, president of (S&T)2 Consultants Inc.
- Mr. Robert Vierhout, Secretary General, European Bioethanol Fuel Association
- Ray Foot, vice-president, Sales and Marketing, Canadian Pacific Railway

For additional information, visit:

www.canadianrenewablefuelssummit.com.



GLOBAL BIOFUEL PRODUCTION SMALL BUT GROWING

In 2006, global biofuel production tipped 670,000 barrels per day, about one per cent of the world's transport fuel market, reports the Worldwatch Institute. Oil remains the world's number one transport fuel (96 per cent), but biofuel production doubled between 2001 and 2006. And production increases are expected to continue in the face of rising oil prices and the growing demand for sustainable and renewable energy sources. "Coordinated action to expand biofuel markets and advance new technologies could relieve pressure on oil prices while strengthening agricultural economies and reducing climate-altering emissions," says Worldwatch Institute President Christopher Flavin.

BBOP – what’s in it for you

The project will give producers, investors and funders reliable information on processing, operations, costs, revenues, market trends and more

The Barley Bioproducts Opportunities Project (BBOP) is designed to give barley producers information they can use in today’s new and emerging valued-added markets.

“Our primary objective is to improve farm gate returns and to offer barley producers new and diversified business opportunities,” says Mike Leslie, CEO of the Alberta Barley Commission. “BBOP will focus on four major areas: technical feasibility; business feasibility; business plan and marketing considerations; and knowledge and technology transfer plan.”

As joint managers of BBOP, the Commission and the Western Barley Growers Association will give producers and regional producer organizations evidence-based information about investing and participating in renewable fuel or other bio-industrial projects. That includes:

- Reliable scientific data on production processing and operations
- Reliable assumptions on costs, revenues and operating margins
- Reliable assumptions on end-use markets and market trends

- Operational management considerations including feedstock procurement, production and product marketing.

Additional updates will keep producers and industry stakeholders abreast of research findings and business plan developments. A final project report, expected in the spring of 2008, will be distributed in Alberta through the Commission’s Barley Country newsletter. The report will also be available through numerous project partners and producer groups.

For more information, contact:
Carman Read, Project Manager
Barley Bioproducts Opportunities Project
e: carmanread@shaw.ca
p: 403.748.4425
c: 403.748.4426
m: 97 East Lake Ramp N.E.
Airdrie, Alberta T3A 0C3

The Barley Bioproducts Opportunities Project is evaluating barley’s potential in rapidly evolving bio-based industries to provide Alberta producers and their customers with the information they need to invest in barley. BBOP is jointly managed by the Alberta Barley Commission and the Western Barley Producers Association.

BBOP manager

Carman Read
C & N Partners
e: carmanread@shaw.ca
p: 403.748.4425 c: 403.318-0972

BBOP administrator

Diane Savage
Western Barley Growers Association
e: wbga@wbga.org
p: 403.912.3998

BBOP monitoring

Darcy Kirtzinger
Alberta Barley Commission
e: dkirtzinger@albertabarley.com
p: 403.291.9111

BBOP communications

Terry Bullick
Bullick Writing & Communications
e: tbullick@telusplanet.net
p: 403.246.5225

Western Barley Growers Association contact

Doug McBain
e: dmcbain@wbga.org
p: 403.637.3880 c: 403.816.0645

Alberta Barley Commission contact

Mike Leslie
e: mleslie@albertabarley.com
p: 403.291.9111 c: 403.826.7729

BBOP address

c/o 97 East Lake Ramp N.E.
Airdrie, Alberta T3A 0C3

