

Strategy.**Science**.Success.

Research Strategy for the Canola Industry

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canolacouncil

EXECUTIVE SUMMARY

The Canadian canola industry currently contributes over \$3.5 billion in farm gate revenue, more than any other grain or oilseed crop, and the socio-economic benefits to the entire Canadian economy total \$13.8 billion.

The potential to grow the canola industry, and by extension the Canadian economy, is clear, but it will take a strategic, long-term commitment to research in order to achieve success.

Significant industry dollars are already being invested to ensure further growth of the canola industry to benefit growers, seed developers, crushers, exporters and consumers. A long-term, focused science strategy is the foundation for building the success of the canola industry.

Human Nutrition

Research has indicated that canola oil can play a favourable role in improving heart health and in managing diabetes. The industry has identified these priorities for research into canola oil's benefits for human health: heart health, diabetes; conversion and efficacy of ALA; neurological health; cancer.

Functionality

Research in this area will also help diversify food markets for canola oil and potentially create opportunities for more "designer" oils. The industry has identified the following research priorities related to food uses of canola: oxidative stability; high value components; altered fatty acid profiles

Biodiesel and Industrial Uses

Biodiesel is an emerging market for canola oil. The canola industry has identified two research priorities to advance the industrial use of canola oil in Canada: lifecycle analysis and sustainability.

Oil Content

Most of the value in canola seed is derived from its oil. Increasing oil content by 1% adds approximately \$90 million of value to the canola industry. A number of private and public research programs are already working on increasing oil content.

Meal Quality

With current varieties and production practices, canola seed produces 55-60% meal on a per tonne basis. In order to position canola meal favourably for the future, the canola industry has identified these priorities: increased meal energy content; impact of high inclusion rates; aquaculture; extracting high value components from canola meal.

Production

The canola industry has outlined a production target of 15 million tonnes by the year 2015. This can only be achieved through a combination of increased acres and increased yields, which will ultimately result in improved profitability for growers and a larger, sustainable supply of canola for the entire industry.

The canola industry has identified the following research priorities related to increasing production: improve yield; protect current yield potential; expand range of adaptation; improve disease and insect resistance; improve sustainability; introduce shatter tolerance; reduce chlorophyll content.

Long term investment in canola research can grow a healthier world

A successful research program requires a long-term investment and a commitment to continuous improvement. Partnering private and public research efforts will be necessary to achieve these goals. If these research objectives can be realized, the canola industry will make significant contributions to a healthier world through innovation, resilience and improved value.

CANOLA...GROWING GREAT 2015

The Canola Council of Canada's *Canola...growing great 2015* strategy outlines the canola industry's long-term goals for production, oil content, meal quality and market expansion. Each of these factors will play a significant role in sustainable growth and development for the industry.

Canadian canola industry's 2015 goals

Element	2006	2015 Target
Production Acres Yield	9.1 million tonnes 13 million 32 bu/acre	15 million tonnes 30% increase (17 million) 35% increase (40.5 bu/acre)
Oil Content	42.5% average	45% average
Classic to Designer Ratio	90/10	75/25
Meal	2,000 kcals/kg energy content (poultry)??	10% increase (90% of soybean meal energy level)
Export Seed	5.2 million tonnes	7.5 million tonnes
Domestic Crush Biodiesel (domestic) Biodiesel (export oil) Food (domestic & export)	3.70 million tonnes 0.05 million tonnes 0.25 million tonnes 3.40 million tonnes	7.50 million tonnes 2.00 million tonnes 0.50 million tonnes 5.00 million tonnes

In order to achieve these goals, the industry will:

- 1. Continue to innovate** across the value chain, from production to finished product.
- 2. Adapt quickly** to changes in global market, production and regulatory environments with emphasis on key markets.
- 3. Focus efforts/initiatives** on those geographical markets and market segments within them which will place value on canola's specific attributes.
- 4. Build** on our genuine belief that canola can contribute positively to improved consumer health and to a better environment.

SCIENCE-BASED APPROACH FOR FUTURE GROWTH

In today's global market, demand for healthier products and environmentally sustainable systems are ever increasing. Vegetable oils in general are experiencing tremendous pressure due to demand from human, animal and industrial uses. This demand has increased commodity prices of oilseed crops and has had a significant impact on global economies.

The Canadian canola industry currently contributes over \$3.5 billion in farm gate revenue, more than any other grain or oilseed crop, and the socio economic benefits to the entire Canadian economy total \$13.8 billion. Canola has a positive impact and a competitive advantage over other oilseeds.

Future demand for canola will be driven primarily by three factors: the benefits of canola for human health; its utility as a food ingredient; and its suitability for use as a feedstock for biodiesel or other industrial uses. Increased demand for canola will also be influenced by global trends such as increasing food demands of a growing population, desire for healthier diets and increasing demand for sustainable production practices. In order to meet these goals, further research into human health benefits, food uses and environmental considerations is necessary.

The potential to grow the canola industry, and by extension the Canadian economy, is clear, but it will take a strategic, long-term commitment to research in crop development, agronomic practices and human and animal nutrition to achieve success.

The canola industry has a strong commitment to science and recognizes the need to develop new solutions to health, environmental and production issues in order to meet its 2015 objectives. Recent industry success, such as achieving a qualified health claim in the U.S., has demonstrated the critical role ongoing research plays in the advancement of the industry.

A long-term, focused science strategy covering a broad range of disciplines including human clinical nutrition studies, animal nutrition studies, genomics work, fundamental agronomy, disease resistance research and germplasm development are all part of the future success of the canola industry. Significant industry dollars are already being invested to ensure further growth of the canola industry to benefit growers, seed developers, crushers, exporters and consumers. But more is needed.

HUMAN NUTRITION

Canola is known internationally as one of the healthiest vegetable oils available. It is low in saturated fat, high in monounsaturated fat, and has an excellent balance of omega-6 and omega-3 fatty acids. Research has indicated that canola oil can play a favourable role in improving heart health and in managing diabetes.

The Canola Council recently convened a research workshop and invited leading scientists from across Canada and the US to identify research gaps and pinpoint opportunities for canola oil research. This information is being used for the development a strategic research plan. Following are some of the priorities identified in the research workshop:

- 1. Heart Health** – Canola’s low saturated fat content has long been accepted as beneficial for heart health, and has an established positive effect on blood lipids. However, interest in blood lipids as a risk factor for cardiovascular disease is falling rapidly, and the tides are turning in favour of markers of inflammation, oxidation, and endothelial function. The effect of canola oil on these emerging risk factors of cardiovascular disease is most likely favourable, but is not well documented. Preliminary clinical trials investigating these risk factors are underway, but further research is necessary, particularly in the areas of canola oil and its positive effects on inflammation and vascular function.
- 2. Diabetes** – Inflammation has recently been implicated as being a significant co-factor in the development of type 2 diabetes. Canola oil may have a significant positive impact on this disease through its effects on inflammation, glycemic index and insulin resistance, thereby improving patients’ ability to manage the disease through diet. Proof of concept work is underway on canola oil and glycemic index and insulin resistance, but detailed clinical studies on canola oil and diabetes are required. Also of interest would be studies done in an animal model to identify what components of canola oil are having a positive effect on these parameters.
- 3. Conversion and direct benefits of ALA** – Although fish is considered the main source of essential omega-3 fatty acids, canola oil is also an excellent source. There are questions about the ability of human metabolism to absorb and elongate plant-based ALA into DHA, which is thought to be the more important form. Preliminary investigations indicate that this conversion is not very efficient, but it is not known if this means ALA is not important in the human diet. Epidemiological evidence shows that ALA has dramatic heart health benefits. In addition, preliminary research has shown that ALA shows unique postprandial vascular benefits which are independent of its conversion to DHA. More research is needed in this area, as well as in the methodologies used to measure conversion and accumulation of ALA, and the role of ALA in reducing inflammation.

FUNCTIONALITY

Canola's light taste, high smoke point and healthy fatty acid profile are some of the main reasons for its strong demand from the food industry. Most recently, the quest for *trans* fat solutions has led to increased interest in canola oil. This demand coupled with interest in reducing saturated fat content and a greater general awareness of health concerns has created significant challenges for the food industry as products need to be reformulated to meet consumer expectations. Research in this area will also help diversify food markets for canola oil and potentially create opportunities for more "designer" oils.

The canola industry has identified the following research priorities related to food uses of canola:

- 1. Oxidative stability** – This factor is a concern both in terms of shelf life and fry life. One major area that requires investigation is the impact of processing techniques and conditions on oil quality, especially oxidative stability.
- 2. High value components** – Several high value components have already been identified in canola oil, including anti-oxidants and phytosterols. Research is required in order to identify other high value fractions, develop methods for extracting these products, and understand their impact on human health.
- 3. Altered fatty acid profiles** – While the demand for canola oil's traditional oil profile is increasing, additional fatty acid profiles such as high stability canola oil with increased oleic acid and/or reduced linoleic acid have entered the marketplace through identity preserved programs. These products have demonstrated that modifying the fatty acid profile can significantly improve functionality and demand for canola in certain markets. Further development of altered fatty acid profiles has the potential to add significant value through enhanced human health and nutrition, development of nutraceuticals, and expanded functionality.

BIODIESEL AND OTHER INDUSTRIAL USES

Biodiesel is an emerging market for canola oil. Canola has a fatty acid profile that is well suited to biodiesel production as demonstrated in Europe. Consumers are increasingly aware of environmental issues, and sourcing fuels, plastics and other resources from renewable sources has become a factor in canola purchasing decisions.

Although some research has been done on biodiesel production using canola or other similar feedstocks in other geographies, Canada has a unique set of challenges in terms of climate and geography that demand further investigation.

The canola industry has identified two research priorities to advance the industrial use of canola oil in Canada:

- 1. Lifecycle analysis** – A complete lifecycle analysis on the use of canola as a feedstock for biodiesel in Canada has not been published. Currently, many studies rely on work done in other geographies that clearly do not apply in the Canadian context. One example would be nitrous oxide emissions. These have been identified as being a problem in *Brassica* cultivation in warmer climates but are unlikely to be anywhere near as high in Canadian conditions. Lifecycle analysis should specifically examine the carbon and energy balance of biodiesel produced from canola grown under Canadian conditions, using Canadian production practices.
- 2. Sustainability** – Consumers seem to be increasingly concerned about the sustainability of practices used to produce the products they use. A comprehensive study examining canola's role in water usage and watershed management, nutrient management, carbon sequestration and other practices related to sustainable production needs to be undertaken. This kind of research will aid better understanding of canola's place in cropping systems, and it will determine which current practices are most sustainable and which should be changed.

OIL CONTENT

Most of the value in canola seed is derived from its oil. Increasing oil content by 1% adds approximately \$90 million of value to the canola industry. Higher oil content also makes Canadian canola more competitive versus oilseeds from other geographies.

Higher oil content varieties – Using advanced breeding techniques to identify and enhance germplasm for higher oil content will lead to higher oil content varieties for growers. A number of private and public research programs are already working on increasing oil content.

MEAL QUALITY

With current varieties and production practices, canola seed produces 55-60% meal on a per tonne basis. Canola meal is used primarily as animal feed, particularly for dairy cows. With large supplies of distiller's dry grains (DDGs) and increased soy meal availability, protein markets will be under pressure.

In order to position canola meal favourably for the future, the canola industry has identified by these priorities:

- 1. Increase meal energy content** – Increasing the metabolized energy content of canola will be an important step in increasing inclusion rates for livestock and monogastrics such as swine and poultry. There are three main areas to be investigated to improve meal energy content:
 - a. Breeding – Use breeding strategies to develop new varieties that yield higher meal energy values through reduced fibre content and/or increased digestible carbohydrate content;
 - b. Processing – Current processing technology damages meal, particularly in the toasting phase. Investigating alternate processing strategies such as vacuum assisted de-solventization or reduced processing temperatures could lead to improved processing technology that would generate a higher energy meal. A survey of existing commercial meals is an important part of understanding what practices are being used today and the impact of various processing regimes on final meal quality.
 - c. Enzymes – The addition of enzymes to meal either after processing or in feed processing could break down some of the fibre components, yielding a higher metabolized energy from canola meal for the animal. Research could provide the fastest and most cost-effective solution.
- 2. Impact of high inclusion rates** – High inclusion rates of canola meal provide challenges to many kinds of livestock. Although some research into this area was done 15 to 20 years ago, new research is needed to understand the impact of high canola meal inclusion rates on feed efficiency, carcass quality, and the accumulated effects of anti-nutrient components like glucosinolates, sinapines, tannins and phytate. With the availability of relatively cheap protein sources such as DDGs and soy meal, feed manufacturers will be looking to increase the protein content of feeds which can also act as an energy source for livestock. Generating current data on high inclusion rates for canola meal will be necessary to maintain demand levels.
- 3. Aquaculture** – This has become a growing, high-value market for high protein and energy feeds. Research is needed to understand the potential role for canola oil and meal as components of aquaculture feed. Preliminary studies indicate that canola meal is a promising feed component and that the fibre content does not pose a problem in fish diets.
- 4. Extracting high value components from canola meal** – This is a way to significantly improve the value of canola meal while providing ingredient sources for food, feed and pharmaceutical manufacturers. Research looking at ways to identify potential products and extract them from canola meal is already under way. Bioactive peptides and protein isolates have already been identified as having commercial potential. More research is needed to identify further high-value components, develop extraction protocols and confirm their utility in human, animal or processing systems.

PRODUCTION

With world vegetable oil demand rising rapidly, the world's oilseed producers will struggle to keep up with demand. The canola industry has outlined a production target of 15 million tonnes by the year 2015. This can only be achieved through a combination of increased acres and increased yields, which will ultimately result in improved profitability for growers and a larger, sustainable supply of canola for the entire industry.

Recent significant advances in the canola industry have improved yields and production opportunities. Private and public sector breeders have provided the industry with a steady flow of cultivars with improved yield, herbicide tolerance, disease resistance and maturity. Canola growers have readily adopted new technology as it has been introduced. Today over 98% of the crop is sown to herbicide-tolerant cultivars and over 65% of the crop is sown to hybrids. Ongoing improvements in cultivar development must be maintained, and new traits need to be developed. This research is being conducted by both private and public programs.

Unfortunately, research into best management practices has not kept up with the flow of new cultivars. There is a serious need for research into agronomic practices that can make the best use of the new characteristics. Identifying the practices that will allow growers to achieve maximum genetic potential, sustain disease resistance packages, and manage rotations is just as important as the innovations themselves.

The canola industry has identified the following research priorities related to increasing production:

- 1. Improve yield** – Improving yields through high performance genetics is one of the most important areas for current and future research. Currently there is significant private and some public investment in this area. Public investment is important to sustain yield improvements for the industry overall. Public breeding programs provide important germplasm and trait development pipelines that are used by private breeding companies.
 - a. Agronomic practices – Crop production research is required to identify the correct and most profitable management practices in a wide range of environments in order for growers to make maximum use of new varieties.
- 2. Protect current yield potential and improve achieved yields through abiotic stress tolerance** – The environment continues to be the number one factor in reduced yields. Development of traits that will provide tolerance to drought, frost, heat, and other stress factors will protect existing yield potential and allow growers in areas that are frequently affected to achieve higher yields.
- 3. Expand range of adaptation** – Canola is grown in Canada on 12-13 million acres annually. In order to sustainably achieve higher acreages, research into cultivars that allow canola to be grown over a wider area is needed. For example, products that have significantly improved maturities would better suit the early season zone; the introduction of more drought and heat tolerance through products such as *Brassica juncea* would fit the brown and dark brown soil zones; and introduction of more cold-tolerant winter canola varieties would be helpful in several regions.

- 4. Improve disease and insect resistance** – Disease and insect pests continue to rob canola growers of yield and dollars. Incorporating resistance into cultivars or developing new products or practices that would reduce pest pressures would significantly improve producer profitability and reliability. Priority areas include:
- a. Clubroot – Currently there are no canola products with resistance to clubroot in Canada. Developing management practices and resistant cultivars is a top priority for the industry. Currently growers and industry are funding research into the disease and the development of resistant germplasm, but more needs to be done in this area.
 - b. Blackleg – This disease continues to be a major factor in canola crop management. Pressure placed on the pathogen through rotations and resistant genes have resulted in changes in the pathogenicity that need to be better understood. New resistant genes must be identified and deployed in future cultivars.
 - c. Sclerotinia – This is perhaps the most economically significant canola disease in Canada. New chemistries are being introduced for control, but longer-term solutions such as genetic resistance or avoidance in future cultivars could be a more consistent solution.
 - d. Beneficial insects – Beneficials represent a significant mitigating factor in the control of insect pests. More research into identifying beneficial insects, identifying management practices that favour their development and understanding how they affect economic thresholds for control would assist growers in making better control decisions and improve the sustainability of their operations. Some public sector and grower-funded research into beneficial insects is occurring.
- 5. Improve sustainability** - The introduction of new traits such as nitrogen use efficiency (NUE) or water use efficiency (WUE) can help improve sustainability of canola production. Products like these represent an opportunity to significantly improve profitability, sustainability and reliability of canola. Significant industry research into areas like NUE and WUE are already under way, but many approaches require investigation to ensure successful products get into growers' hands.
- 6. Introduce shatter tolerance** – Introducing tolerance to shattering would reduce yield losses, enable straight cutting of canola, increase oil content and decrease chlorophyll content. Development of cultivars with shatter tolerance is already under way in both private and public research programs, but more research and development is required to make a variety with improved shatter tolerance available.
- 7. Reduce chlorophyll content** – Chlorophyll content (green seed) is a significant economic factor in the canola industry, and in some years is responsible for reduced grades for growers and increased costs for processing oil. Developing varieties that are able to clear chlorophyll faster or otherwise reduce the amount of chlorophyll in the crop would represent a significant cost savings for the industry. Research into understanding the pathways involved in reducing chlorophyll content and developing lower chlorophyll varieties is needed.

LONG TERM INVESTMENT IN CANOLA RESEARCH CAN GROW A HEALTHIER WORLD

The canola industry is already engaged in many kinds of research, from human clinical trials to canola variety development. Sustaining the growth of the canola industry depends on its ability to access sufficient research funds to accomplish projects in each of these priority areas. A successful research program requires a long-term investment and a commitment to continuous improvement. Partnering private and public research efforts will be necessary to achieve these goals. If these research objectives can be realized, the canola industry will make significant contributions to a healthier world through innovation, resilience and improved value.

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2008 CANOLA RESEARCH

Canola industry members, including the Canola Council of Canada, Alberta Canola Producers Commission, Saskatchewan Canola Development Commission and Manitoba Canola Growers Association are funding approximately \$2,602,113 worth of research projects in the 2008 fiscal year. This amount represents the annual contribution and not the total contribution to these projects, most of which are 3-5 years in duration.

Germplasm Development

Project Title	Institution	Industry Funding
Developing high yielding Brassica rapa cultivars with resistance to brown girdling root rot, blackleg, white rust and clubroot	AAFC	\$40,000
Development of stem rot resistant Brassica napus canola for western Canada	AAFC	\$45,000
Sclerotinia resistance genes in canola	AAFC	\$33,000
Development of a new industrial oil seed crop for hydroxyl fatty acid production	Plant Biotechnology Institute	\$20,000
Rapa varietal development program	AAFC	\$85,178
An integrated approach to Clubroot in canola development of resistant germplasm and breeding strategy	University of Alberta	\$86,538
Evaluation of winter Brassica rapa for cultivation in Alberta	University of Alberta	\$27,050
Integrated management of Clubroot of Crucifers	University of Alberta	\$38,956
Antifungal peptide from pine for multiple disease resistance in canola	University of Alberta	\$21,563
Evaluation of resistance to flea beetles in PR10 transgenic canola	University of Alberta	\$27,872
Subtotal		\$425,157

Utilization Research – Industrial Products

Project Title	Institution	Industry Funding
Bio Bus III – Biodiesel hybrid bus evaluation		\$21,600
Production of Epoxidized Canola Oil (ECO)	University of Saskatchewan	\$39,795
Biodiesel and lithium grease production technology	University of Saskatchewan	\$110,000
Lubricant base oils from oilseed	University of Saskatchewan	\$150,000
Production of propylene glycol from crude glycerol: a value addition to canola biodiesel industry	University of Saskatchewan	\$36,400
Alberta-Bunge industrial Chair in lipid utilization	University of Alberta	\$100,000
Subtotal		\$457,795

Utilization Research – Canola Meal

Project Title	Institution	Industry Funding
Influence of feeding increasing amounts of pressed canola cake on grow-finish pig performance in a commercial environment	University of Saskatchewan	\$42,400
Amino acid utilization and peripheral tissue metabolism in ruminants fed full fat canola based diets	University of Saskatchewan	\$20,000
The use of canola, pea and flax fractions in aquafeeds	University of Saskatchewan	\$10,560
Development of functional protein products from canola/rapeseed meal	AAFC	\$60,000
Maximizing the use and value of canola meal and full-fat canola seeds by defining their digestible and net energy values in growing pigs and adult sows	Prairie Swine Centre	\$26,000
Trimethylamine research with laying hens - genetics of egg tainting in chickens	University of Saskatchewan	\$7,575
Preparation of high digestibility canola meals from regular canola and yellow seeded canola	POS Pilot Plant	\$115,000
A new, high energy canola meal for poultry and swine: The effect of yellow seed coat, processing and enzyme supplementation	University of Manitoba	\$20,000
Estimation of the net energy content of six samples of canola meal in growing pigs	Prairie Swine Centre	\$24,000
Evaluation of yellow seeded canola products for poultry	Nova Scotia Agricultural College	\$19,000
Subtotal		\$344,535

Utilization Research – Canola Oil

Project Title	Institution	Industry Funding
Efficacy of consumption of canola and flax oils in management of hypercholesterolemia and other disease risk factors	University of Manitoba	\$108,000
Monounsaturated and n-3 fatty acids, oxidative stress and inflammation in adults at risk for type 2 diabetes	University of British Columbia	\$110,000
Effect of canola oil on glycemic control and coronary heart disease and risk factors in type 2 diabetes	University of Toronto	\$308,000
Adding value to canola: Identification and extraction of antioxidative component(s)	University of Manitoba	\$90,000
Subtotal		\$616,000

Agronomic Research

Project Title	Institution	Industry Funding
The development of a semiochemical monitoring and detection system for the diamondback moth on canola	University of Alberta	\$27,735
Determination of pathogenic variability of <i>L. maculans</i> in Western Canada and resistance in Canadian <i>B. napus</i> cultivars	AAFC	\$25,000
Impact of timing, rate and application technology on biological control of <i>Sclerotinia</i> stem rot	AAFC	\$25,000
Reducing seedling blight to improve stand establishment in hybrid canola	Alberta Agriculture	\$20,000
Identifying agronomic practices that conserve and enhance natural enemies of insect pests of canola	University of Alberta	\$38,525
Investigation on the individual genes of <i>Brassica carinata</i> in canola for their resistance to blackleg pathotypes	University of Alberta	\$33,333
Development of reduced-risk strategies through coordinated monitoring, forecasting and risk warning systems for insect pests	AAFC	\$36,000
A large-scale survey of races of <i>Leptosphaeria maculans</i> occurring on canola in Western Canada	AAFC	\$50,000
Impact of traditional and enhanced efficiency phosphorus fertilizers on canola emergence, yield, maturity and quality	AAFC	\$15,525
Seedborne transmission of clubroot of canola: evaluation of significance and control	University of Alberta	\$9,000
Survey and evaluation of soil micro-organisms for control of clubroot on canola	AAFC	\$26,257
Development of bio-climatic models to forecast potential distribution and severity of clubroot in western Canada	AAFC	\$23,751
Effect of non-host crops and host management on clubroot of canola	University of Alberta	\$10,338
Managing canola for a sustainable biodiesel platform	AAFC	\$29,100
Antifungal peptide from pine for multiple disease resistance in canola	University of Alberta	\$43,125
Evaluation of resistance to flea beetles in PR10 transgenic canola	University of Alberta	\$20,872
Delaying nitrogen fertilizer application to optimize harvest yield of canola in Saskatchewan	East Central Research Foundation	\$10,800
Economic adaptation of canola quality <i>Brassica juncea</i> and sunflowers across soil-climatic zones	AAFC	\$20,000
Pod shatter resistant canola	AAFC	\$35,000

Evaluating in-season yield potential in canola using the GreenSeeker sensor	Indian Head Agricultural Research Foundation	\$21,160
Hybrid canola's response to high fertility regimes in east central Saskatchewan	East Central Research Foundation	\$8,000
To evaluate the pre-harvest crop management strategies of straight cutting, desiccation, pushing and swathing in Argentine and Polish canola on the effects of yield characteristics	South East Research Farm Inc.	\$7,000
Optimizing harvestability of oilseeds for profitability	Wheatland Conservation Area Inc.	\$14,000
Integrating drift reduction technologies with agronomic practices	WARC	\$4,000
Fertilizer N efficiency and utilization on weeds and crops in a canola-barley rotation study	WARC	\$25,000
Cultural control of seedling blight in hybrid and specialty canola	Alberta Research Council	\$4,000
Determining the economic plant density in canola	University of Saskatchewan	\$9,135
Evaluating canola and other crucifer cultivars for food and biodiesel oil production on saline lands	AAFC	\$6,500
Engineering plants with improved phosphorous usage efficiency by modifying glycerolipid metabolism	Plant Biotechnology Institute	\$18,000
Minimizing harvest losses and improving seed quality in canola using Spodnam	Wheatland Conservation Area Inc.	\$4,000
Agronomy of Camelina sativa	AAFC	\$12,650
Canola Production Research Phase III - Western Canola Agronomy	AAFC	\$100,000
Managing canola for a sustainable biodiesel platform	AAFC	\$15,820
Growing season weather impact on canola (<i>Brassica napus</i>) quality in western Canada	University of Manitoba	\$10,000
Subtotal		\$758,626