National Sunflower Association of Canada

National Sunflower Research Strategy

Prepared for:
Special Crops Value Chain Roundtables (SC VCRT)

Executive Summary:

Sunflower (*Helianthus annuus L.*) is native to North America and the only native oilseed in the northern Great Plains Region. It has been grown commercially in Canada since the early 1940's. The National Sunflower Association of Canada (NSAC) is a leader in the sunflower industry in Canada. NSAC is a producer funded organization representing approximately 400 growers of both confection and oilseed sunflowers across the Prairie Provinces. Although sunflowers are not a new crop, there are many research needs. Very little investment in research is conducted in Canada because sunflowers are considered a small acreage crop. Through extensive consultation, this Research Strategy was developed to help NSAC to prioritize research needs, to target their limited efforts and resources and to create more focused applications for research funding in the future. This Strategy contains both broad and specific research opportunities required to increase innovation within the sunflower industry in Canada. Research needs within the areas of agronomy, pest management, plant breeding, economics, market development, and value-added were identified. Collaboration within and outside the Canadian sunflower industry is ongoing and there are further opportunities identified within the Strategy. This will ensure implementation of such research is coordinated and avoids duplication.

Background:

The National Sunflower Association of Canada (NSAC) is a producer funded organization with a mission to "insure the profitability and long term growth of the sunflower crop through industry wide leadership". The Board of Directors is comprised of representatives from all sectors of the sunflower value chain – growers, processors and exporters, buyers, researchers, extension specialists, life science manufacturers, and the Canadian Grain Commission. The majority of the Board members are elected growers (seven) with six appointees from various sectors of the sunflower industry and two NSAC staff rounding out the Board (http://www.canadasunflower.com/about/board-of-directors/). A key focus for NSAC is to build relationships with stakeholders from the entire sunflower value chain. In recent years, NSAC's emphasis has been to address issues of genetics, pest management, and building the Canadian Sunflower Brand.

NSAC was initiated by a group of industry stakeholders in 1996. The group met to address the significant drop in sunflower acreage as a result of the closure of an industry-leading oil crushing facility in Manitoba. The majority of sunflowers grown in Canada are grown in Manitoba, approximately 90 percent. The remaining acres are produced in southeastern Saskatchewan, with smaller regionalized production in south central Alberta, and southern Ontario.

Sunflower acreage in Canada was as high as 300,000 acres (121,000 ha) in the 1980's. For the previous four growing seasons, Statistics Canada reported sunflower seeded acres as:

- 133,000 acres (54,000 ha) in 2010
- 35,000 acres (14,200 ha) in 2011
- 100,000 acres (40,500 ha) in 2012
- 70,000 acres (28,300 ha) in 2013.

In recent years, sunflower acres have been competing against other annual crops such as canola, soybeans and grain corn. These other commodities have been more attractive due to perceived increased profitability, ease of management/production, reduced equipment investment, etc.

There are two types of sunflowers grown in Canada – oilseed and confection type. Approximately 65 to 75 percent of the acres in Canada are confection type. Oilseed sunflower seeds are usually smaller and darker black in colour than confectionary. Oilseed varieties contain between 38 to 50 percent oil and are important in the vegetable oil market domestically and internationally. There are four different oil profiles: traditional, mid-oleic (NuSun), high oleic, and high stearic/high oleic. NuSun varieties, which are less prone to oxidization, do not need hydrogenation to produce stable products with zero trans fatty acids. The latter is the newest oil type and the oil is called Nutrisun®. This new oil is marketed as a replacement for partially hydrogenated oils or tropical oils with higher saturate levels.

Sunflower oil is very high in polyunsaturated fatty acids and is used for frying or in products such as salad dressings, shortenings or margarines. After crushing for oil, the meal, which is usually about 35 percent protein, is used in livestock rations.

Large oilseed sunflowers (those that are larger than a number eight sieve/screen) can be dehulled and marketed as 'human edible' and sold into the bakery industry worldwide. A premium of approximately $0.02 per lb is available for large oilseed sunflowers designated as human edible. Quality is crucial with insect damage tolerance levels at two percent or lower. The market for hulls is currently limited but includes such uses as poultry bedding and as an alternative biomass heating source.

When insect damage is greater than two percent or the seed size is too small, oilseed sunflowers are then destined for the birdfeed market. Manitoba, where the majority of Canadian sunflower production is concentrated, does not have a large scale crushing facility, and therefore, most oilseed sunflower production is processed for the birdfeed market or exported raw to crushing facilities in the United States.

Confectionary sunflowers have a larger seed size, with a slightly lighter hull colour and a prominent white stripe. Confectionary sunflowers are marketed three ways: in shell, as kernels and birdfeed. Large sunflower seeds (in shell) are roasted, salted and packaged for human consumption in the snack food market. In shell confectionary sunflowers are sold domestically but also exported into the United States, Germany, Holland, Belgium, Japan, Mexico, South America and Middle Eastern countries. Medium-sized seeds are dehulled and used primarily in the baking industry. Dehulled confection types are marketed both domestically and internationally into countries such as United States, Belgium, Germany, Netherlands, and China. Smaller confectionary types are marketed into the North American birdfeed market as 'striped bird food'.

Since in shell confectionary sunflowers are destined for human consumption, there is little tolerance for contamination from pests (insects or disease) or presence of other off-crop types (eg. potential allergens or cause dental injury). Like oilseed sunflowers, the threshold for human consumption is two percent damage/off-type or lower. Historically, confectionary sunflowers that achieve the highest grade have obtained a $0.10 per lb premium in the market place. Quality is crucial. Middle Eastern markets request long seed type confections due to their single seed consumption habit when eating sunflowers. Accessing these markets is difficult with many of the current round shaped varieties available. As well, the appeal of confectionary sunflowers with round seed type to the North American industry is uncertain. Their use has been declining with the Canadian sunflower seed acreage and the potential for market share growth could be limited.

Typically, 65 to 75 percent of the total Canadian sunflower acreage is designated to confection-type production. In the United States, a major global competitor, approximately 65 percent of the total sunflower acreage is designated to oilseed-type production.

Research Strategy Development Process:

A stakeholder meeting was held in November 2013 with a number of representatives from the sunflower value chain in attendance (see Appendix 1). Prior to attending the meeting, each invited participant was provided with a 'pre-questionnaire' to help identify research needs, gaps, opportunities, etc. A copy of the pre-questionnaire is attached in Appendix 2. One of the seed representatives shared the pre-questionnaire at a regional meeting with seed dealers/distributors and those responses were also received and compiled.

In addition, grower input was garnered through an informal telephone 'survey'/conversation. Six growers who grew sunflowers in the past but had decreased their acreage base or no longer grew sunflowers were contacted. They were asked what would it take to significantly increase their sunflower acreage or why they no longer grew any, what was limiting sunflower expansion or innovation, what opportunities needed to be capitalized on, and what research priorities NSAC should focus on in the short (3 years) and long term (5 years plus). Six current growers with a consistent sunflower acreage were also contacted for their input. They were asked why they continued to grow sunflowers, what one thing was missing in the industry to make it thrive, what opportunities needed to be capitalized on, and what research priorities NSAC should focus on in the short and long term.

In total, 29 responses were compiled to initiate the discussion at the stakeholder meeting in November 2013. A summary of the responses was presented as a PowerPoint presentation at the outset of the meeting. It was very useful in initiating discussion and beginning the process of identifying research needs. A copy of the PowerPoint presentation can be made available if required. The presentation outlined industry challenges, opportunities, and subsequent research needs.

Based on feedback from the presentation, broad research needs were determined and categorized. Next specific research opportunities were identified under the various categories when feasible. Finally, participants were asked to prioritize the research needs identified. Again the goal of the meeting was to receive input and some consensus from the entire sunflower value chain which included: growers, processors and exporters, buyers, breeders and researchers, extension commodity specialists, seed industry representatives and pest management/life science partners. The meeting was quite successful and one example of the entire sunflower value chain working towards the common good of the industry.

Research Needs Identified:

1) Variety Breeding/Genetic Enhancement

It was unanimous that this is the most important area for the Canadian sunflower industry to focus its efforts and allocate resources. As one participant pointed out during the stakeholder meeting, without access to better genetics all of the other research areas are irrelevant. Access to improved, more innovative varieties is fundamental to the success of the Canadian sunflower industry.

Currently there are no sunflower breeding programs in Canada, either public or private. At present, two varieties hold 80 percent of the sunflower seed market share and the two varieties are distributed by one company. One of these two varieties is more than 20 years old and continues to perform but market access is limited due to its round seed size that is unattractive to new and emerging international markets preferring longer seed size. The other variety is newer and has wider market access; however, quality has been inconsistent.

Essentially, the Canadian sunflower industry is dependent on American seed research and seed supplies. This is problematic, again since a majority of the acreage in the United States is oilseed-type production. In addition, varieties are not completely adaptable to Canadian climatic conditions. As a result, the Canadian industry is at a disadvantage because it cannot access a range of seed varieties that would help stabilize annual yields and help ensure consistent quality. Canadian sunflower acreage is limited, and therefore, public and private investment into sunflower breeding is also limited.

In 2011, NSAC received funding under the Canadian Agriculture Adaptation Program (CAAP) for their '*Confection Sunflower Variety Development Initiative*' project. The objective of the three year project is to develop adaptable confection hybrids with desirable seed type for the Canadian market. The breeding program intends to select confection sunflowers that are early maturing (less than 120 days to maturity), high yielding (1500 lbs per acre (1680 kg/ha)) with adequate bushel weight, long or extra long seed size, and desirable seed colour (black with prominent white stripe). A secondary objective is to incorporate a herbicide tolerant trait into the adapted hybrids. Preliminary results from the project show potential and it is crucial that this type of research continues. Building on the success of this project, it was felt that NSAC should leverage more funding for breeding research on behalf of the sunflower industry.

Single Nucleotide Polymorphism (SNP) marker technology is currently being used in the breeding initiative and it is important that this continue. This is being done in a consortium with the National Sunflower Association in the United States. It is currently being used for disease screening (eg. downy mildew, rust) and accelerates the selection process as more plants can be screened more rapidly and with less investment.

Another desirable variety trait identified as a research need in plant breeding was standability. This can infer a variety trait or may be a factor of disease tolerance (eg. stalk rot or *verticillium* wilt). Genetic disease resistance should be, when possible, inserted into the breeding lines. For instance, downy mildew, rust and *verticillium* wilt resistance genes are identified and have been inserted into many new commercial sunflower hybrids released in the United States. These resistance genes are available from the United States Department of Agriculture (USDA) and could be inserted into varieties being bred for the Canadian industry. Some are currently only within oilseed-types but USDA is beginning to experiment with insertion into confection-types. The sunflower industry in Canada recognizes it is involved in trait utilization rather than trait development. As a result, collaboration with public institutions, such as the USDA and their genetic resources, are crucial.

Collaboration with private industry was also identified as an opportunity. At the stakeholder meeting a number of seed representatives noted that due to the relatively small number of sunflower acres in Canada, their companies cannot justify significant investments into sunflower research.

2) Disease Management

One of the major limitations to sunflower production and profitability is *Sclerotinia sclerotiorum*. Sunflower is susceptible to *Sclerotinia* infection from emergence to maturity and disease damage can be significant (both in production and in quality). Management of *Sclerotonia* is a high priority to the Canadian sunflower industry. *Sclerotinia* can affect the sunflower plant in a number of ways resulting in three different disease types: *Sclerotinia* wilt or basal rot, *Sclerotinia* mid-stalk rot, and *Sclerotinia* head rot. There are a number of research opportunities that can help address *Sclerotinia* management:

- Fungicide options. A number of foliar fungicides have been investigated by AAFC, Morden, MB that resulted in disease suppression. Some of these products were experimental and others are registered in other crops but not currently in sunflowers. Other new foliar fungicide products could be evaluated for their efficacy on sunflowers. There is an opportunity for the sunflower industry in Canada to support minor use applications of pesticides such as these for suppression of *Sclerotinia*.
- Fungicide timing. Recently, penthiopyrad was registered for *Sclerotinia* suppression in sunflowers and there is potential for picoxystrobin to obtain a registration for suppression in the future. The current label for penthiopyrad instructs growers to "begin applications prior to disease development and continue on a 7 to 14 day interval. Use higher rate and shorter interval when disease pressure is high" (*Guide to Field Crop Protection, 2014*). There is a need for research on fungicide timing to help discern under what conditions/circumstances the latter application instructions should be followed and how plant staging and environmental factors affect application decisions and efficacy. Another important component is communicating and educating growers about optimal and judicious use of fungicides for *Sclerotinia*. Research needed for fungicide timing can include scientific and applied research.
- Disease forecasting. *Sclerotinia* damage can be significant but investigation of best management practices (BMP's) (eg. monitoring and disease forecasting) may help with its management. There may be an opportunity to monitor and forecast *Sclerotinia* risk via the establishment of spore traps, *Sclerotinia* spore testing techniques and using weather data to predict spore production and subsequent disease severity/risk. Using such BMP's has the potential to improve fungicide performance and management (eg. some infections may require more than one application per season or some infections may require only one application but later in the season). This research area may include small plot scientific research but also on-farm applied research. Growers and the research community can work together to address these issues.
- Genetic resistance. Recognized as a long term goal, this is the most desirable and effective strategy for *Sclerotinia* management in sunflowers. The USDA has a National *Sclerotinia* Initiative (http://www.ars.usda.gov/Research/docs.htm?docid=20122) which is coordinated by their research agency, the Agriculture Research Service (ARS). The ARS-led National *Sclerotinia* Initiative's objective is to neutralize the disease's economic threat to seven different crops, including sunflowers, but also soybean, canola, edible dry beans, chickpeas, lentils and dry peas. This Initiative is a consortium of several federal and state university scientists and five crop commodity groups. One of the sources of genetic resistance being explored is in the native perennial sunflower (*Helianthus spp.*). AAFC Research Scientist, Dr. Khalid Rashid, Morden, MB., has collected more than 400 different accessions of wild perennial sunflower from Manitoba and some accessions contain or exhibit resistance to *Sclerotinia*. Dr. Rashid is collaborating with ARS's National *Sclerotinia* Initiative to identify and obtain genetic resistance

for insertion into sunflower hybrids. This disease research and subsequent insertion into the hybrid development breeding program needs to be supported and expanded.

3) Weed Management

One of the reasons sunflowers has lost acres to crops such as corn, soybean and canola is their relative ease of production. The majority of those crops are produced using herbicide tolerant systems and that is an attractive characteristic for growers. Growers are managing larger acreage bases and a simple production system is attractive.

- Herbicide tolerance. Access to sunflower varieties that are herbicide tolerant would increase profitability per acre, require less management, and ultimately increase sunflower acres. The ability to partner with private industry for trait utilization or sharing germplasm is important to address this need.
- Volunteer weed control. Conversely, when crops with the same herbicide tolerant system are grown in sequence, volunteer weed control can be a challenge. At present, volunteer canola control can be a challenge in Clearfield® sunflowers. Research is currently needed to identify BMP's for volunteer canola control in sunflowers. As more herbicide tolerant crop-types may be introduced into the marketplace, weed control within herbicide tolerant sunflower production will become more of a challenge and require more investment in research.
- Minor use support. Again, there may be an opportunity to participate in research and support minor use herbicide applications on sunflowers in Canada. Increasing the number of herbicide options available to Canadian growers increases their global competitiveness.

4) Insect management

Early season insect pests:

Insects that currently limit early season sunflower production, such as wireworm and cutworm were identified as priorities. In the event of changes to neonicotinoid applications/regulations, seed treatments and/or soil applied pesticides should be investigated to manage these two insect pests.

- Minor use support. There may be an opportunity to participate in research and support minor use insecticide applications on sunflowers in Canada.

Late season insect pests:

As mentioned previously, quality of confectionary and oilseed sunflowers destined for human consumption is very, very important. One of the limitations to quality is the damage done by late-season insects. For instance, the industry standard for kernel brown spot (caused by lygus piercing and feeding) in confectionary sunflowers is 0.5%. Three of the late-season insects identified as industry priorities are: banded sunflower moth, lygus bug and sunflower midge.

- Research into late-season insect management that is needed includes the establishment of economic thresholds (eg. sunflower midge), integrated pest management (including biological, cultural, and chemical measures), identifying factors that affect insect population dynamics, and investigating insect forecasting.

5) Profitability - relative to other crops, and consistency

Growers, both who continue to grow sunflowers and those who no longer grow them, consistently agree that, sunflowers is frequently their most profitable crop. In 2014, there is a potential for

Canadian sunflower acres to increase as a result of their profitability relative to other crops (Manitoba Co-operator, 2014).

- Profitability Comparison. The profitability of sunflowers needs to be investigated relative to other crops. Sunflower varieties with desirable seed-type will increase market access and influence profitability. Varieties with better disease resistance or herbicide tolerance will influence input production costs. As sunflower varietal improvements are achieved, profitability relative to other commodities needs to be compared. Profitability bench marking should be done with current production dynamics in anticipation of the above-mentioned production innovations in future years.
- Consistency. The inability of sunflowers to be profitable consistently needs to be investigated. As some growers indicated, sunflowers can be "hit and miss" without any obvious explanation for the "misses". The process leading up to the development of this document included a relatively small telephone 'survey' to capture grower opinions. A larger, more comprehensive study would serve to identify production and profitability limitations better. Research could explore historical data (eg. Manitoba Agricultural Services Corporation production data or climatic data) to try and explain sunflower's fluctuating performance. This could lead to examining the role of crop sequencing, crop rotation, soil adaptability, fertility management, climatic influence, crop water use, disease incidence, etc. in sunflower profitability.

6) Stand Establishment

There is an old saying 'well sown, half grown' which illustrates the importance of good stand establishment. A crop that is not well established is going to struggle throughout the growing season. Production and profitability will be negatively impacted as stand establishment contributes to yield and quality. Research is needed in the area of stand establishment.

- Plant population. Current recommendations are based on existing seed size, type and maturity. As genetic modifications are made to maturity and increased seed size, research needs to investigate how this impacts seeding rates and target plant populations.
- Seeding technology. Seeding equipment precision is changing rapidly and there may be an opportunity to investigate seed singulation technology, seed equipment calibration and optimum intra-row spacing with sunflower establishment.

7) Bird control

Sunflowers are vulnerable to feeding damage from blackbirds, especially late in the season as the crop is maturing. Sunflower seeds are very palatable to birds and are easy to access in the ripening heads which act as perches as the birds feed. There are a number of cultural and mechanical control measures (eg. managing neighboring resting sites, managing planting dates, imploring scare cannons, etc.) that have been used in the past with limited success. There is a need to explore new and innovative strategies to reduce bird damage. The National Sunflower Association in the US identified this as a "research area of interest" in 2013 so collaboration with NSAC's counterpart in the US is prudent.

8) Harvest management

Sunflowers are a long season crop and often one of the last crops to be harvested prior to the onset of winter. Fall frosts accelerate crop dry down which is physiologically mature at 20 to 50 percent moisture. Chemical desiccation is effective in hastening crop dry down before a killing

frost is experienced. It is important to keep the period between crop maturity and harvest as condensed as possible to minimize losses due to disease (*Sclerotinia*) and bird predation.

- Desiccation BMP's. There is a need to research sunflower desiccation and its influence on seed quality. Research may include the investigation of product application timing, application technology, plant staging, etc.
- Harvest Efficiency. Harvest equipment that is suitable for small grains is generally adequate for harvesting sunflowers. Typically, pan headers are mounted on traditional straight cut headers and are suitable for both row crop and solid seeded stands. All-crop headers are only used with sunflowers grown as a row crop. However, growers and processors have indicated that there is a need to research header equipment/attachments to investigate harvest efficiency and their influence on crop quality. Collaborative research with an organization such as the Prairie Agricultural Machinery Institute (PAMI) could be conducted to address harvest management research for solid seeded or row crop production systems. Dockage can be significant especially in confectionary seeds destined for human consumption. Harvest management research should examine optimum combine settings, crop conditions, weather conditions, etc. that will impact the level of dockage retained in the harvested sample vs. being returned to the field.

9) Value-Added

There is interest in conducting research into value-added or new and alternative opportunities to add innovation to the Canadian sunflower industry. Research may include:

- Exploring new uses or alternative product opportunities for sunflowers (eg. sunflower flavoured beverages).
- Investigating the health promoting products (eg. sterols) found in co-products like sunflower hulls.
- Investigating the opportunity for increased use of sunflower in livestock rations.
- Investigating the use of sunflower screenings and hulls as alternative biomass energy sources. In particular, the feasibility of developing and producing a pellet or log product form.
- Investigating unique or 'northern' attributes that may be contained within the sunflowers grown here in Canada. This would entail germplasm investigation.

Conclusion:

With input and consensus from the entire Canadian sunflower value chain, this comprehensive Research Strategy document was developed. As a result of the broad consultation and input, the need for research in the areas of agronomy, pest management, plant breeding, economics, market development, and value-added were highlighted. Undertaking the research identified within this Strategy, will help increase innovation within the sunflower industry in Canada. An important component to the sunflower industry in order to address these identified research priorities is stable, long term funding.

Collaboration within and outside the Canadian sunflower industry is ongoing and other opportunities were identified in the process to develop this strategy. The United States is where a lot of expertise in sunflower agronomy and production is located and NSAC has an excellent working relationship with partners in the United States (eg. North Dakota State University (NDSU) and USDA). This will ensure that the implementation of this Strategy will be coordinated without duplication or redundancy.

Appendix 1

Industry Stakeholders Attendance - Research Strategy Input Meeting

Researchers
Dr. Khalid Rashid – Research Scientist. AAFC, Morden, MB
William May – Crop Management Agronomist. AAFC, Indian Head, SK
Mike Hagen – Sunflower Breeder. Cansun LLC, Fargo, ND

Extension Specialists
Anastasia Kubinec – Business Development Specialist. Manitoba Agriculture, Food and Rural Development, Carman, MB
Shannon Friesen – Regional Crops Specialist. Saskatchewan Ministry of Agriculture, Weyburn, SK

Processors/Exporters
Mike Durand – Nestibo Agra Commodity Processors Inc., Deloraine, MB
Eric Ouellette – Spitz/Fritolay/Pepsico, Mississauga, ON

Seed Representatives
Fred Parnow – NuSeed, Breckenridge, MN
Mike Hutton – Syngenta, Winnipeg, MB
Talbot Bergsma – Dow AgroSciences, Carman, MB

Pest Management/Life Science Representatives
Brad Ewankiw – FMC of Canada, Winnipeg, MB
Robert Hornford – BASF, Winnipeg, MB

Growers & NSAC Board Members
Gregg Fotheringham – Chairman
Mark McDonald – Vice-Chairman
Devin Toews – 2nd Vice-Chairman
Kelly Dobson – Past-President
Luc Remillard
Aaron Elskamp
Ian Pritchard
Darcelle Graham – NSAC Executive Director

AACF Special Crops Value Chain Roundtable Advisor
George Adnam – AAFC, Regina, SK

Others (unable to attend but provided input via the questionnaire)

Processors/Exporters
Ben Friesen – Legumex Walker Inc., Winkler, MB

Buyers
Jesse Vanderveen – Vanderveen Commodities, Carman, MB

Value-Added
Lee Anne Murphy – Manitoba Agri-Health Research Network, Winnipeg, MB

Pest Management Representatives
Myles Robinson – NuFarm Canada, Brandon, MB
Frances Boddy – DuPont, Oakville, MB

Appendix 2

Stakeholder Input 'Pre-Questionnaire'

Background:
The National Sunflower Association of Canada (NSAC), through the Special Crops Value Chain Roundtable, has been awarded funds to develop a ***National Sunflower Research Strategy***.

The objective of the Research Strategy is to identify and outline research priorities along the entire sunflower value chain, and therefore, from the perspective of growers and industry. Developing such a Strategy will ultimately aid in growing the Canadian sunflower industry from both an innovation and marketability standpoint.

As a key stakeholder in the sunflower industry, we would appreciate your input into the development of this comprehensive Research Strategy. Please take some time to think about and answer the following questions. Responses will be compiled and used to initiate and to frame the discussion at the industry roundtable meeting in Brandon on November 14. If you are unable to attend, we would especially appreciate your ideas and suggestions.

Thank you in advance for your input!

1. **What ONE thing would you change about the sunflower industry to make it thrive?**

2. **What would it take to make #1 happen?**

3. **What are some constraints limiting sunflower expansion and/or innovation (list from most to least important)?**

4. **What opportunities in the sunflower industry are not being capitalized upon (again list from most to least important)?**

5. **What research gaps or needs do you think there are in the industry?**

6. **What research priorities do you think NSAC should focus on in the short-term (less than 3 years) and long-term (5 years and beyond)? Again, list in order from most to least important.**

Appendix 3

References

Manitoba Farmers 'Kicking Tires' on Sunflowers – Special Crop Contracts Attract Interest at Ag Days. Manitoba Co-operator, January 30, 2014 - Volume 75, Issue 5, pg. 11.

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http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/prim11a-eng.htm

Sunflower Sector - Overview of the Sunflower Sector in Manitoba
http://www.gov.mb.ca/agriculture/statistics/pdf/crop_sunflower_sector.pdf

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