

DEVELOPING CARINATA VARIETIES AND HYBRIDS FOR DRIER CANADIAN PRAIRIES WITH KEY TRAITS USING MOLECULAR BREEDING TOOLS AS A PREFERRED INDUSTRIAL OILSEED PLATFORM

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Climate change is predicted to have a more significant effect on the Canadian Prairies compared to global estimates, with temperatures rising higher, creating an increased risk of droughts (www.climateatlas.ca). Ways to mitigate climate change include the use of renewable sources of energy, such as biofuels and the development of climate-resilient crops. *Brassica carinata* (carinata) is a drought- and heat-tolerant oilseed, which has recently been developed in Canada as a dedicated industrial feedstock crop for oil used in biofuel production, and could become part of a pro-active Canadian strategy to battle climate change and its effects on agriculture. Its benefits to western Canadian farmers include the following:

- a. Carinata, as an industrial crop, is complementary to food crops currently being produced and as such can fill a potentially valuable market niche by providing a dedicated, high quality industrial oil feedstock for the biofuel industry and a high protein meal co-product for the livestock feed industry;
- b. It can be incorporated successfully into existing crop rotations;
- c. Due to abiotic stress tolerance, carinata can be grown in areas that may not be as productive or may carry a higher risk for other crop options, such as canola, due to climate or soil conditions;
- d. It represents a crop that can be produced sustainably and which offers farmers an opportunity to diversify their cropping system and gain additional income.

In 2011 and 2012, ~12,000 acres of carinata production was contracted to prairie farmers in the semi-arid brown soil zone. However, plans to increase this in 2013 and beyond were impacted by a feedstock oil market not yet able to support expansion as well as lack of regulatory approvals for oil and meal sales. As a result, Agrisoma delayed further commercial expansion of acres in western Canada until a) market conditions could support it, b) regulatory approvals could be gained, and c) policy to support a low carbon solution could be evident. In the interim, Agrisoma has developed new carinata varieties that could be grown in more diverse geographies, with the aim of capitalizing on international market opportunities for its oil and meal feedstocks in jurisdictions where those factors are in play.

Agrisoma now has offtakes in place for oil and meal in the European biofuel and animal feed markets. As the European market demands feedstock meal that is GMO free, exports of carinata grain must be routed through ports that can provide strict segregation of non-GMO carinata grain, requiring the development of a robust segregation system in western Canada that functions along side the current system handling GM canola. This work is underway by Agrisoma.

Recent events have greatly improved the outlook for expanded carinata production in the Canadian Prairies:

- i. In 2015 Canada pledged to reduce GHG emissions to 30% of 2005 levels by 2030 and to achieve these reductions, creation of a carbon pricing initiative run jointly with the provinces has been announced, one effect of which will be to stimulate development and implementation of alternative low carbon intensity biofuels and increase demand for the plant-based oil feedstocks. Additional demand in Canada for low carbon feedstocks generated through a Canadian low carbon fuel /feedstock accreditation system would be a driver for growth of carinata acres in Canadian Prairies.
- ii. Civil aviation is responsible for 2% of annual GHG emissions. In response to the threat of climate change resulting from GHG emissions, The International Air Transport Association (IATA) has developed a plan to achieve carbon neutral growth worldwide by 2020 and to subsequently cut emissions in half by 2050 (<http://www.iata.org/policy/environment/pages/climate-change.aspx>). Substitution of petroleum-based jet fuels by low carbon intensity biofuels is an important contributor to achieving these targets. Canadian Airlines such as WestJet and Air Canada are now actively working to assist in development of a domestic and international airport Biofuel infrastructure as well as a biofuel production value chain.
- iii. Carinata meal has higher protein and lower fiber content than canola meal, increasing its value as an animal feed additive. Based on testing carried out by the Feeds Innovation Institute of the University of Saskatchewan, the CFIA approved the marketing of carinata meal to the Canadian beef cattle industry in 2014. In the US, similar

approval was granted by USDA in 2017. The anticipated approval of carinata meal for use as a dairy cattle feed will represent another important driver for increasing carinata acres in the southern prairies of Canada.

There are currently 2000 acres of commercial production being carried out in the Northern tier states, primarily in Montana, North and South Dakota. Virtually all of this production is being shipped to European producers of oil and meal through US ports to satisfy Europe's requirements for non-GMO content. By contrast, the North American biofuel and animal feed market does not have the same requirement for segregation of non-GMO grain shipments. It is anticipated that successfully obtaining the appropriate regulatory approvals, specifically D4 type RIN and California LCFS credits for biofuels produced from carinata oil, as well as approval for carinata meal use by the dairy cattle industry will lead to increased North American market access. By 2019, assuming all regulatory approvals have been obtained and with resulting market access to North American biofuel markets assured, this will allow for carinata production to resume in Canada at an initial annual production of 50,000 tonnes of grain. Agrisoma's goal will be to steadily increase Canadian carinata production to meet increasing demand for its oil and meal feedstocks so that by 2025, a total of 500,000 tonnes of carinata grain will be produced by Canadian farmers on the southern prairies.

In order to make carinata-derived products even more price-competitive with existing petroleum-derived products and to better capitalize on the anticipated expanded markets for carinata oil and meal, we propose to build on the initial development of AAFC carinata varieties supported by the Growing Forward 1 and 2 (GF1, GF2) programs and to take carinata breeding to the next level by creating a new generation of carinata varieties that are higher yielding, better adapted to the specific characteristics and challenges of the southern Canadian Prairies and amenable to cost effective and sustainable production methodologies. The project has three objectives, the development of (i) new carinata varieties with improved traits such as disease resistance and improved seed quality, (ii) improved methods for rapid carinata variety development (enhanced selection efficiency) and (iii) high-yielding carinata hybrid varieties. The project will deliver better yielding varieties with improved oil and meal characteristics to allow for expanded market access. Clubroot resistance will allow farmers to grow carinata in affected fields. Further, this project will result in higher profitability of carinata production, lower feedstock costs for processors and end-users, and will provide western Canadian farmers with a climate-resilient cropping alternative that can be produced sustainably.