

## IDENTIFYING AND DEVELOPING HERBICIDE-TOLERANT GERMLASM FOR CARINATA AND YELLOW MUSTARD

Principal Investigators: DR. CHRISTINA EYNCK & DR. BIFANG CHENG Agriculture and Agri-Food Canada (AAFC) Saskatoon Research & Development Centre

Carinata (*Brassica carinata*) has been developed at AAFC-SRDC as a dedicated industrial oilseed crop for applications such as biofuels, bio-lubricants, and biopolymers. The seed meal, a by-product of the crushing process, is a high-value feed ingredient for livestock. The economic opportunity for carinata as feedstock for the emerging bioeconomy is significant as the global markets are large. Agrisoma Biosciences Inc., Mustard 21's (M21) industrial partner, has made significant investments over the course of DIAP (GF 1) and GF 2 to develop the crop in collaboration with AAFC-SRDC. Agrisoma has also secured approval for carinata as a sustainable feedstock for industrial use (RSB certification) and has built a value chain for both carinata oil and meal. With this, carinata is in a good position to be a preferred industrial oil feedstock that also addresses the greenhouse gas concerns of the transportation sector, particularly aviation.

Canada is the world's largest exporter of condiment mustard, i.e. yellow mustard (*Sinapis alba*) and brown and oriental mustard (*Brassica juncea*), with a market value of \$120-140M; about 80% of the exports are from yellow mustard. To remain competitive on the global market, Canada needs to continually raise the bar of mustard quality and maintain a sustainable supply through breeding better varieties.

Mustard production in Canada is concentrated in the drier regions of the Canadian Prairies (Southwestern Saskatchewan and Southeastern Alberta), adding significant GDP to the agricultural economy. Carinata as a new crop has great potential to add to this existing base.

One major challenge for carinata and yellow mustard (*Sinapis alba*) is very limited herbicide options for managing hard-to-kill broadleaf weeds such as wild buckwheat, narrow-leaved hawk's beard, red root pigweed and Russian thistle. These weeds impact yield through competition for resources and lower grain quality through contamination with weed seeds. Most herbicide technologies developed by multi-national companies are developed for larger commodity crops and herbicide technology options for smaller crops like carinata and mustard are lacking. This is aggravated by the fact that carinata and yellow mustard are susceptible to herbicide carry-over in the soil and cannot be grown in the year after Group 2 (ALS inhibitors) application. Group 2 herbicides are extensively used in both cereal and pulse crops, which greatly reduces the number of available acres in the following year for carinata and yellow mustard crops.

In front of this background, the objective of the proposed study is to create non-GMO herbicide-tolerant (HT) lines of yellow mustard through seed mutagenesis and of carinata through seed and microspore mutagenesis. Microspore production for yellow mustard is not possible yet and therefore, for this species, only seed mutagenesis will be pursued.

Most of the herbicide-tolerance traits in other crops like canola were developed through chemical mutagenesis of seeds. Among the chemical mutagens, ethyl methane sulfonate (EMS) is the most effective and a popular method of choice. Similarly, chemical or physical mutagenesis of isolated microspores followed by selection under herbicide pressure has also been utilized to develop herbicide tolerance in a number of crops. Part of this project (Activity #3.2) will focus on creating new Group 2 HT in carinata using various mutagens, e.g. EMS, N-ethyl-N-nitrosourea (ENU), Nmethyl-N-nitrosourea (NMU), 5-bromouracil, and nitrous acid.

The proposed research will lead to carinata and yellow mustard germplasm with resistance to Group 2 herbicides, which will provide significant benefits to mustard producers such as in-crop weed control and the option to re-crop where soil residual Group 2 activity remains. These outcomes will make carinata and yellow mustard more competitive with crops with established herbicide technologies, such as canola: growers are familiar with advances such as Roundup Ready canola and have become accustomed to spraying crops during the growth cycle in order to manage weeds. Further, the project will give producers rotation options that are fully compatible with current production methods. Increased acreage of yellow mustard will ensure reliable supplies of condiment mustard to processors and exporters. Increased acreage of carinata will provide a sustainable feedstock for the growing industrial oil market.