

## GERMPLASM AND VARIETY DEVELOPMENT OF CONDIMENT MUSTARD FOR IMPROVED YIELD AND QUALITY

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Canada is the world's largest exporter of condiment mustard (*Sinapis alba* and *Brassica juncea*). Yellow (*S. alba*), brown and oriental (*B. juncea*) mustards are grown on an average of 200-250 thousand hectares in the arid regions of western Canada each year, with ~80% of the total production in Saskatchewan. Yellow mustard occupies about 55 to 65% of the total acreage. Development of mustard varieties with enhanced seed yield will increase the profitability of mustard producers and secure the competitiveness of the Canadian mustard industry in the global condiment mustard market.

Yellow mustard is an obligate outcrossing species due to its sporophytic self-incompatibility. Recurrent selection has been used in Canada as a major method for cultivar development and germplasm enhancement in this crop. Current cultivated varieties Andante, AC Pennant and Adagio developed via this method have been improved in quality traits such as protein and mucilage contents, but seed yield has not been increased due to its low heritability. Current brown and oriental mustard varieties were developed via pedigree breeding since *B. juncea* is a self-pollinated crop. The quality traits such as seed weight, oil and protein contents of the cultivars, Centennial Brown (brown mustard) and Cutlass (oriental mustard), have been improved, but seed yield exhibits only limited progress. Mustard has lagged behind all major crops in Canada in respect to yield increase over the last four decades. To close this real yield gap has been the number one research and development priority since 2009 for the two previous AAFC - DIAP and GF2 programs. This investment (2009-2018) has helped to make huge progress towards yield improvement. This priority mandate is now at a stage that will need AAFC CAP (AAFC Canadian Agricultural Partnership) support to start delivering significant yield improvements with the use of the latest breeding tools and techniques accessing a much broader germplasm base.

With funding support from the Developing Innovative Agri-Products Initiative of the Growing Canadian Agri- Innovations Program (DIAP), Growing Forward 2-Agri-Innovation Program (GF2), and the mustard industry Mustard 21 Canada Inc. (M21) since 2009, we have directed our breeding approach and efforts towards developing high-yielding synthetic varieties in yellow mustard, and hybrids in brown and oriental mustard by exploiting heterosis. In yellow mustard, initial synthetic lines, producing six to seven percent higher seed yields than the check variety Andante across four locations of Advanced Yield Trials (AYT), have been developed and are being tested as candidate varieties in the Mustard Adaptation Test (MAT). In brown and oriental mustard, we have successfully improved the Ogura cms (cytoplasmic male sterility) system, which makes it possible to develop high yielding hybrids in this crop. Brown mustard hybrids produced using the improved Ogura cms system and the available condiment mustard germplasm from Canada exhibited over 15% higher yield than the check variety Centennial Brown. Hybrids produced from genetically diverse parental lines in GF2 are more likely to have high heterotic potential leading to higher seed yield and will be tested during the initial years of CAP.

In this proposed CAP project, we aim to develop diverse elite parental lines with an even broader genetic base to further enhance the seed yield of synthetics in yellow mustard and hybrids in brown and oriental mustard. The synthetic and hybrid varieties will have strong growth vigour (heterosis) and produce a high yield as well as improved quality traits and disease resistance. In addition, they will also have much more uniform performance compared with the current open-pollinated varieties, especially in plant height, seed size and maturity. Variety uniformity for maturity will make it easier for the farmers to harvest the crop. The high yield will increase the profitability of mustard producers and the value chain. The significance of the work will be a continued recognition in the market place for Canada as the world's largest exporter of high quality condiment mustard. Mustard 21 Canada Inc. (M21), crop sector member of Diverse Field Crop Cluster (DFCC), and the mustard industry are stepping up to invest the resources to make these new varieties are available starting in 2018/19.