Discovery offers bio-solution to severe canola crop losses

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Marcus Samuel is assistant professor in the Faculty of Science. Credit: Riley Brandt, University of Calgary

A genetic discovery by a University of Calgary-led international research team offers a solution to a long-standing "green seed problem" that causes millions of dollars annually in canola crop losses.

Led by Marcus Samuel in the Faculty of Science, researchers from the U

of C, the University of Toronto and the University of Bordeaux in France, have uncovered a plant gene regulatory network that could be genetically enhanced to prevent green seeds from occurring in mature canola.

"The annual loss in North America alone is close to $150 million from this de-greening issue," says Samuel, assistant professor and chair of the plant biology program in the Department of Biological Sciences.

"I want to see this basic science translated into a viable application. Canola is a huge cash crop and we have a real solution to a major problem."

The team's research, which includes five years of work by U of C faculty and students, was just published in the *Proceedings of the National Academy of Sciences* of the United States of America, a top-ranked journal.

Canola is the major cash crop in Alberta, which produces about 35 per cent of Canada's canola that generates in the province about $5 billion in revenue annually.

Across the country, the oilseed crop, whose seeds are pressed into canola oil, contributes about $15 billion a year to the Canadian economy.

However, every year around the time when canola matures, an unpredictable touch of a light frost can damage crop quality and cause severe losses.

"The frost doesn't kill off the plant, but it 'fixes' the green colour in the seeds," Samuel explains.

"Non-lethal" frosts, occurring at temperatures of zero to minus a degree

or two Celsius, can result in up to 20 per cent green seeds – as opposed to mature brown or black seeds – in mature canola, he says.

This presence of chlorophyll (pigment that imparts green colour to plants) in mature seeds affects the oil quality, produces unpleasant flavours and odours, and reduces the oil's shelf life.

The research team investigated the de-greening process in a weed species called *Arabidopsis*, a "model" research plant whose complete genetic makeup is known and which is a close genetic relative of canola.

The research team, using a "mutant" strain of *Arabidopsis* that produces mature green seeds, performed genetic analyses that uncovered a pathway required for seed development and removal of unwanted chlorophyll during seed maturation.

They found that a protein that regulates gene expression (how the gene's information is used in synthesizing a functional gene product), called ABI3, is important in removing seed chlorophyll and enabling the seeds to de-green.

In an illustration of how basic science builds upon itself, the researchers identified that ABI3 regulated expression of a gene mapped in 2007 as controlling chlorophyll degradation and resulting in yellow versus green seed colour. This colour difference was first identified as a trait in the 1800s by genetics pioneer Gregor Johann Mendel, who used it as a marker to study the inheritance of traits.

The team also showed that a higher expression of ABI3 in *Arabidopsis* led to seeds that were able to de-green normally to produce mature brown-black seeds, despite harsh cold treatments.

"This overexpression allows these plants to withstand cold much better

and for the system to be functional even though it's hit with cold," Samuel notes.

"Given the similarity of *Arabidopsis* and canola, it would be easy to isolate the same genes from canola and use transgenic technologies (which introduce new genes into organisms) to create varieties that could withstand freezing conditions yet produce mature brown-black seeds," he says.

"We actually have demonstrated in our laboratory tests that the canola genes work the same way."

More information: www.pnas.org/content/early/201 … 114110.full.pdf+html

Provided by University of Calgary

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