EASTERN CANADA
OILSEEDS DEVELOPMENT ALLIANCE

**Lead Researcher:**
Dr. Don Smith, McGill University

**Activity 9 Factsheet**
**Canola and Microbial Signals**

### *Background*

Crop plants have close relationships with associated root microbes. These microbes are often beneficial to plant growth, in a variety of ways. Work from the Smith laboratory at McGill showed that lipo-chitooligosaccharides (LCOs), involved as microbe-to-plant signal compounds during the establishment of the legume-rhizobia nitrogen fixing symbiosis, can stimulate the growth of most crop plants by improving stress tolerance. If the interaction with stress the alters the effects of LCOs on plant growth, as it has also been show to do with other similar microbe-to-plant signals, such as thuricin 17 (Th17), the effects of some of the microbe-to-plant signals can vary under field conditions, depending on plant stress levels. However, because the signals are applied at very low concentrations their cost is very low and, in other crops, they have been shown to be profitable to growers over the long term.

### *Objectives*

The overall objective of this activity is to improve our understanding of the ability of microbe-to-plant signals to enhance the growth and productivity of canola. Specific objectives include:

1. To determine the effect of signal compounds (lipo-chitooligosaccharides – LCOs; thurcin 17 – Th17) from plant growth promoting rhizobacteria (PGPR) on plant growth and yield of canola on clay loam and sandy loam soils.
2. To understand the potential for commercial application of Th17 as a crop growth enhancer, in this case, regarding canola.
3. To evaluate the ability of microbe-to-plant signals to help winter canola survive winter stresses.

### *Methodology*

The experiment was conducted on two soil types (sandy loam and clay loam) at the Lods Agronomy Research Centre (Macdonald Campus, McGill University, Sainte-Anne-de-Bellevue, Canada) for both spring and winter canola.

For spring canola, fertilizer was broadcast onto the experimental site in the first year (2013) at the rate of 100 kg N $ha^{-1}$ (urea 46-0-0), sulphur, as ammonium sulphate (21-0-0 with 24 % S) at 20 kg $ha^{-1}$ and boron as Granubor (10% boron) at 2 kg $ha^{-1}$. In 2014, Fertilizer was broadcast onto the experimental site at the rate of 50 kg N $ha^{-1}$ (27.5-0-0), 30 Kg P $ha^{-1}$ (11-50-0), 40 kg K $ha^{-1}$ (0-0-60) for clay soil, 50:50:60 kg NPK $ha^{-1}$ for sandy soil along with sulphur, as ammonium sulphate (21-0-0 with 24 % S) at 20 kg $ha^{-1}$ and boron as Granubor (10 % boron) at 2 kg $ha^{-1}$.

For winter canola, in 2013, fertilizer was broadcast onto the experimental site at 50 kg N $ha^{-1}$ (urea 46-0-0), sulphur, as ammonium sulphate (21-0-0 with 24 % S) at 20 kg $ha^{-1}$ and boron as Granubor (10 % boron) at 2 kg $ha^{-1}$; in addition 50 kg N $ha^{-1}$ (urea 46-0-0) was applied after the winter (May 14, 2014).

In 2015, Fertilizer was broadcast onto the experimental site at 50:50:60 kg NPK $ha^{-1}$ along with sulphur, as ammonium sulphate (21-0-0 with 24 % S) at 20 kg $ha^{-1}$ and boron as Granubor (10 % boron) at 2 kg $ha^{-1}$. In addition 50 kg N $ha^{-1}$ (urea 46-0-0) was applied after the winter.

The signal compounds (LCO $10^{-6}$ M and Th17 $10^{-9}$ M) were applied in two levels: seed treatment (seeds –were surface wetted then allowed to dry) and foliar application when the plants were at 20 % flowering. The herbicide Liberty 200 (2.5 L $ha^{-1}$ - post emergence) was applied on canola seedlings at the 2-3 leaf growth stage.

The experiments were organized following a completely randomized block design with four blocks for each experiment and the plot size was 4 x 2.6 m in 2013 and 2015. In 2014 the plot size was 5 x 2.6 m.

***Data collection***

Data were collected and recorded according to established protocols, on variables including plant emergence, stand count, yield components and yield. Data were subjected to statistical analyses using the ANOVA procedure of SAS (9.3) to detect differences among the treatments. Means were compared using the LSD test at both $P < 0.05$ and $P < 0.1$.

***Sandy Loam Soil***

Spring signal experiments:

In 2013, the results showed that there was a difference in emergence due Th17 seed treatments. Further, the number of seeds pod$^{-1}$ significantly differed due to the treatments. For yield, the highest occurred in both the LCO $10^{-6}$ M combinations (seed treatment and foliar spray) 4179 and 3972 kg ha$^{-1}$, which showed 21 and 15.2 % increases in yield over the control, respectively; Th17 $10^{-9}$ M foliar spray (4080 kg ha$^{-1}$), which was increased by 18.4 % over the control; followed by the water spray control (3792 kg ha$^{-1}$). The lowest yield was for the overall control (seed treatment with water) (3445 kg ha$^{-1}$). Spring canola did not perform well in 2014.

In 2015, no signal treatment did better than the water control (seed treatment with water) (2569 kg ha$^{-1}$).

Winter signal experiments:

In 2013-2014, results showed that, there were significant differences for emergence, number of branches, pods per plant$^{-1}$ and number of seeds pod$^{-1}$, but not for emergence and stand count after the winter, due to treatments. The results showed that, there were no significant differences in yield due to treatment, but the yield of all the signal treatments were greater than the control. The numerically highest yield occurred in LCO $10^{-6}$ M foliar spray (4408 kg ha$^{-1}$), followed by Th17 $10^{-9}$ M (seed treatment) (4238 kg ha$^{-1}$). The % increases over the control for these treatments were 27.4 and 22.5 %, respectively. Water only controls also showed some positive effect. In 2014-2015, the canola did not survive after the winter.

In 2015-2016, there was no significant difference in yield due to treatments, however the highest yield occurred in Th17 $10^{-9}$ M seed treatment and foliar spray which increased the yield 21.3 and 15.1 %, respectively, over the control treatment. Following this result is a 14.1 % increase over control in the LCO $10^{-6}$ M seed treatment. The LCO $10^{-6}$ M foliar spray at 20 % flowering increased yield 6.5 % over the control.

***Clay Loam Soil***

Spring signal experiments:

In 2013, the highest yield occurred for both the LCO $10^{-6}$ M combinations (seed treatment and foliar spray), 2753 and 2519 kg ha$^{-1}$, respectively, which were 31 and 19.9 % greater than the control. Th17 $10^{-9}$ M seed treatment (2512 kg ha$^{-1}$) also showed a higher yield, which was 19.6 % greater than the seed treatment with water control (2344 kg ha$^{-1}$). The lowest yield was for the overall control, where nothing was applied to the seeds or sprayed on the plants (2100 kg ha$^{-1}$). Spring canola did not performed well in 2014.

In 2015, the results showed that, there were no significant differences in emergence, number of plants at harvest, number of branches and number of pods due to treatments. There were also no significant differences in number of seeds, yield, 1000 seed weight or harvest index due to treatments.

Winter-canola signal experiments:

For 2013- 2014, the results showed that there were no significant differences in emergence or stand count after the winter, number of branches, pods per plant$^{-1}$ or number of seeds per pod$^{-1}$ in canola due to treatments, but the number of seeds per $pod^{-1}$ for all the treatments were greater, numerically, than the control. The results indicated no significant difference in yield due to treatments, but the yield of all signal treatments was greater than the control. For yield, the numerically highest yield occurred for the water seed treatment (4445 kg $ha^{-1}$), followed by LCO $10^{-6}$ M foliar spray and seed treatment (4172 and 4146 kg $ha^{-1}$), respectively. The increases over the control for these treatments was 26, 18.3 and 17.5 %, respectively. Water only controls also showed some positive effect.

In 2014-2015, the canola did not survive the winter.

***Conclusions***

This work demonstrated that the microbe-to-plant signal compounds evaluated have potential as new types of plant growth regulators, for deployment in the production of canola.

- Signal compounds (LCO and Th17) increased the yield of spring and winter canola, although the increases were not always significant.
- There are potential interactions with environmental conditions (stress) under field conditions.

Two new/improved practices were developed through this activity:

1. Foliar spray of canola with PGPR signal compounds (LCO and Th17): LCO at $10^{-6}$ M and Th17 at $10^{-9}$ M, used for foliar spray for canola and the results showed increased yield of canola versus the control.
2. Seed treatment of canola with PGPR signal compounds (LCO and Th17): We are now in a position to treat canola seeds with signal compounds from plant growth promoting rhizobacteria (PGPR) that stimulate plant growth and yield.

*Funding for this activity has been provided by the Agri-Innovation Program's Research and Development stream, under the Growing Forward 2 policy Framework. Les fonds pour cette activite proviennent du volet Recherche et developpement du programme Agri-innovation, une initiative du cadre strategique Cultivons l'avenir 2. Major funding provided by Vittera Inc. and Bunge Limited.*