**Activity 17**
**Crop Rotation with Potatoes (Quebec)**
**Annual Report – March 31, 2016**

## Overall Objective

The overall objective of this activity is to complement Activity 16 (*Assessment of the impact and interactions of emerging crops on potato-based cropping systems)* and to complete the following:

1. Evaluate the integration of canola in a potato cropping system and measure the benefits and/or negative impacts during the potato year.
2. Compare rotation systems including canola with conventional and new potato cropping systems.
3. Determine the best temporal position in the cropping system for the canola and evaluate the impact on other crops included in the rotation.
4. Evaluate the influence of canola crop on potato soil-borne disease evolution.
5. Measure nutrient balance and economic impact.

## Audience

The audience is crop producers, specifically those who grow or who have an interest in growing canola.

## Highlights

Since the project is at the beginning of the 5-year experiment it's still too soon to reveal any real impact of the different rotation systems on the crops. However, the outcomes below identify the processes used in this experiment.

## Outcomes

### *Objectives*

Objectives of this activity are to:

1. Evaluate the integration of canola in a crop rotation system for production of potato and measure the benefits and/or negative impacts during the potato year;
2. Compare rotation system including canola with conventional and new potato crop rotation system; and
3. Determine the best temporal position in the crop rotation system for the canola and evaluate the impact on other crops included in this rotation.

### *Methodology*

The trial took place in Ste-Croix near Quebec City. The plots were established in a sandy soil.

This trial takes place over five years. Each year, a rotation pattern is set up on the same place in the field. For the second year (2015), plots were planted with buckwheat, barley, canola, potatoes, soybean or corn.

The following rotation system was used:

**Table I.** Rotation system

| Treatment | Year | | | | |
|---|---|---|---|---|---|
| | 2014 | 2015 | 2016 | 2017 | 2018 |
| **T1** | P | B | P | B | P |
| **T2** | P | M | P | M | P |
| **T3** | P | C | P | C | P |
| **T4** | P | S | P | S | P |
| **T5** | P | S | C | P | S |
| **T6** | P | C | S | P | C |
| **T7** | P | S | S | P | S |
| **T8** | P | C | C | P | C |
| **T9** | P | B | H | P | B |
| **T10** | P | S | B | P | S |
| **T11** | P | B | S | P | B |
| **T12** | P | C | B | P | C |
| **T13** | P | B | C | P | B |
| **T14** | P | M | S | P | M |
| **T15** | P | S | M | P | S |
| **T16** | P | M | S | P | M |
| **T17** | P | C | M | P | C |
| **T18** | P | M | C | P | M |
| **T19 (Monoculture)** | P | P | P | P | P |

P: Potato, B: Barley, M: Maize (corn), S: Soybean, C: Canola, B: Buckwheat, H: Hay

The experiment was conducted in a randomized complete block design with four replicates. The plots have an area of 28 $m^2$.

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12101 T8 | 12102 T4 | 12103 T3 | 12104 T19 | 12105 T2 | 12106 T11 | 12107 T1 | 12108 T12 | 12109 T5 | 12110 T14 | 12111 T7 | 12112 T13 | 12113 T9 | 12114 T10 | 12115 T17 | 12116 T16 | 12117 T15 | 12118 T18 | 12119 T6 |
| 12201 T4 | 12202 T2 | 12203 T19 | 12204 T11 | 12205 T12 | 12206 T1 | 12207 T8 | 12208 T9 | 12209 T16 | 12210 T7 | 12211 T13 | 12212 T3 | 12213 T5 | 12214 T14 | 12215 T18 | 12216 T15 | 12217 T6 | 12218 T17 | 12219 T10 |
| 12301 T5 | 12302 T18 | 12303 T6 | 12304 T10 | 12305 T13 | 12306 T2 | 12307 T4 | 12308 T19 | 12309 T17 | 12310 T14 | 12311 T9 | 12312 T8 | 12313 T12 | 12314 T7 | 12315 T1 | 12316 T11 | 12317 T16 | 12318 T15 | 12319 T3 |
| 12401 T6 | 12402 T8 | 12403 T10 | 12404 T1 | 12405 T14 | 12406 T17 | 12407 T18 | 12408 T15 | 12409 T9 | 12410 T12 | 12411 T4 | 12412 T5 | 12413 T19 | 12414 T11 | 12415 T3 | 12416 T7 | 12417 T16 | 12418 T2 | 12419 T13 |

**Figure 1.** Experimental design used in Ste-Croix

Potato tubers and corn were hand planted with a ruler and cereals plots were sown with a Melroe 244 cereal drill of 18 rows on May 29th.

Harvest of each crop was completed on the following dates:

- Buckwheat: August 10th
- Barley: August 25th
- Canola: September 2nd
- Potato: September 23rd
- Soybean: October 21st
- Corn: October 21st

Measured parameters for cereals were:

1. Fresh weight of 1 $m^2$ of grain;
2. Weight of 1 $m^2$ of shoot biomass;
3. Fresh weight of 500 grains; and
4. Fresh weight of 500 ml of grain.
    a. Test weight was calculated from those data using the “Test Weight Conversion Chart” from the Canadian Grain Commission.

Measured parameters for potatoes were:

1. Yield of the different size categories;
2. External quality (growth crack, misshapen, common scab, rhizoctonia, etc.);
3. Internal quality (hollow heart, brown center, vascular discoloration, etc.); and
4. Specific gravity.

***Results***

Since the project is at the beginning of the 5-year experiment it's still too soon to reveal any real impact of the different rotation systems on the crops. At first, it should be reminded that in 2014, potatoes were planted in every plot. With that said, it's important to specify that each one of the crops planted in 2015, i.e. buckwheat, barley, canola, potato, soybean and corn, received the same amount of crop residue (potato). At this stage of this 5-year experiment, we shouldn't expect to see any difference or at least very few between the different treatments, since the previous crop was the same for every plot.

Also, it is relevant to note that yields for all crops were high and this may be justified by "the plot effect." Because we used a commercial-type drill in really small plots, it was more difficult to achieve a constant and fairly fast speed to allow a plant density similar to producers. This led to a seeding rate slightly higher than what is conducted in fields. Furthermore, as compared to what is observed in commercial crops, when we harvest the one square meter plot, there was no shortage and all the grains were collected. This "plot effect" is also observe every year in potato plots, since yields are often quite high.

Aside from the potatoes, no disease and no insects (except for few flea beetle in soybean) were observed in the different crops. As the fields have never grown canola, barley or buckwheat, it is not surprising to see these results.

***Results interpretation***

1. Results obtained for most of the crops implanted in this second year of the 5-year experiment show that there is no significant difference amongst the treatments. With potato plots established in 2014 for all treatments, these results are what we expected.
2. Most of the crops (except the potatoes and soybean) were free of diseases and insects. This could be explained by the fact that canola, barley and buckwheat were never grown in this field, at least not in the last 10 years.
3. The treatment with potato plots (monoculture) has generated fewer yields in 2015 than 2014. Since potatoes were grown in this field last year, and also several times in the past years, it was possible to see common diseases (late blight) related to this crops. This data could be the result of negative effects of potato monoculture. Upcoming tests (2016, 2017, etc.) will allow us to

further analyze the results.

4. The soybean crop yield is higher for one treatment, i.e. T7, compared to the other treatments, regarding the shoot biomass as well as the weight of 500 grains. At first sight, nothing could justify those differences, but when we analysed the results, it appears that only one replicate of the T7 treatment shows significantly higher results. Since fertilization was made by broadcast application, it may be possible that this particularly plot received more fertilizer.

***Issues***

At year 2 of this 5-year project, various crops were sown in plots. Because we used a commercial-type drill in really small plots, it was more difficult to achieve a constant and fairly fast speed to allow a plant density similar to producers. This led to a seeding rate slightly higher than what is generally used in fields. For the upcoming year of the project, some modifications will be made and some parts will be replaced on the drill in order to have more uniform plots.

**Future Work**

The experiment will be implemented again next year.