Activity 12

Integrated Pest Management Strategies Against Insect Pests of Canola in Eastern Canada

Annual Report – March 31, 2016

Overall Objective

The objective of this activity is to develop integrated pest management strategies against the flea beetle, pollen beetle and cabbage seedpod weevil (CSW) in Eastern Canada. This activity will include trials to assist in the:

1. Evaluation of the influence of seeding date against flea beetles, CSWs and pollen beetles.
2. Evaluation of the efficiency of chemical control against flea beetles.
3. Determination of the economic threshold for CSWs through its introduction into trials.
4. Determination the economic threshold and efficiency of insecticides for pollen beetles.

The goal of this activity is to provide results that will help canola producers in Eastern Canada reduce their use of insecticide and improve canola yield by using different strategies against the main insect pests of canola. The reduction in insecticide will help increase growers' returns, improve biodiversity in the field and reduce potential runoff in watersheds.

Audience

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

Performance Measures

Improvement of knowledge

This activity resulted in knowledge improvement in four key areas:

1. Knowledge about impact of different seeding date on flea beetle abundance;
2. Knowledge about efficacy of three insecticides against flea beetles;
3. Information about parasitism rate of cabbage seedpod weevil and thresholds; and
4. Knowledge about efficacy of insecticides against pollen beetles.

Media reports

Two media reports occurred in relation to this activity:

1. King, C.2016. Canola IPM Quebec research evaluates integrated pest management options. Top Crop Manager, April 2016
2. King, C. 2016. The little beetle that could… become a serious problem for Prairie canola growers. Top Crop Manager, June 2016

Information events

One event was held with 225 attendees:

1. Journée phytoprotection du CRAAQ, July 17, 2015. Labrie, G., Froment, D. et Gagnon, M.-È. Les insectes dans la culture du canola : diagnostic et méthodes de lutte. Journée Phytoprotection du CRAAQ, 17 juillet 2015, CÉROM, St-Mathieu-de-Beloeil.

Highlights

The overall objective of this activity is to develop integrated pest management strategies against flea beetle, pollen beetle and cabbage seedpod weevil (CSW) in Eastern Canada. The current year can be summarized as follows:

1) Early seeding dates succeeded to attract flea beetles and insecticides significantly reduced their defoliation in both experimental sites (Normandin and St-Augustin-de-Desmaures) during summer 2015. This strategy was applied in trap crop trial in one site in St-Prime. Two rows of canola were sown in the middle of a canola field 10 days before the rest of the fields. Only the trap was sprayed with an insecticide. The trap attracted more flea beetles and defoliation by flea beetles did not reach threshold in the rest of the field. Yield was similar in trap crop and west of the field. East part of the field was bordered by an alfalfa fields, and flea beetles reinvaded the fields later during summer, causing higher defoliation in this part of the field and reduced yield.
2) The main foliar active ingredient used against flea beetles is lambda-cyhalothrine. However, this product is not registered against the striped flea beetle, which is the main species observed in canola fields in Quebec. In 2015, three insecticides (Decis, Sevin, Malathion) were tested against flea beetles at Normandin (NO) and St-Augustin (SA). Defoliation by flea beetles did not reach economic threshold of 25% of defoliation and no differences in yield were observed.
3) During summer 2015, 24 canola fields were monitored in the province of Quebec to evaluate the impact of CSW and its parasitism. CSW was captured in 75% of the fields, but no fields reached economic threshold of 2 CSW/sweep nor 25% of damaged pods. Parasitoids were observed in 45.8% of the fields monitored, an increase of 7% from 2014 and parasitism rate varied between 38 and 100%. Percentage of grains consumed by CSW was 25% less in pods with parasitoids. This increase of parasitism year after year since 2009 demonstrate that this natural control is successful to control this pest and that no chemical control is necessary.
4) Introduction of 2 or 8 pollen beetle/plant in cages at CEROM demonstrated that 8 pollen beetle/plant leads to 1 larvae per flower at 60% flowering period. While not statistically significant, control cages presented between 495 and 662 kg/ha, a higher canola yield than experiments with the introduction of 8 and 2 pollen beetles/plant. Insecticides succeeded to reduce the abundance of pollen beetle in Normandin, St-Augustin and Harrington Research Center, with Success 480 SC most efficient at the three sites.

Outcomes

Introduction

Three main pests impacting canola are present in Eastern Canada, the flea beetle (*Phyllotreta striolata* and *P. crucifera*), the cabbage seedpod weevil (*Ceutorhynchus obstrictus*), and the pollen beetle *Brassicogethes viridescens* (Fabricius) (syn. *Meligethes viridescens*) (Bilodeau et al. 2012; Dosdall and

Mason 2012; Labrie et al. 2010; Mason et al. 2003). While some strategies are used in western Canada against flea beetles and cabbage seedpod weevil, conditions are different in the east and we need to develop adapted IPM strategies. The pollen beetle is present only in the Maritimes and Quebec and little information on this species and its damage is available.

Flea beetle damage and therefore the use of foliar insecticide are increasing in some areas of Quebec (Bilodeau et al. 2012). Feeding by these pests at early stages reduces photosynthate production, and seedlings can be killed when beetles sever the shoot apex. Although some seedlings recover from flea beetle damage, the impact on the crop can be considerable because of reduced stand density and delayed maturity. Flea beetles have been controlled by seed treatment, but their efficacy seems to be reduced in recent years (Tansey et al. 2008) and many producers need to treat two or three times with foliar insecticides to avoid high yield loss (Parent, unpublished data). The main foliar active ingredient used against flea beetles is lambda-cyhalothrine. However, this product is not registered against the striped flea beetle, which is the main species observed in canola fields in Quebec (Labrie et al. 2010). We thus need to test the efficacy of other insecticides against these pests. Cultural control practices can also be used against flea beetles to reduce their impact and the use of insecticide. A recent study demonstrated that early seeding of canola attracted flea beetles and that damage to canola was concentrated to these earliest dates (Labrie, Vanasse and Pageau unpublished data). These results are opposite to studies in Alberta, which demonstrated less damage when canola is sown early (Carcamo et al. 2008). A strategy that used different seeding dates could reduce damages by flea beetles, but it will depend on temperature and ecoregion (Carcamo et al. 2008). More studies are needed on the impact of seeding date on flea beetles in Eastern Canada.

The cabbage seedpod weevil is prevalent in Ontario and Quebec (Dosdall and Mason 2010; Labrie et al. 2010), with increasing abundance in some areas. Expansion of the species to the Maritimes could occur if acreages of canola increase. Cabbage seedpod larvae consume 5-6 grains per pod and can reduce yield between 10 to 35% (Buntin 1999; Nilsson 1987). Work on this species has been intensive in western Canada and control strategies have been evaluated (Dosdall and Mason 2010). However, we discovered a European parasitoid of the cabbage seedpod weevil, *Trichomalus perfectus*, in Quebec and Ontario (Labrie et al. 2010; Mason et al. 2011). In Europe, *T. perfectus* is the most important parasitoid responsible for reducing *C. obstrictus* abundance (Williams 2003). Estimates of parasitism by *T. perfectus* are in the range of 10% to up to 95%, and can be high even at low pest densities (Büchi 1991; Buntin 1998; Haye et al. 2010; Kulhmann et al. 2006; Murchie et al. 1997; Murchie and Williams 1998). Parasitism of cabbage seedpod weevil observed in Saint-Augustin-de-Desmaures (U. Laval experimental site) between 2010 and 2012 increased from 12% to 90% (Létourneau et al., 2012, unpublished data). Economic thresholds for cabbage seedpod weevil in North America were developed without consideration of natural enemy control. Foliar insecticides are applied when two to four cabbage seedpod weevils are caught by sweep net at the beginning of flowering period. With the recent presence of parasitoids, we need to evaluate the economic threshold for this species, taking into account the parasitism rate in each area, which is not included in the threshold in western Canada (Dosdall and Mason 2010).

Another insect pest which is increasing in range and abundance is the pollen beetle, *Brassicogethes viridescens* (Fabricius) (syn. *Meligethes viridescens*) (Labrie et al. 2010; Mason et al. 2003). This species was first observed in the Maritimes and in Maine in the 1990’s (Hoebeke and Wheeler 1996) and in Quebec in 2001 (Mason et al. 2003). Very high abundance was observed in 2012 in some areas of Prince Edward Island and Quebec (Noronha and Labrie, 2012, unpublished data). Females deposit their eggs inside flower buds, where larvae feed on the pollen on developing stamens in the bud, causing bud losses (Ekbom and Borg 1996). The pollen beetles have decreased yield by 70-80% in Europe (Hansen 2004; Nilsson 1987) and no strategies have been developed against this pest for Canada. In Europe, the economic threshold is between 0.1 and 3 pollen beetles per plant (Hansen 2004). In our conditions, no information is available on the amount of damage and yield loss this species can cause. We thus need to develop economic thresholds under our conditions and evaluate the efficiency of insecticides against this new species.

Objectives

The overall objective is to develop integrated pest management strategies against flea beetle, pollen beetle and cabbage seedpod weevil (CSW) in Eastern Canada.

Specific objectives are:

1. Evaluate the influence of seeding date against flea beetles, CSW and pollen beetle.
2. Evaluate the efficiency of chemical control against flea beetles.
3. Determine the economic threshold for cabbage seedpod weevil (CSW).
4. Determine the economic threshold and efficiency of insecticides for pollen beetle.

Methodology

Trials at Saint-Augustin-de-Desmaures (SA) were conducted by Anne Vanasse (U. Laval, QC). Trials at Normandin (NO) were conducted by Denis Pageau (AAFC-Normandin, QC). Trials at St-Mathieu-de-Beloeil were conducted by Geneviève Labrie (CÉROM, QC) and trials at Harrington Research Center (HA) were conducted by Christine Noronha (AAFC – Charlottetown, PEI).

1) Seeding dates trials

In 2015, canola (variety 45H29) was sown at several different dates (May 19th, May 29th, June 9th) at NO, with or without insecticide treatment, in plots of 8 rows x 5.5 m (replicated four times). Flea beetle damage (% of surface consumed) was assessed five times on fifteen plants per plot (three plants at five locations) for each seeding date between cotyledon and five leaves stage. Two yellow sticky cards were placed vertically, flush with the ground, in each plot to assess flea beetle abundance and species composition. Half of the plots were treated with Decis® (150 ml/ha) at 2-3 leaves stages, while the others were left untreated.

At SA, canola (variety L150) was sown at three different dates (May 7th, May 17th, June 4th), with and without insecticide treatment. Canola was sown in plots of 9 rows x 6.53m for flea beetles (8 plots) and in 8 other plots for cabbage seedpod weevil and pollen beetle evaluation. Flea beetle damage and abundance was assessed the using the same manner as at Normandin. Half of the plots were treated with Decis® (150 ml/ha) at three leaves stages, while the others were left untreated. During the flowering period, three sweeps at two different locations in the border of each plot were completed to evaluate the abundance of CSW and pollen beetle. Insects were counted in the field and returned to the same plot.

Half of the plots were treated with Matador (83 ml/ha) at 20% flowering period, while the others were left untreated.

Canola was harvested in the center of each plot to compare yield between treatments (NO: September 22th (D1, D2); October 16^{th}; SA: August 28^{th}, September 4^{th}, September 17^{th}).

1b. Trap cropping trial against flea beetles
This trial was conducted on two sites in Saguenay Lac-St-Jean area (St-Prime and Roberval). A trap crop of canola was sown in the middle of the field a few days before the rest of the field (St-Prime: trap crop = May 15^{th} and rest of the field = May 29^{th}; Roberval: May 23th and June 1^{st}). Only the site of St-Prime was affected by flea beetles. The trap crop at St-Prime was treated with Ripcord (50 ml/ha) on June 4^{th}. Flea beetles damage was assessed on three plants at 10 different stations each week between cotyledon and 5 leaves in the trap crop and at 77 m east and 75m west of the trap crop. One week before harvest by the producer, 5 meter squares of canola were manually collected in each part of the canola fields and sent to CEROM for yield evaluation.

2) IPM trials against flea beetles

2a. Insecticide trials against flea beetles
Canola (45H29) was sown on May 29^{th} at NO in plots of 6m x 10m (replicated four times for each product and with control). At St-Augustin, canola (L140P) was sown on May 7^{th} in plots of 9 rows x 5m (replicated four times for each product and with control). Flea beetle damages were assessed four times for each seeding date between cotyledon and five leaf stage by estimating the proportion of each cotyledon surface consumed by the beetles on fifteen plants per plot (three plants at five locations). Two yellow sticky cards were placed vertically, flush with the ground, in each plot to assess flea beetle abundance and species composition. Half of the plots were treated at the cotyledon stage (Decis@150 ml/ha, Sevin@750 ml/ha, Malathion 500@1.12L/ha) on June 18^{th} (NO) and May 29^{th} (SA), while the others were left untreated.

Canola was harvested in the center of each plot to compare yield between treatments (NO: September 22^{th}; SA: August 28^{th}).

3) Economic threshold against cabbage seedpod weevil with consideration of parasitism

3a. Evaluation of damages by CSW and parasitism rate in Quebec canola fields.
Evaluation of damages and parasitism rate of CSW have been completed for 24 canola fields monitored by the Ministry of Agriculture of Québec (MAPAQ) during the summer of 2015. For each field, 1000 pods were collected and sent to CÉROM, where they were placed in emergence boxes and left at a controlled temperature and humidity (21C; 65%RH) for 6 weeks. All parasitoids that emerged were collected, counted and placed in alcohol 70% for future identification. After 6 weeks, all pods were opened and the presence of CSW larvae, parasitoids nymphs or adults and number of grains consumed were counted.

3b. Introduction of CSW in cages (CÉROM).
No winter canola has survived to winter in Québec, due to harsh temperatures and no parasitoids were collected for introduction in cages. Thus, only introduction of CSW were done during the summer of 2015. Cages of muslin (1m x 1.5m x 2m) were installed at cotyledon stage in canola plots at CÉROM research

center. Four different introduction rates of CSW were used in the experiments (3.5, 7, 14 and 21 CSW/sweep), and each treatment was replicated four times. Control cages without insects were installed at the same time. Cabbage seedpod weevil was introduced at the beginning of the flowering period. Presence of the insects was noted two times per week throughout the season. At maturity, 1000 pods were collected and examined for emergence holes of cabbage seedpod weevil inside the pods (at CÉROM laboratory). Canola was harvested in each cage on August 27th and August 28th for yield evaluation.

4) Determine the economic threshold and efficacy of insecticides for pollen beetle

4a. Introduction of pollen beetle in cages to evaluate yield loss and economic threshold (CÉROM)

Cages of muslin (1m x 1.5m x 2m) were installed at the cotyledon stage in canola plots at the research center. Two different introduction rates of pollen beetles (150 and 640/cage; which correspond to 2 and 8 pollen beetles/plant) were used in the experiments, and each treatment was replicated three times. Control cages were installed at the same time. Presence of the insects (adults and larvae) were noted two times per week during the season. At bud stage, 25 buds were observed in each cage on July 13th and 17th. Canola was harvested in each cage on August 27th for yield evaluation.

4b. Trials of insecticides against pollen beetle (St-Augustin-de-Desmaures (QC), Normandin (QC), Harrington Research Farm (PEI)).

The plots (SA: 4.86 m x 6.53m; NO: 6 x 10m; HA: 4 x6m) were set up in a randomized complete-block design and planted with variety L140P (SA), L150 (HA) or 45H29 (NO) at a seeding rate of 6 kg/ha. Treatments consisted of three insecticides (Malathion 500 @ 1.12 L/ha, Matador 120 EC @ 83 ml/ha, Success 480 SC @ 182 ml/ha) and untreated plots. Pollen beetle abundance was observed by sweep net (6 sweeps in QC sites and 10 sweeps in PEI site) one day before insecticide treatment (SA: July 4th; NO: July 5th; HA: July 10th) and three to four days after. In HA, 30 pollen beetle adults were introduced in each plot 24 hours before insecticide treatment because no insects were observed. Insecticides were applied at the beginning of the flowering period. Canola was harvested in the center of each plot to compare yield between treatments (SA: no harvest due to harsh conditions in spring and birds in fall; NO: September 22th; HA: September 9th).

Results

1a. Seeding date

Defoliation by flea beetles was higher in the first seeding date than the second or third seeding date at Normandin ($F_{2,\ 22,76} = 177.78$; $P < 0.001$; Figure 1), but no differences were observed at St-Augustin ($P > 0.05$). Defoliation by flea beetles did not reach the threshold of 25% defoliation in either site. Insecticide treatment significantly reduced defoliation by flea beetles at the three seeding dates at Normandin ($F_{1,\ 22,92} = 104.36$; $P < 0.001$; Figure 1), and the two first seeding dates at St-Augustin ($F_{2,\ 14,96} = 7.98$; $P = 0.004$; Figure 1).

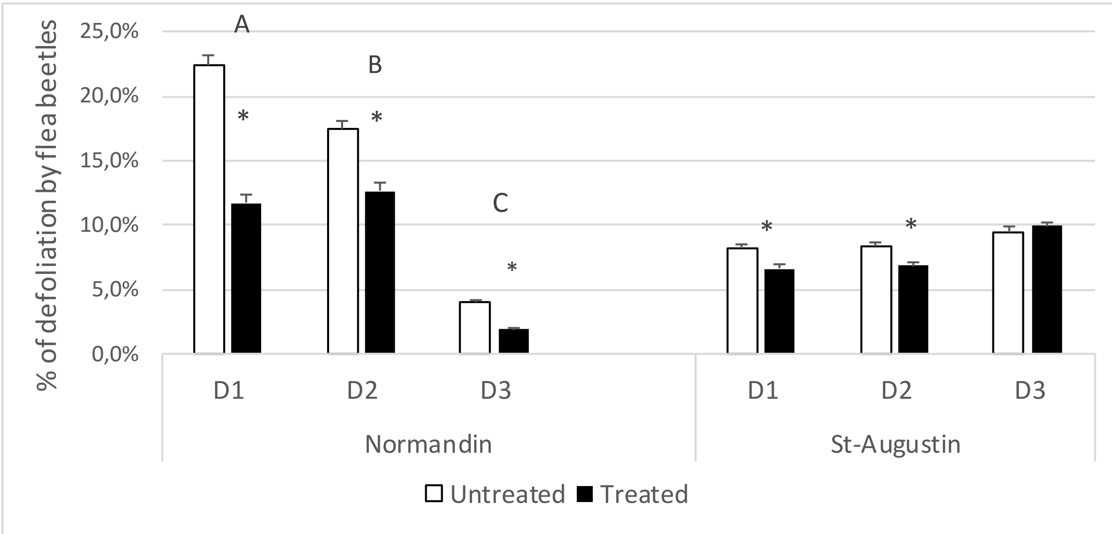
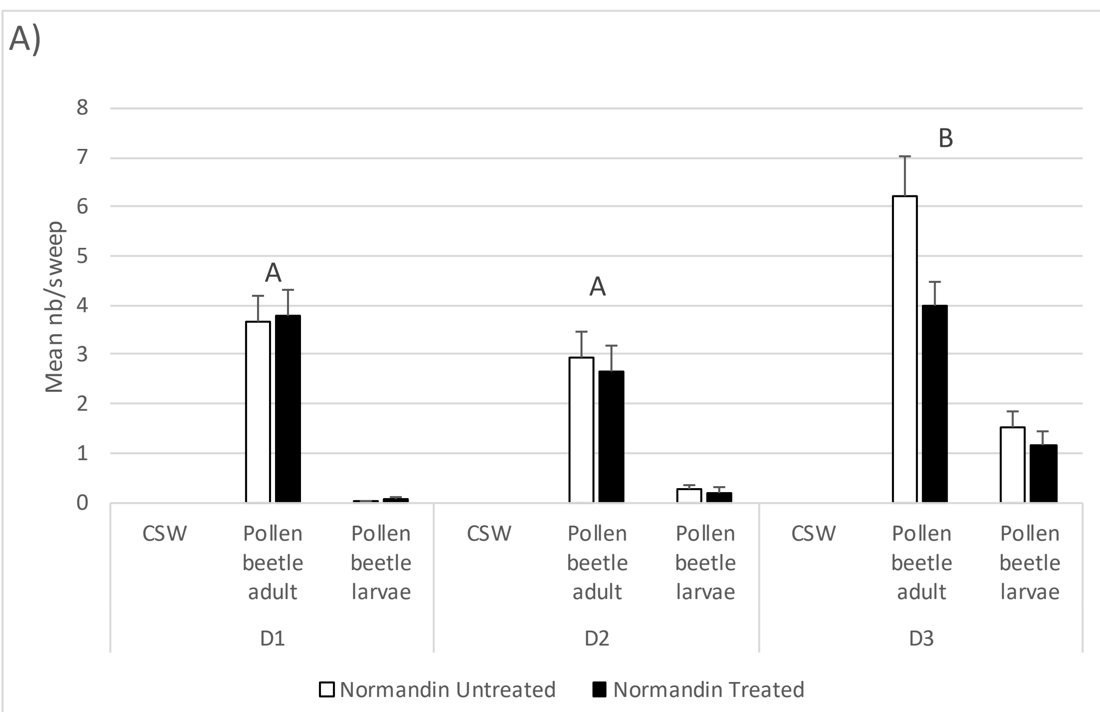


Figure 1. Damage by flea beetles following three seeding dates and insecticide at Normandin and St-Augustin during summer 2015. Note: Different letters indicate significant differences between seeding date, while asterisk indicate significant differences between insecticide treatment.

Abundance of pollen beetle was significantly different with the third seeding date compared to the first and second seeding dates at Normandin (χ^2 = 16.12; df = 2; *P* < 0.001; Figure 2A). No CSW were observed at Normandin. At St-Augustin, there were no differences between abundance of CSW or pollen beetle following seeding date or insecticide treatment (χ^2 = 2.15; df = 2; *P* = 0.34; Figure 2B).



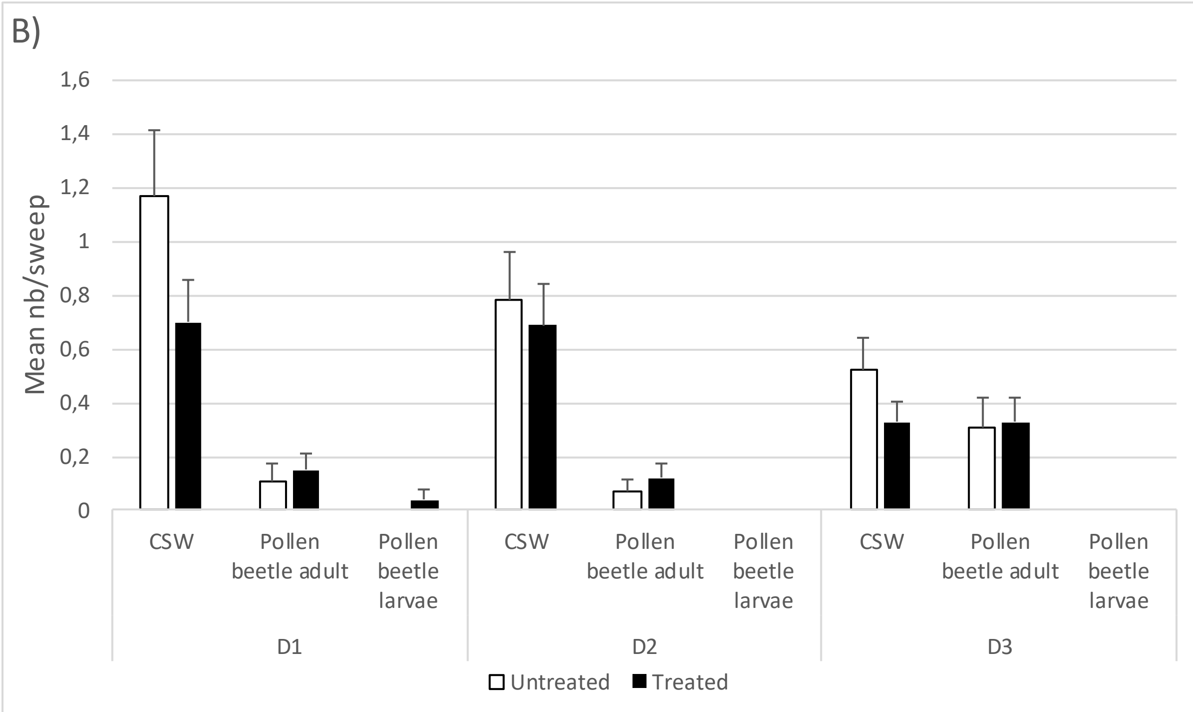


Figure 2. Abundance of CSW and pollen beetle in sweep net at A) Normandin and B) St-Augustin following three seeding dates and insecticide during summer 2015. Note: asterisk represent significant differences between insecticide treatment.

Yield was highest the first and second seeding dates at Normandin ($F_{2,16}$ = 18.44; $P < 0.001$; Figure 3A) and highest at first and third seeding dates at St-Augustin ($F_{2,9}$ = 10.04; $P = 0.0051$; Figure 3B). Yield was not different between insecticide treatments for Normandin and St-Augustin ($P > 0.05$; Figure 3A and B).

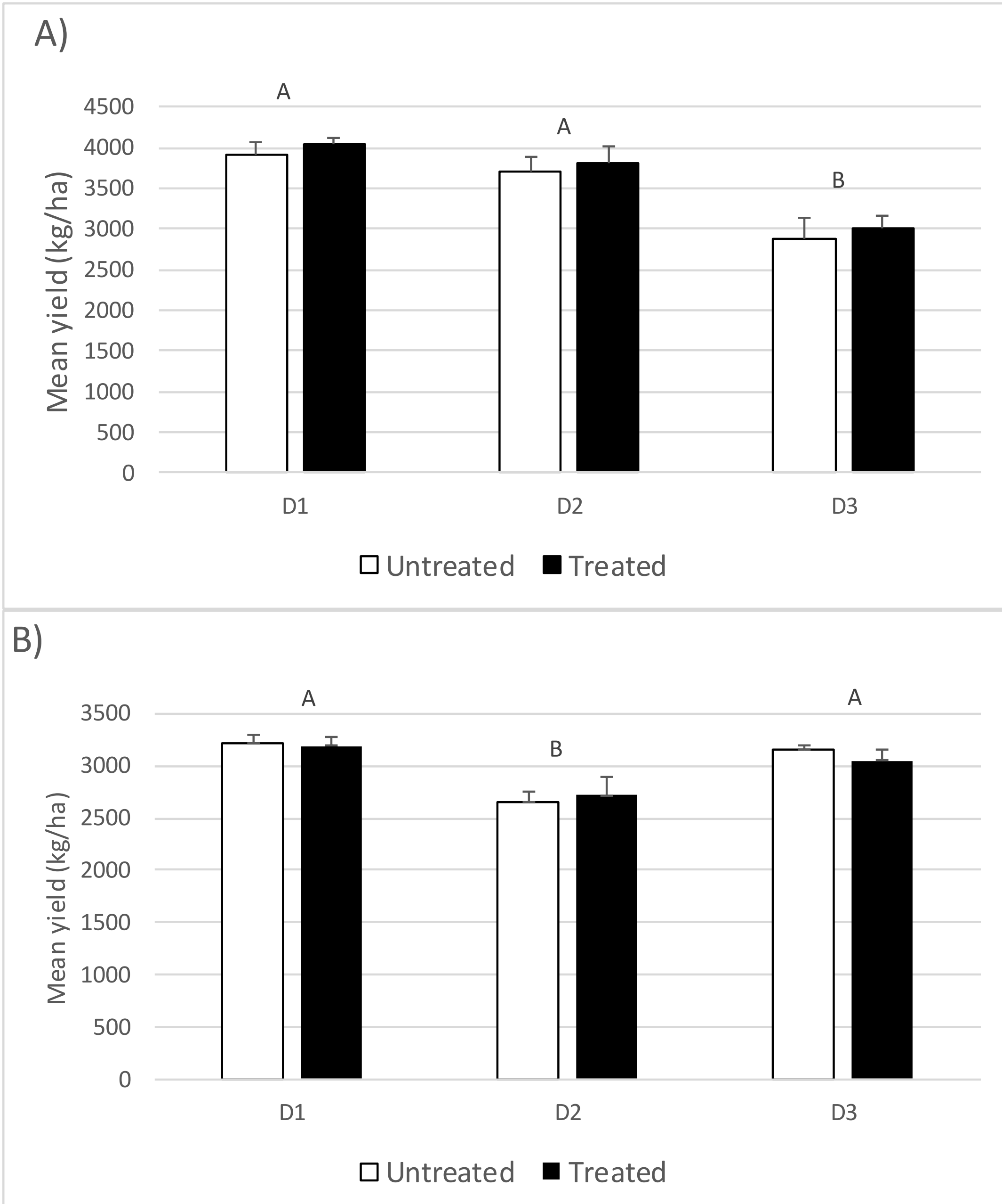


Figure 3. Mean yield of canola at A) Normandin and B) St-Augustin in 2015 following three seeding dates and insecticide against canola insect pests. Note: different letters indicate significant differences between seeding date.

1b. Trap cropping trials against flea beetles

In the trap crop at St-Prime, defoliation by flea beetle reached the threshold of 25% of defoliation at the cotyledon stage. Insecticide treatment succeed to reduce defoliation by flea beetles in the trap crop and the rest of the field did not reach the threshold of 25% of defoliation (Figure 4).

Yield was highest in the trap crop compared to the east part of the field ($F_{2,8}$ = 13.1; P = 0.003; Figure 5).

This eastern part of the canola field was bordered by an alfalfa field that was infested by flea beetles, which could explain why the highest defoliation and lowest yield was observed in that part of the field.

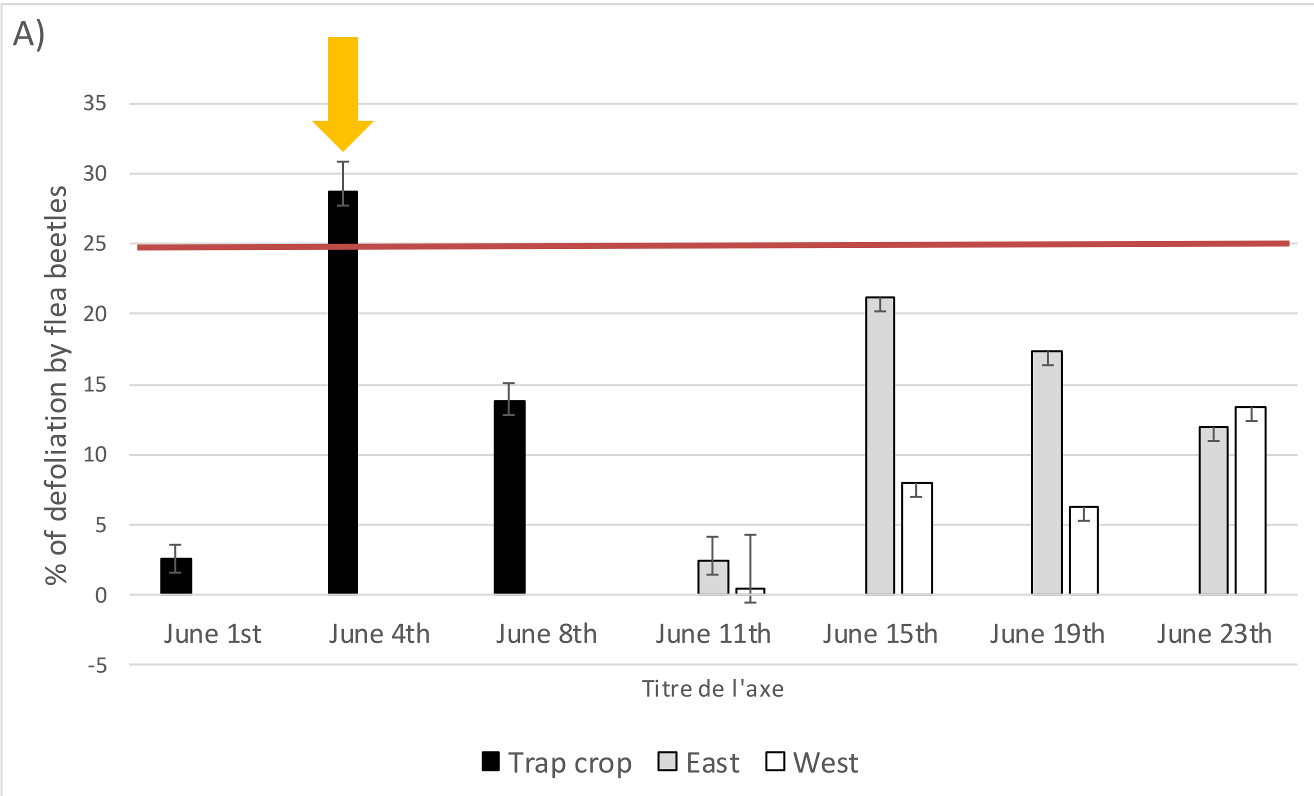


Figure 4. Defoliation by flea beetle in the trap crop trial at St-Prime during summer 2015. Note: Arrow indicate insecticide treatment against flea beetles.

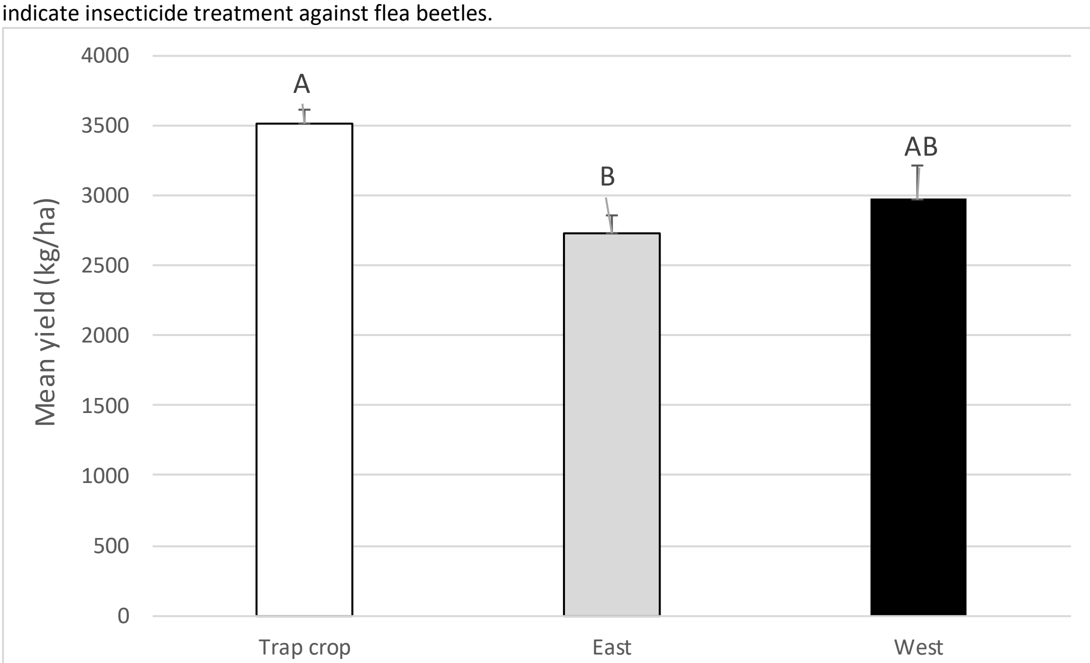
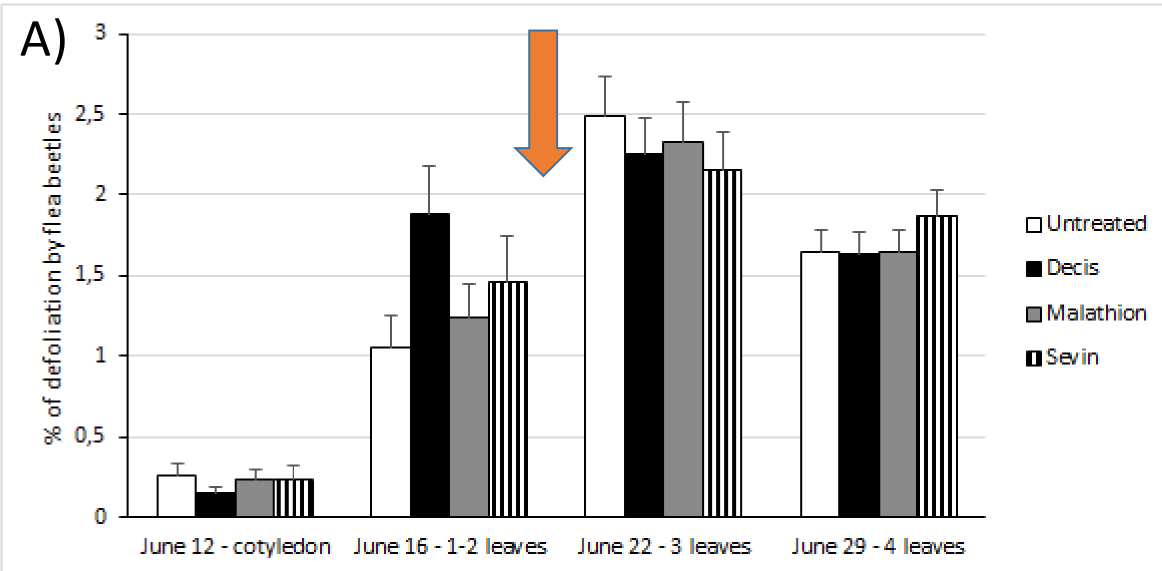


Figure 5. Mean yield of canola in the trap crop trial at St-Prime during summer 2015. Note: different letters indicate significant differences between treatment.

2. Insecticide trials against flea beetles

Defoliation by flea beetles did not reach the economic threshold of 25% of defoliation at either site and no differences in defoliation were observed at Normandin for each stage (Figure 6).



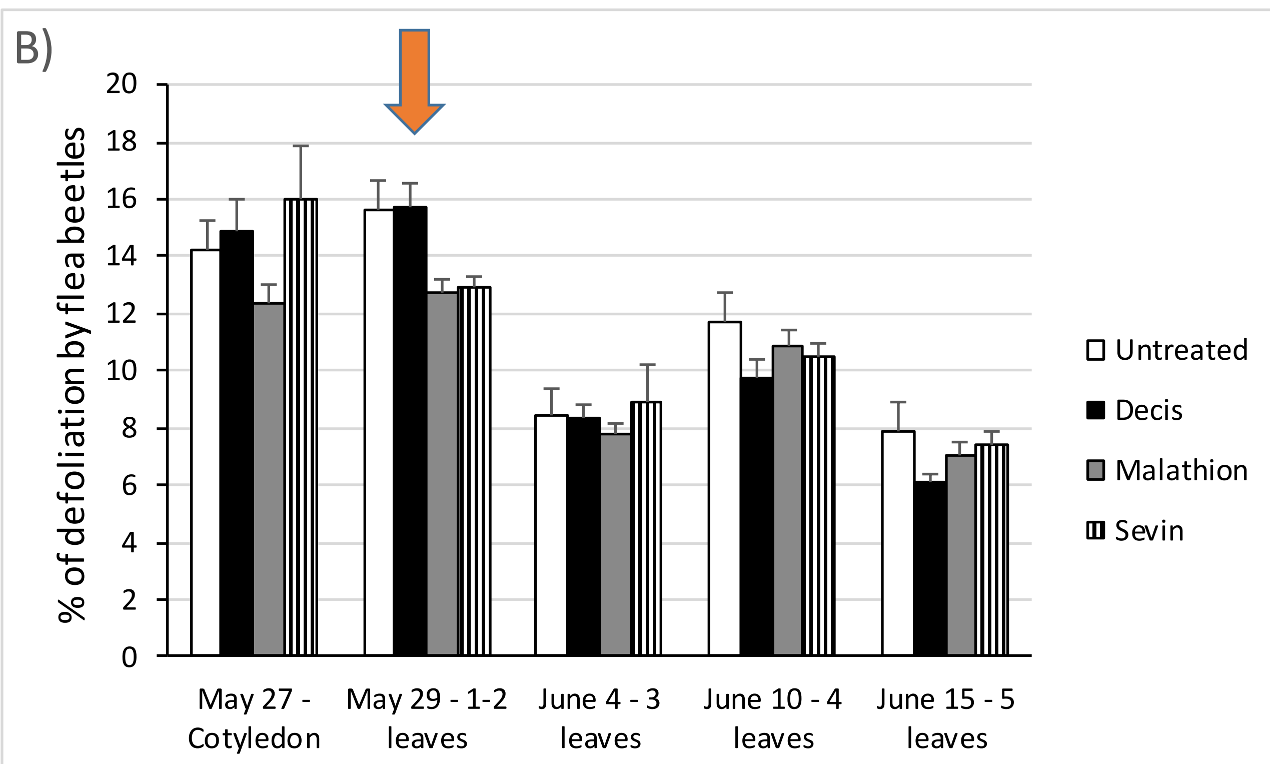


Figure 6. Defoliation by flea beetles following insecticides treatment during summer 2015 at Normandin (A) and St-Augustin (B). Note: Arrow indicate insecticide treatment against flea beetles.

No differences in yield were observed between insecticide treatments at Normandin ($F_{3,8}$ = 0.29; P = 0.83; Figure 7A) and St-Augustin ($F_{3,8}$ = 0.39 ; P = 0.77; Figure 7B).

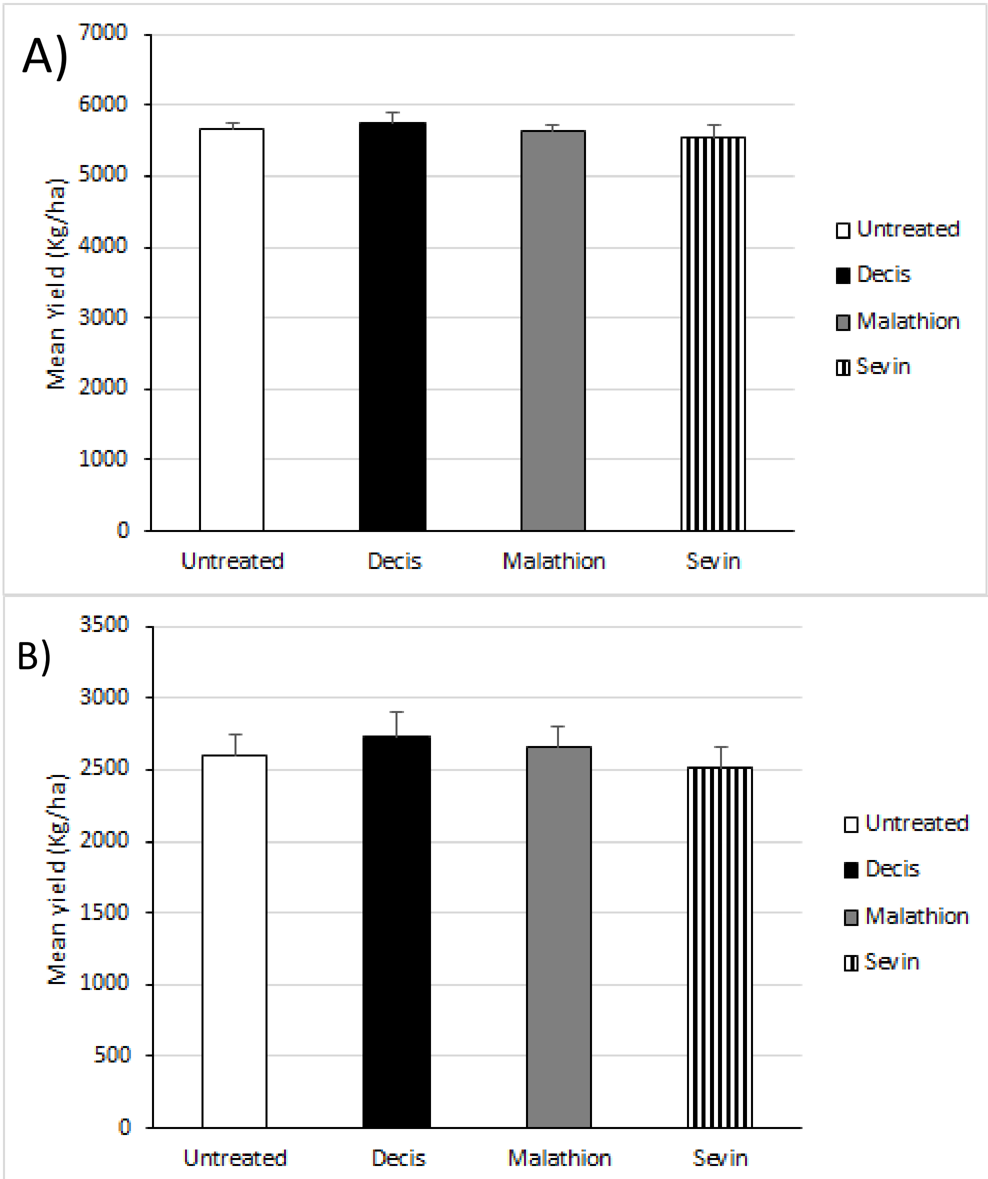


Figure 7. Mean yield of canola at Normandin (A) and St-Augustin (B) in 2015 following insecticides treatments against flea beetles.

3. Economic threshold against cabbage seedpod weevil with consideration of parasitism

3a. Evaluation of damages by CSW and parasitism rate in Quebec canola fields.

Cabbage seedpod weevils (CSW) were captured in 18 fields in Quebec (75% of fields; Figure 8). There was an 80% increase in CSW observation in Saguenay-Lac-St-Jean area in 2015 compared to 2014, where CSW was observed in only 1 field out of 5. Damaged pods by CSW were observed in 17 fields out of 24 (Figure

9). However, no fields reached the economic threshold of 25% damaged pods.

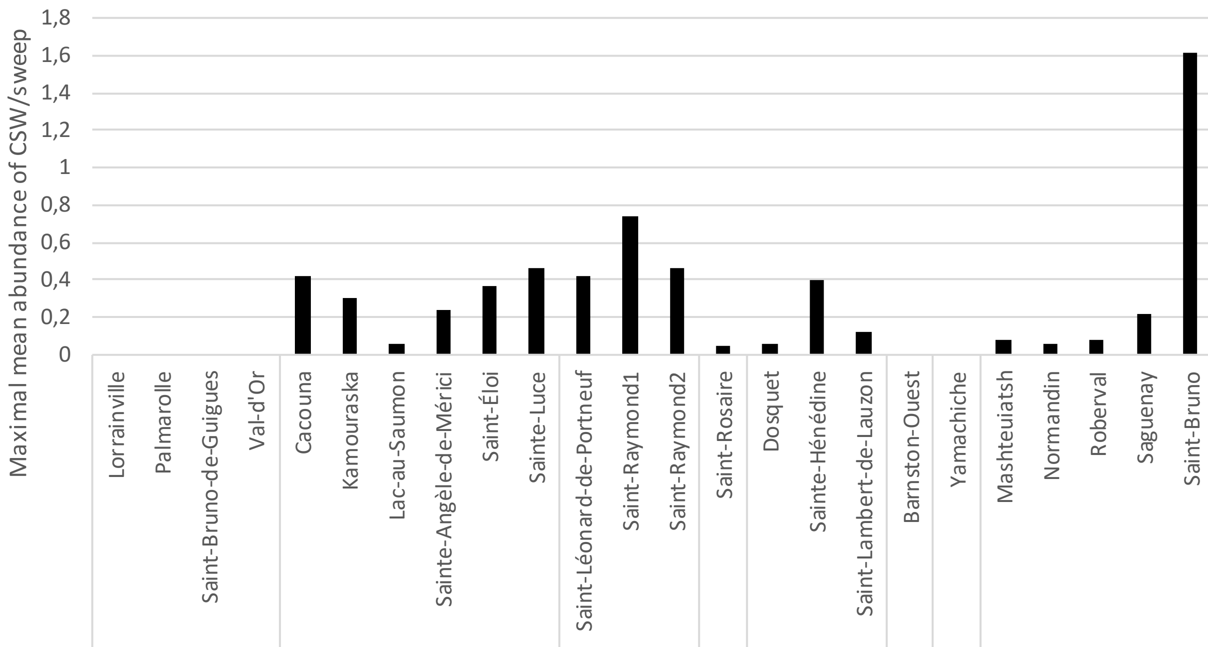


Figure 8. Maximal mean abundance of CSW in canola fields of Québec during summer 2015. Note: threshold is at 2 CSW/sweep.

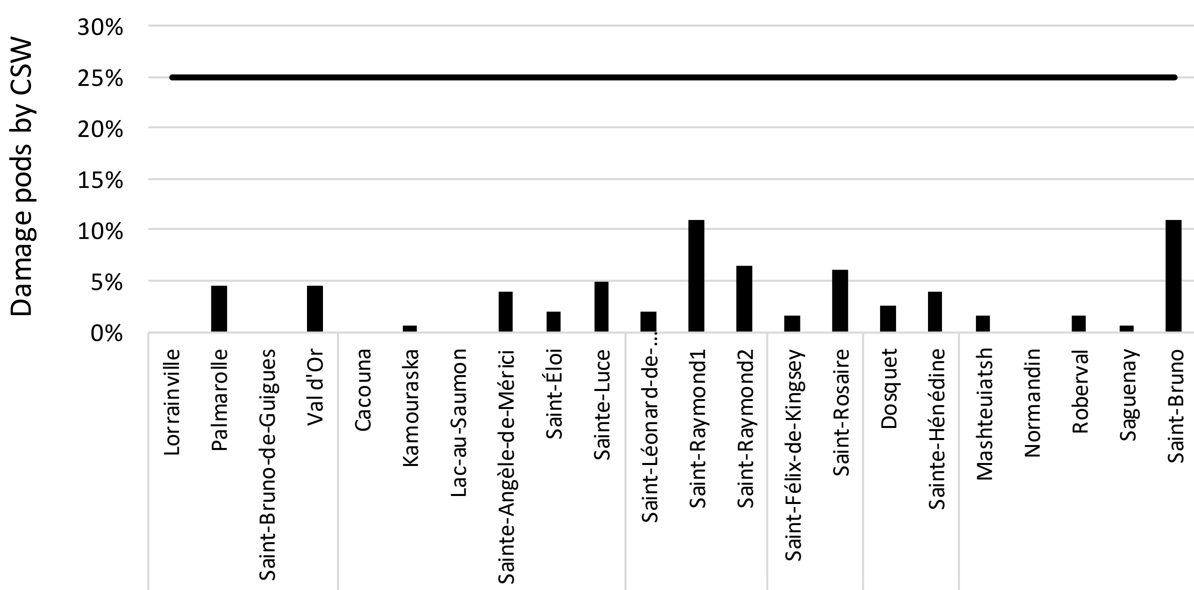


Figure 9. Percentage of damaged pods by CSW in canola fields of Québec during summer 2015. Note: Threshold is at 25% of damaged pods.

On those fields, 55 parasitoids emerged from 11 fields, representing 45.8% of fields with parasitoids (Figure 10), an increase of 7% from 2014. Parasitism rate varied between 38 and 100%, with a mean parasitism rate of 76% (Figure 11), an increase of 48% compared to 2014. Percentage of grains consumed by CSW was 25% less in pods with parasitoids than in pods without parasitism (Figure 12).

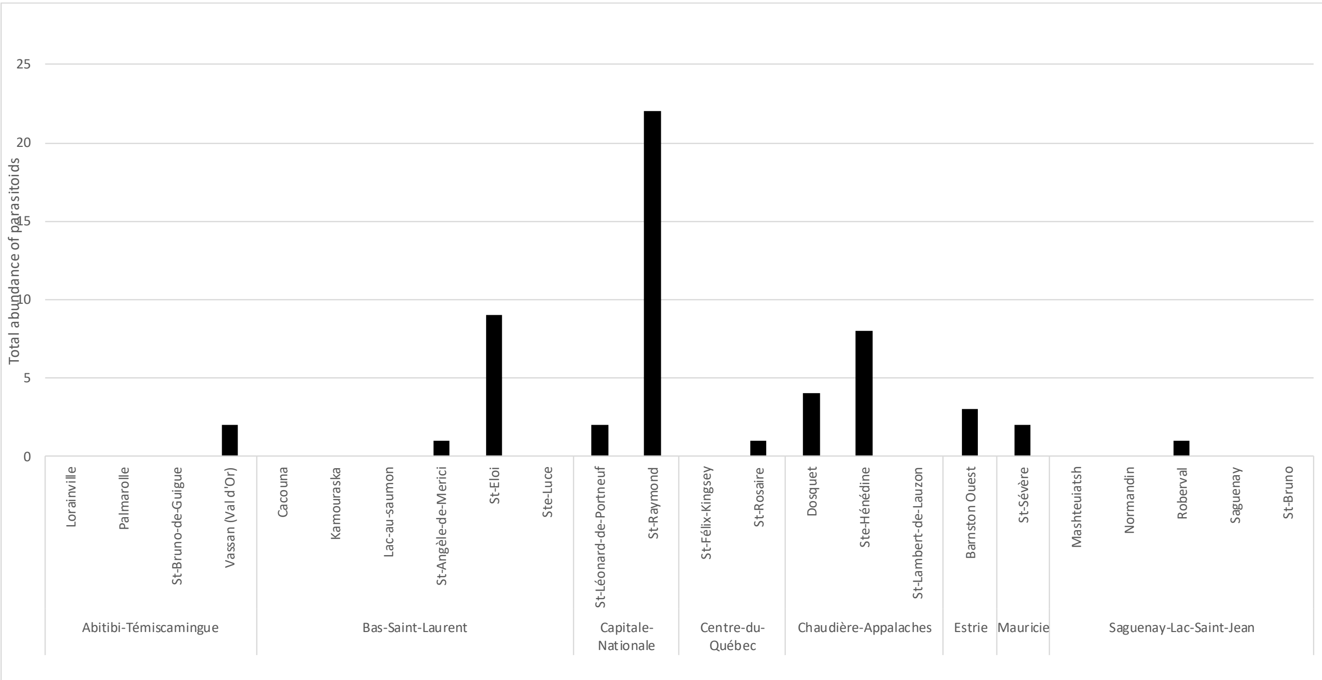


Figure 10. Total abundance of parasitoids of CSW in canola fields of Québec during summer 2015.

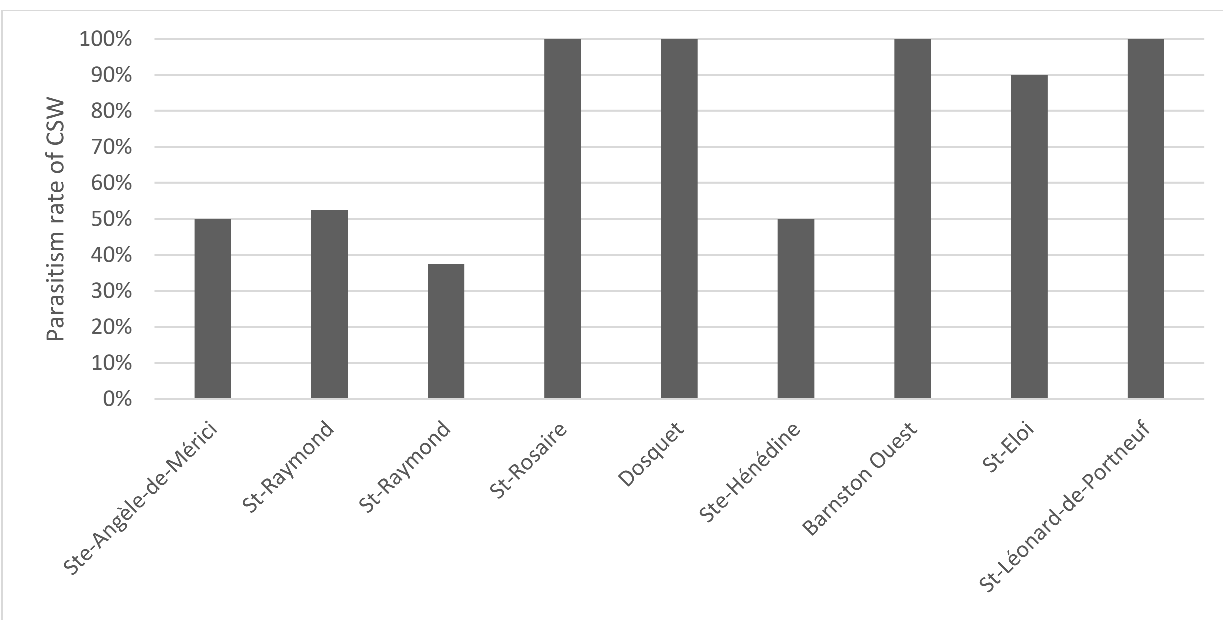


Figure 11. Parasitism rate of CSW in canola fields of Québec during summer 2015.

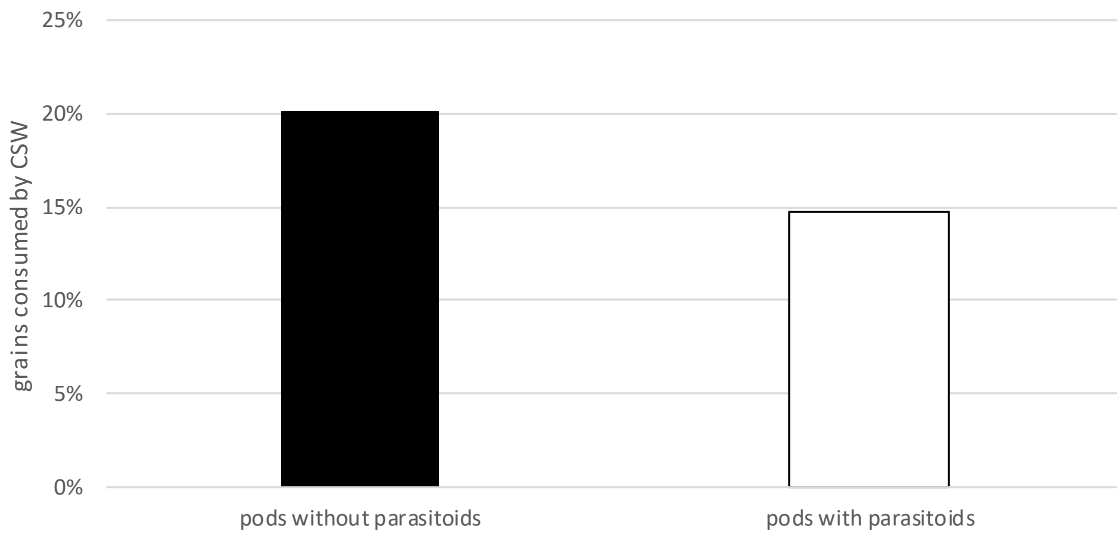


Figure 12. Percentage of grains consumed by CSW in pods with and without parasitoids in canola fields of Québec during summer 2015.

3b. Introduction of CSW in cages (CÉROM).

There were no differences in yield between treatments ($F_{4, 15} = 0.38$; $P = 0.18$; Figure 13).

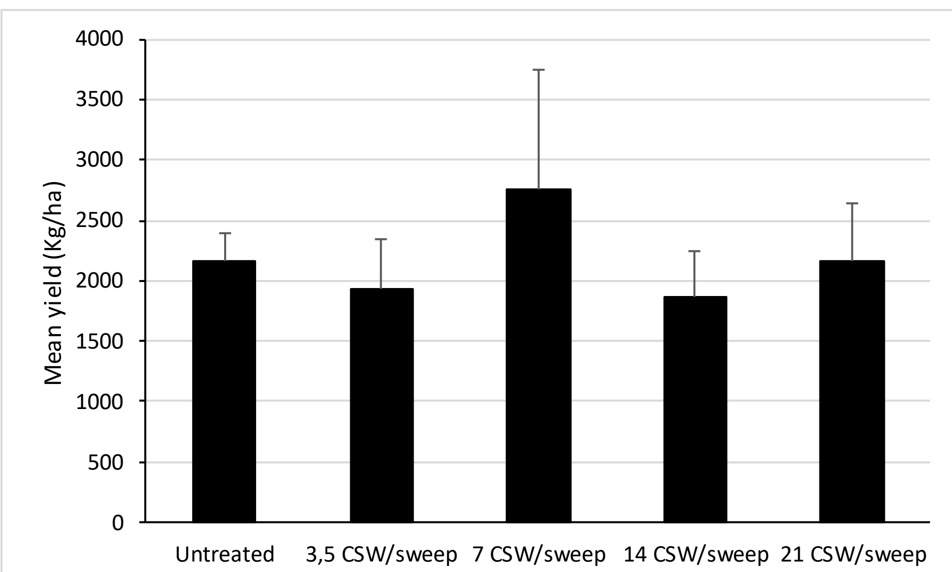


Figure 13. Mean yield of canola in cages with different introduction rate of CSW at CEROM during summer 2015.

4. Determine the economic threshold and efficacy of insecticides for pollen beetle

4a. Introduction of pollen beetle in cages to evaluate yield loss and economic threshold (CÉROM)

There were the highest number of pollen beetle larvae in cages with an introduction rate of 8 pollen beetle/plant (Figure 14). Yield was similar between control and 2 or 8 pollen beetle/plant ($F_{2,3} = 0.04$; $P = 0.96$; Figure 15).

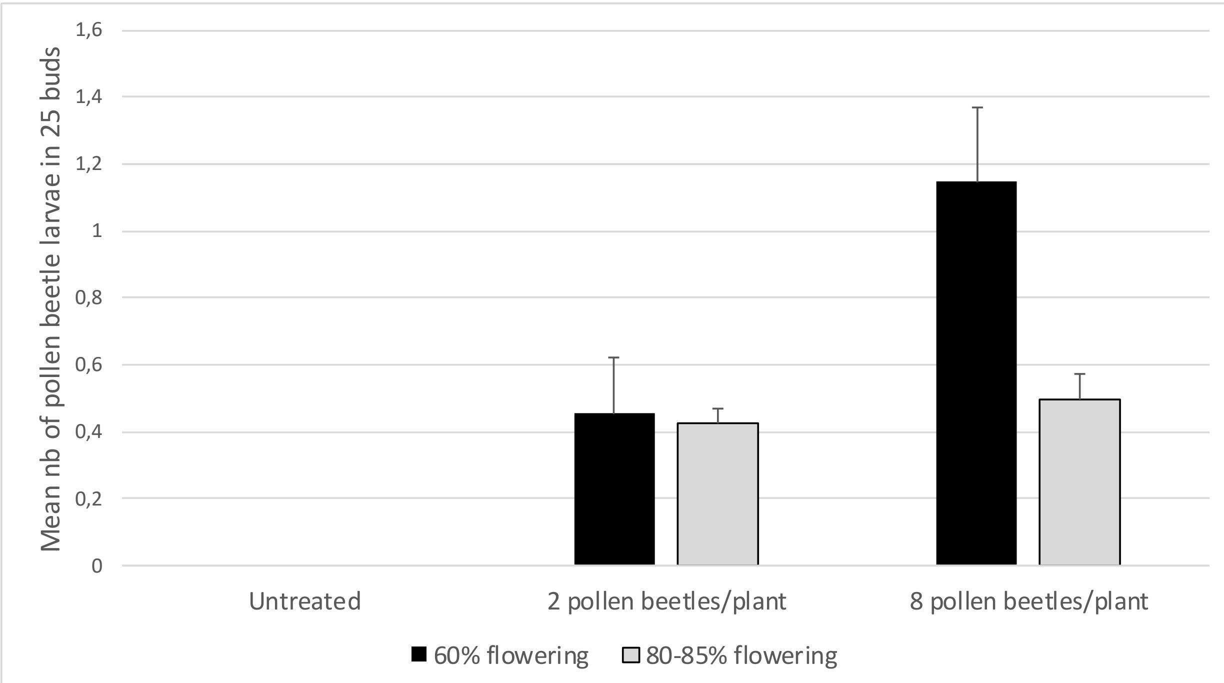


Figure 14. Mean number of pollen beetle larvae in 25 flower buds in cages with different introduction rates of pollen beetle during summer 2015.

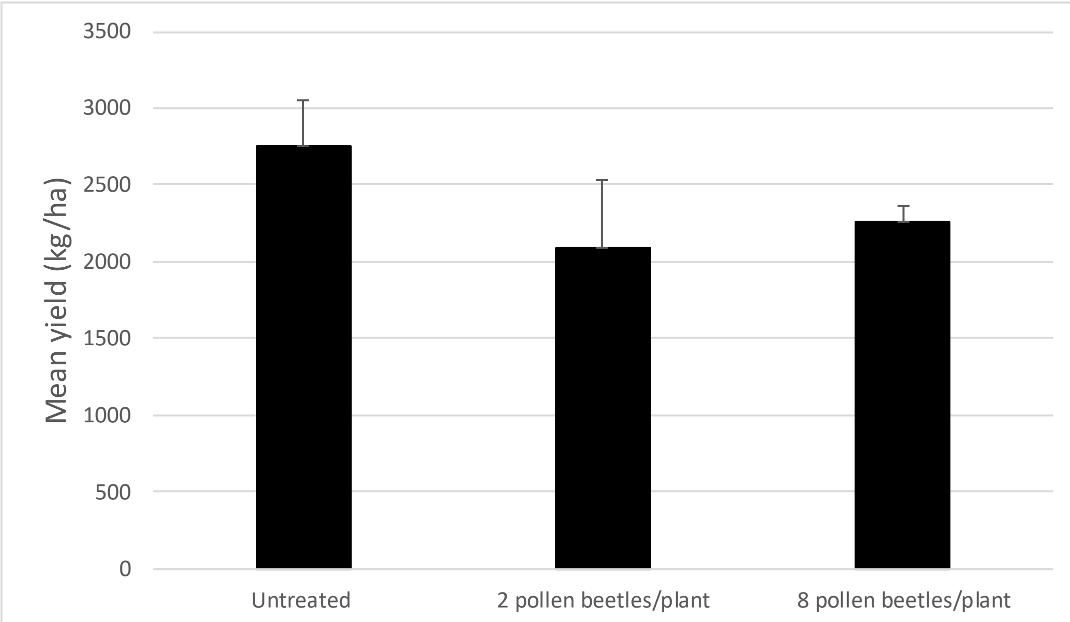
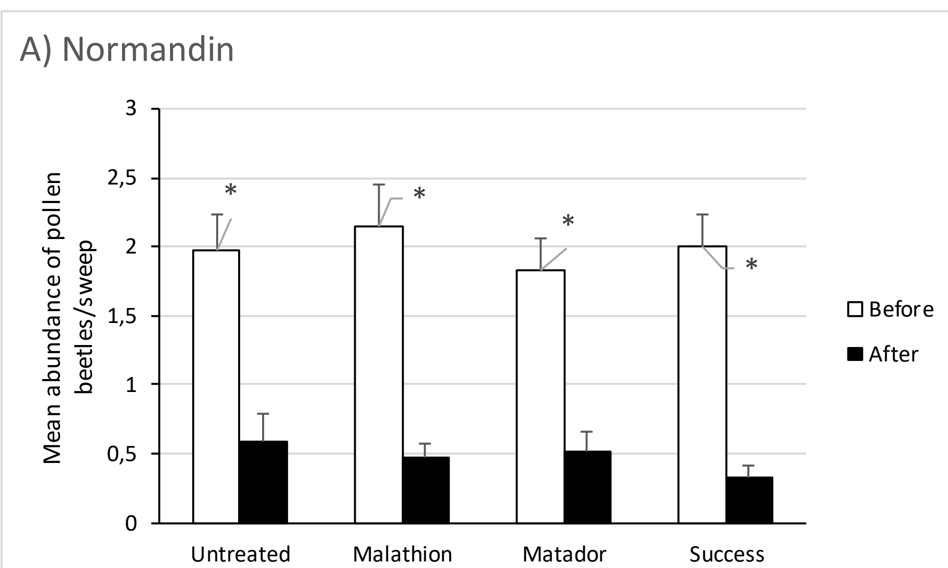
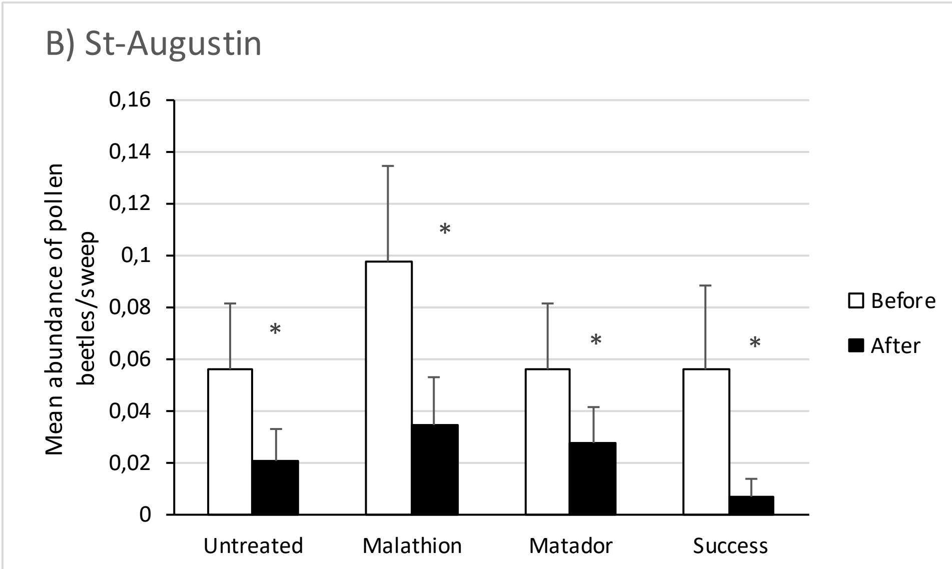


Figure 15. Mean yield of canola in cages with different introduction rate of pollen beetles at CEROM during summer 2015.

4b. Trials of insecticides against pollen beetle (St-Augustin-de-Desmaures (QC), Normandin (QC), Harrington Research Farm (PEI)).

There were significant differences in abundance of pollen beetles for the four treatments at Normandin ($F_{1,180}$ = 127.15; P < 0.001; Figure 16A), at SA ($F_{1,276}$ = 9.26; P = 0.002; Figure 16B) and for Matador and Success four days after treatment at HA (Figure 16C).





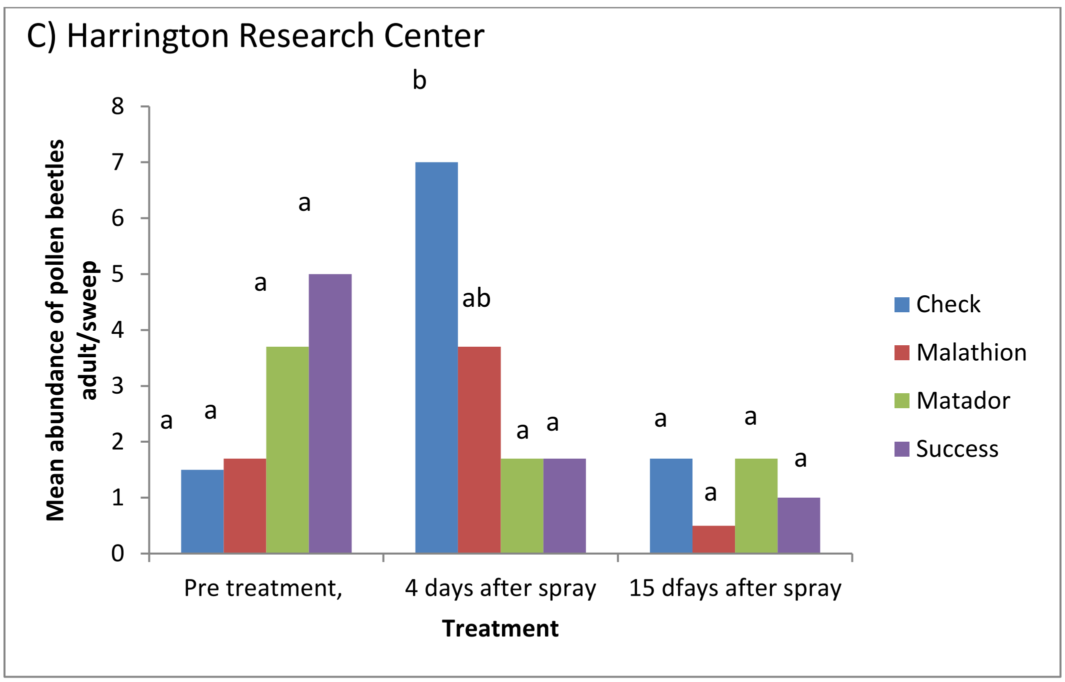


Figure 16. Abundance of pollen beetle adults before and after different insecticide treatment in A) Normandin, B) St-Augustin and C) Harrington Research Center during summer 2015. Note: asterisk or different letters represents significant differences between treatment.

There were no yield differences between insecticide treatments at Normandin (*P* > 0.05; Figure 17) and Harrington Research Center (Table 1; *P* > 0.05).

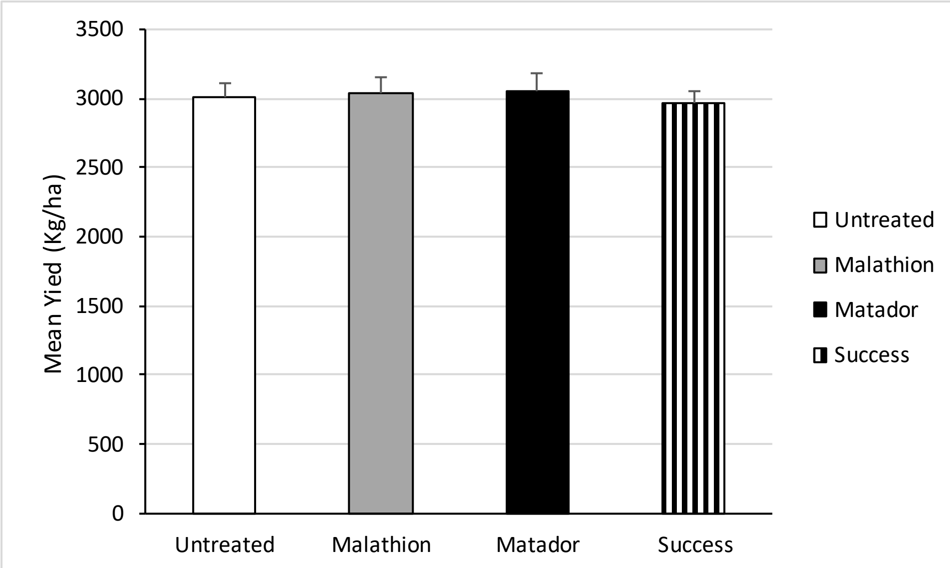


Figure 17. Yield of canola in plots treated by three insecticides against pollen beetles at Normandin during summer 2015.

Table 1. Mean yield, moisture, oil DM, Linolenic DM and Oleic DM in each treatment.

Treatments	Yield mt/ha	moisture	Oil DM	Linolenic DM	Oleic DM
Check	1.61	6.06	48.76	8.01	66.18
Success	1.65	5.97	49.74	7.97	66.61
Malathion	1.65	5.90	49.76	8.13	66.37
Matador	1.41	6.03	49.30	7.85	66.22

Discussion

Flea beetles.

Flea beetles were most abundant in the first and second seeding dates in both sites in 2015, which corresponds to our hypothesis and to temperature conditions during the spring. Tansey et al. (2015) demonstrates that abundance of flea beetles is observed when air temperature reaches 15°C, which corresponds to the first seeding date in both sites. However, the threshold of 25% defoliation was not reached on both sites and no differences in yield were observed. The trap cropping trial added in 2015 was efficient to attract the flea beetles in the trap crop and to reduce the defoliation in the rest of the field without treating all the field with insecticide. The trap cropping could thus be a good alternative to attract flea beetles in only one area and to reduce the use of insecticide. The seeding date and trap cropping trial demonstrates, however, that a predictive model including temperature, phenology of canola and biology of flea beetles will be an important tool for the IPM of this insect. Trap cropping could not be effective without knowing when the insects will emerge and when to seed the trap inside a field.

Cabbage seedpod weevil.

In 2015, CSW was captured in 75% of the fields, but no fields reached the economic threshold of 2 CSW/sweep nor 25% of damaged pods. Parasitoids were observed in 45.8% of the fields monitored, an increase of 7% from 2014 and the parasitism rate varied between 38 and 100%. Percentage of grains consumed by CSW was 25% less in pods with parasitoids. This increase of parasitism year after year since 2009 demonstrates that this natural control is successful to control this pest and that no chemical control is necessary.

Pollen beetle.

Introduction of pollen beetles in cages at CÉROM demonstrated highest number of larvae in flowers at 8 pollen beetle/plant. The threshold in Europe varied between 1 to 3 pollen beetle/plant at bud stages, and as high as 10 during the flowering period. In our case, introduction of pollen beetles was at the very beginning of the flowering period of canola. While no statistical differences were observed in cages with 2 or 8 pollen beetle/plant compared to the control, there were between 495 and 662 kg/ha more yield in control cages. Trials in 2016 will allow calculation of threshold for the pollen beetle in Quebec. All insecticides succeeded to reduce the abundance of pollen beetle adults in two out of three experimental sites (NO, SA), and Matador and Success were successful in PEI. While these sites did not reach the threshold and no yield differences were observed, some insecticides are demonstrating efficiency against this pest.

Future Work

The experiment will be implemented again next year. The reduction of the budget in 2016 for Laval University and CEROM will cut the insecticide trials against flea beetles (Laval University) and the cages for CSW (CÉROM).

In the trap crop trials, we learned that the crops in the landscape at 1km from canola fields can influence greatly the efficiency of this cultural method.

Direction for the next year of trials includes:

1. For seeding date evaluation, a model with phenology of the plant and biology of the flea beetles will be developed during winter 2017. This model will allow producers to choose properly their seeding date.
2. Insecticide trials on flea beetles. This trial will be conducted only at Normandin.
3. Damages and parasitism of CSW. Cages trials with introduction of parasitoid will not be conducted. Evaluation of parasitism in canola fields of Quebec will be done.
4. Insecticide trials on pollen beetle and economic threshold. Same products will be tried at the three experimental sites. Introduction in cages will be done at CEROM. Final analysis of data will allow the calculation of threshold for this pest.