Final Report for Agricultural Demonstration of Practices and Technologies (ADOPT) Program

Principal Investigators:

Robin Lokken[1] and Lana Shaw[2]

[1]Conservation Learning Center, Prince Albert, SK
[2]South East Research Farm, Redvers, SK

Project Identification

1. **Project Title:** Demonstration of Methods to Control Flea Beetle in a Non-Neonic Environment
2. **Project Number:** 20180493
3. **Producer Group Sponsoring the Project:** CLC and SERF
4. **Project Location(s):**
   - Conservation Learning Center (CLC) – Prince Albert, SK
   - South East Research Farm (SERF) – Redvers, SK
5. **Project start and end dates (month & year):** April 2019 – February 2020
6. **Project contact person & contact details:**

A. Robin Lokken AAg
Manager
Box 1903
Prince Albert, SK
S6V 6J9
info@conservationlearningcentre.com
306-960-1834

B. Joanne Kowalski
BOD Chair
jkowalski@sasktel.net
306-980-8688

Objectives and Rationale

7. **Project objectives:**

- To provide information to area producers about the alternative options available to control flea beetles in canola should Canada proceed with a ban on neonicotinoids
- To provide a backdrop to discuss the potential impact on non-target and beneficial insects, and other pest management strategies that could be used.

8. **Project Rationale:**

Flea beetle damage results in over $300 million annually in crop losses in North America. Early scouting of flea beetles is necessary since flea beetles feed on newly emerged canola seedings and can cause considerable damage quickly. Flea beetles invade canola fields from the edges, and if caught in time, can be controlled by an insecticide application to the field perimeter before spreading farther into the field.

Since flea beetles are present in large numbers over a short period of time, they tend to overwhelm natural enemies and seed treatments are standard practice in western Canada. Over 90% of the canola grown in western Canada receives a seed treatment to reduce yield losses associated with flea beetle damage in canola. Under extreme flea beetle pressure, foliar sprays are used for added protection. Most canola seed treatments belong to the chemical group neonicotinoids. While there are a few non-neonic seed treatment options available belonging to the chemical group sulfoximines and diamides, the recommendation is to use this seed treatment in combination with a neonic product, since they are not found to be as successful when used alone. Foliar sprays for flea beetle control are pyrethroids, carbamates, or organophosphates.

Cultural control methods can also help control flea beetle pressure. Practices that promote good stand establishment will reduce yield losses due to flea beetles. Large seeds with good germination have a faster growth rate, shortening the period the canola is in the susceptible seedling stage. Direct seeding can reduce damage since flea beetles prefer relatively warm conditions. Stubble creates a cooler microclimate compared to tilled soil that warms up quicker. Early seeding can decrease flea beetle damage because larger plants will be less susceptible to flea beetles once they emerge. Higher seeding rates can reduce the damage by diluting the damage to individual plants. Intercropping with non-host crops may even help reduce flea beetle damage. However, when flea beetle populations are very high, cultural controls may not be enough.

Canada confirmed plans in August 2018 to phase out neonicotinoids, thiamethoxam and clothianidin, over the next three to five years. This would include almost all seed treatment options for Canola in Saskatchewan. As a result, producers will lose their first and best line of defence against the control of flea beetles in canola. Furthermore, seed treatments tend to be less toxic than foliar insecticides, and with foliar insecticides there is a greater chance of negatively affecting and killing non-target insects such as pollinators and other beneficial insects. This project will demonstrate some of the other alternatives available to help control flea beetles that will need to be used if neonicotinoids are banned. It will also provide a backdrop to discuss potential impact on non-target and beneficial insects.

Methodology and Results

9. Methodology:

Trials were established in May 2019 at two locations: Redvers in the south east and Prince Albert in the north central region of Saskatchewan. Various flea beetle control methods were investigated including seed treatments, foliar insecticides, and cultural methods. Treatment list is provided in Table 1. Original project proposal had listed a non-neonic seed treatment of Lumiderm, however this treatment had to be removed since Lumiderm is not available as a stand-alone product.

Table 1. Treatment list of methods used to control flea beetles in canola.

	Treatment Description
1	No flea beetle control seeded at standard rate/date
2	Neonic seed treatment Helix
3	Foliar insecticide Malathion
4	Foliar insecticide Decis
5	Foliar insecticide with permethrin Pounce*
6	Higher seeding rate (125 plants/m^2)
7	Early seeding date
8	Intercropped peas and canola (canola-50 plants/m^2, peas-65 plants/m^2)
9	Intercropped peas and canola treated with Helix

*foliar insecticide permethrin has a relatively higher mammalian safety and should have a higher residual control than Decis or Matador

The project was set up as a randomized completed block design with 4 reps. Plots were approximately 4 m x 7 m at both sites. Untreated and treated PV760TM canola seed was sourced from Nutrien Ag Solutions. Both the treated and untreated seed were from the same seed lot. The canola seeding rate was a targeted 100 plants/m^2 at the CLC and 75 plants/m^2 at SERF for all treatments except for the higher seeding rate and the intercrop treatments. The early seeding date was 1 week early. Weeds and disease were kept non-limiting, and fertility was applied based on spring soil test results.

Data collection included insect ID during canola emergence using a sticky trap and sweep net to determine the non-target insects present before foliar treatment. Flea beetle species were also identified. Plant densities were determined at 10-14 days after emergence at both sites and a final plant stand count was completed after harvest at the CLC. Flea beetle damage was determined at 2 stages: when the first leaf was visible but not unfolded and when the second leaf was visible but not unfolded. Digital photos were collected at 2 locations per plot (front edge and middle of plot). An estimate of % seedling defoliation (using the visual rating key provided at: https://www.canolawatch.org/2011/05/09/estimating-flea-beetle-damage-in-canola/) was determined by rating 10-20 plants at each of the 2 locations per plot. The same locations were used for both sample dates at the CLC. Only one sample date occurred at Redvers due to late flea beetle arrival. Date of maturity was recorded at Redvers and yield was determined at both sites. Other weather-related conditions such a precipitation, wind, air, and soil temperature were monitored. Data analysis was completed using ANOVA in Statitix10 software. Mean comparisons were determined by LSD. Significance was determined at $p<0.05$.

CLC Site Specific Methods:

All nine treatments were established at the Prince Albert site. The early seeded date was May 17, 2019 and the remaining treatments were seeded May 24, 2019. Monocrop canola treatments received 112 lb/ac N and 25 lb/ac P_2O_5. The intercrop treatments received 25 lb/ac P_2O_5 only and spruce green peas were intercropped with the canola. Green peas matured before the canola and much of the pea yield was lost prior to harvest. Flea beetle pressure was high at the CLC and foliar insecticides were applied June 4, 2019. Centurion was applied June 12 to control grassy weeds. Reglone was used to desiccate the trial on September 6, 2019 and the plots were harvested September 16, 2019.

SERF Site Specific Methods:

At SERF near Redvers, a trial with eight treatments was established with the Malathion treatment omitted. The early seeded date was May 16, 2019 and the remaining treatments were seeded May 23, 2019. All treatments received 60 lb/ac N, 25 lb/ac P, 5 lb/ac S in a side-band at seeding. Inca peas were used in the intercrop. The flea beetle pressure on the home quarter of SERF was quite low in 2019. The trial was nearly abandoned in spite of good establishment because by June 10/11, there was no flea beetle damage or activity. The first flea beetle rating period passed around June 5 with no beetle activity to rate. By June 14, the flea beetles had arrived when the canola was at 1 to 2 leaf stage. Plant counts and multiple photos of flea beetle damage were taken in each plot on June 14 just before a two-day rain. As a result of the late arrival of the flea beetles past the recommended application stage and a period of rain, the insecticides were not applied to the relevant treatments. The peas established well and the intercrop looked productive all season, although the peas would have performed better with an earlier seeding date. The trial was not sprayed with broadleaf herbicide to avoid killing the peas or having to spray individual treatments. Centurion was applied on July 12, 2019 for grassy weed control. The trial was dessicated on Sept 4 and harvested on Sept 17.

10. Results

Weather conditions at the CLC were very dry and cooler than normal (Table 2). Emergence of canola was initially very patchy especially with the high flea beetle pressure. However, the final canola yields were high.

Table 2. Weather conditions over the 2019 growing season at the Conservation Learning Centre (CLC) near Prince Albert and the South-East Research Farm (SERF) near Redvers. Long-term 30-year means are also presented for SERF and the 6-year average from SRC climate station on site at CLC.

Location	**Year**	**May**	**June**	**July**	**August**	**Avg. / Total**
		-----------------------------Mean Temperature (°C) -------------------				
SERF	2019	9.5	16.3	18.5	16.6	15.2
	Long-term	**12**	**16**	**19**	**18**	**16.3**
CLC	2019	9.5	15.8	17.4	15.1	14.5
	2012-2018	**11.8**	**16.1**	**18.5**	**17.3**	**15.9**
		-------------------------------- *Precipitation (mm)* ---------------------				
SERF	2019	18.0	79.0	54.0	88.0	239
	Long-term	***60***	***91***	***78***	***64***	***293***
CLC	2019	30.0	54.4	57.4	16.8	158.6
	2012-2018	**36.4**	**80.6**	**96.1**	**48.0**	**261.1**

In Redvers, spring weather was cool with three nights at or below zero between the first seeding date on May 16 and second seeding date on May 23. Neither of the seeding dates experienced frost damage. The peas matured earlier than the canola but the maturity date was not recorded. From August 24 to the harvest date, there was 102 mm of precipitation, which contributed to the deterioration of the peas. Part of the peas were harvested in the intercrops but much of it was lost. The canola component in the intercrop was relatively low.

Table 3. Results of various methods used to control flea beetles in canola at the CLC near Prince Albert in 2019. Different letters indicate significant differences (p>0.05).

	Treatment Description	Plant Stand (plants/m^2)	Flea Beetle Damage 1 (%)	Flea Beetle Damage 2(%)	Plant Stand at Harvest (stubble/m^2)	Canola Yield (kg/ha)	Canola Yield (bu/ac)
1	No flea beetle control	29 cd	30 bc	29 bc	36cd	3203.8	57.2 ab
2	Neonic seed Treatment	60 a	24 cde	24 cd	69 a	3204.8	57.2 ab
3	Foliar Insecticide Decis	33 bcd	20 e	20 cd	36cd	3329.1	59.4 a
4	Foliar Insecticide Pounce	29 cd	25 cde	19 d	42 c	3012.6	53.8 ab
5	Foliar Insecticide Malathion	47 ab	28 bcde	24 cd	55 b	3275.7	58.5 a
6	High Seeding Rate	31 cd	30 bcd	40 a	28 d	3177.2	56.7 ab
7	Early Seeding Date	43 bc	34 ab	29 c	37cd	2729.4	48.7 b
8	Intercropped Peola no neonic	23 d	39 a	39 a	13 e	287.6	5.1 c
9	Intercropped Peola with neonic	18 d	22 de	38 ab	31cd	421.2	7.5 c
	P-value	0.0003	0.0019	0.0001	<0.0001	<0.0001	

Highest stand count at both sites was accomplished with a neonic seed treatment (Tables 3 and 4). Intercropping had the lowest plant count, which is to be expected since canola was seeded at a lower rate. At the CLC, the foliar insecticide malathion resulted in a higher plant stand than no flea beetle control. In Redvers, due to late flea beetle pressure and rains preventing timely application of insecticides, foliar insecticides were not applied. As a result, the foliar insecticide treatments at Redvers are equivalent to treatment 1, no flea beetle control. Plant stand counts completed after harvest were similar to initial stand counts, with the neonic seed treatment and malathion having higher plant stands than all other treatments (Table 3).

Table 4. Results of various methods used to control flea beetles in canola at the SERF near Redvers in 2019. Different letters indicate significant differences (p>0.05).

	Treatment Description	Plant Stand (plants/m^2)	Flea Beetle Damage June 10 (%)	Days to maturity	Canola Yield (kg/ha)	Canola Yield (bu/ac)
1	No flea beetle control	31 bcd	15 bc	102.25 bc	1675	29.8 ab
2	Neonic seed Treatment	52 a	3 c	100.25 d	1884	33.5 a
3	Foliar Insecticide Decis	23 cde	18 bc	103.5 a	1606	28.6 b
4	Foliar Insecticide Pounce	31 bcd	21 b	102 bc	1818	32.4 ab
5	Foliar Insecticide Malathion					
6	High Seeding Rate	43 ab	39 a	102 bc	1737	30.9 ab
7	Early Seeding Date	37 abc	21 b	101.25 cd	1809	32.2 ab
8	Intercropped Peola no neonic	7 e	5 bc	102.25 bc	287	5.1 c
9	Intercropped Peola with neonic	16 de	1 c	102.75 ab	362	6.4 c
	P-value	0.0002	0.0029	0.0003	<0.0001	

There was earlier and greater flea beetle pressure at the CLC as was evident by the higher percent damage (Table 3). The flea beetle present at the CLC was the striped flea beetle (Figure 1). Initial flea beetle damage recorded on June 3 was greatest for the early seeding date and the intercropped peola with no neonic seed treatment. Prior to the application of foliar insecticide, a sweep net test was completed to determine the presence of any potential beneficial insects. The sweep net did not collect any insect specimens. The canola crop was incredibly short and there was minimal vegetation and insect presence when sweeping. Sticky traps were also installed in the control treatments. Photographs are included in the appendix. Easily recognizable insects present included flea beetles, various flies, damsel flies, spiders, moths and 1 potential parasitic wasp. One week later, flea beetle damage was greatest for the high seeding rate and both peola treatments.

Figure 1. Flea beetle damage on canola at the CLC near Prince Albert. The striped flea beetle, as pictured, was the common species present at the CLC in 2019.

Only one timing of flea beetle damage was recorded at SERF due to the later arrival of flea beetles. Flea beetle species present at SERF was the black crucifer flea beetle. High seeding rate had approximately 20% more damage than the control treatments, and the neonic seed treatment and the intercrop treatments had the lowest flea beetle damage (Table 4). The neonic seed treatment had the fewest days to maturity. The other treatments that had a higher flea beetle pressure or were intercropped had slightly delayed maturity. Early flea beetle damage has been known to result in uneven maturity.

Canola yield was lowest for the intercropped treatments, which is to be expected since a lower seeding rate was used (Tables 3 and 4). At Prince Albert, the use of Decis or Malathion resulted in higher yields of 10 bu/ac more than the early seeding date treatment (Table 3). Earlier seeding was anticipated to reduce flea beetle damage since earlier seeded canola typically will have better access to moist soil conditions that will favor rapid germination. However, spring 2019 was incredibly dry and the earlier seeded canola may have offered an earlier food source for already waiting flea beetles.

High seeding rate, foliar insecticides and a neonic seed treatment all had similar yields as the control that had no flea beetle control at the CLC (Table 3). While the action threshold of 25% was reached, an economic benefit is not achieved until the damage reaches 50%. Therefore, the flea beetle damage experienced at the CLC may not have been severe enough to result in yield loss. The neonic seed treatment may have offered better protection in Redvers than the CLC. There was reduced flea beetle damage on canola that received the seed treatment and yield was 5 bu/ac greater than treatment 3, which was also considered a control due to foliar insecticide not being applied. The seed treatment used in this study was helix vibrance (active ingredient thiamethoxam) without Lumiderm. Helix vibrance has been found to be more effective against crucifer flea beetle populations, while Lumiderm is more effective against the striped flea beetles that were present in Prince Albert.

References:

https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/crops-and-irrigation/insects/flea-beetle-management-for-canola-rapeseed-and-mustard-in-the-northern-great-plains

https://www.canolacouncil.org/canola-encyclopedia/insects/flea-beetles/

11. Discussion and Conclusions

The more northern CLC location had high striped flea beetle pressure, while the southern SERF had less and later flea beetle pressure dominated by the crucifer flea beetle. The neonic seed treatment had higher plant stands and lower flea beetle damage. At the CLC, the foliar insecticide malathion had a higher plant stand than the other foliar applied insecticides. While no honey bees were present on sticky traps or during application of the foliar insecticide, there were many other types of insects collected on the sticky traps. Due to unusually dry spring conditions, the early seeding date did not appear to help control flea beetle damage. The intercropped peola had more success at reducing flea beetle damage in Redvers than Prince Albert, but unless peas are properly matched maturity wise with the canola used, final yields do not support the practice. Helix vibrance, the neonic seed treatment used, appears to have better control on crucifer flea beetles than the striped flea beetles. Lumiderm has had better success controlling striped flea beetles, but is not available as a stand-alone treatment. Typically, Lumiderm is offered in combination with helix to offer added and longer protection against striped and crucifer flea beetles and cutworms. This demonstration investigated various methods to control flea beetles, but did not investigate any methods in combination. The study also did not investigate Lumiderm. When managing flea beetles the recommended practice is to use a combination of cultural and chemical controls. The preferred strategy for chemical controls is to use a seed treatment because flea beetles can destroy plant stands quickly, before a post-emergence insecticide can be applied. This trial demonstrated that there are other methods available to control flea beetles should the preferred method of control be banned. However, there is a risk of not being able to apply foliar insecticides in time, and foliar insecticides are not flea beetle control specific. This trial was featured at the July 2019 CLC Field Day with approximately 50 people in attendance and the SERF tour of this trial on July 18 with 30 people in attendance.

12. Acknowledgements

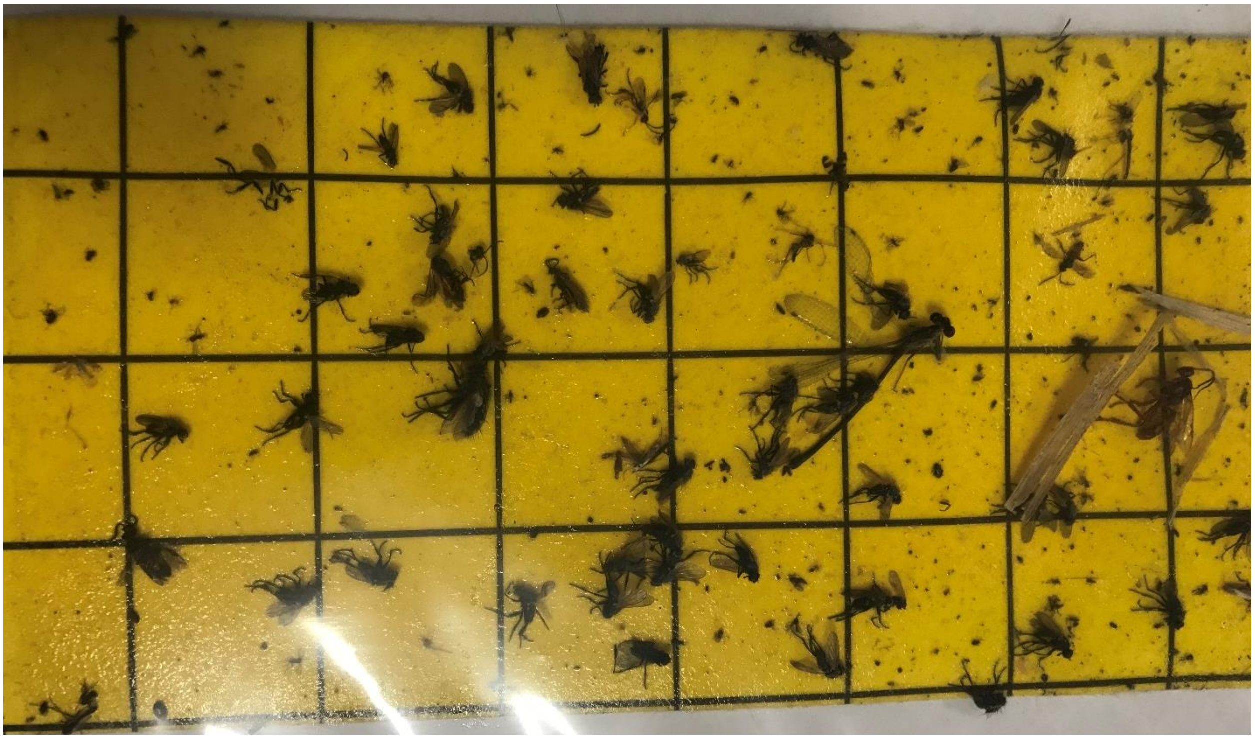
The Conservation Learning Centre graciously acknowledged the Ministry's support through signage directly in field with the project, verbally during the Field Day and on the Field Day agenda handed out to all visitors. Many thanks to Nutrien Ag Solutions for helping develop the demonstration, sourcing the canola seed used and for donating inputs. Thank you to FMC for providing the foliar insecticide treatment Pounce.

14. Abstract

A demonstration of methods to control flea beetles in a non-neonic environment was carried out in two locations at the Conservation Learning Centre (CLC) near Prince Albert and the South-East Research Farm (SERF) near Redvers in 2019. Helix Vibrance (thiamethoxam) treated and untreated canola seed was compared to three foliar insecticides Decis (deltamethrin), Pounce (permethrin), and Malathion (malathion), and three cultural methods including higher seeding rate, early seeding date and intercropping. Striped flea beetle pressure was high at the CLC and there was a lower and later crucifer flea beetle presence at SERF. The helix neonic seed treatment improved plant stands at both sites, but appeared to be more effective on the crucifer population in Redvers. The use of Decis and Malathion resulted in a 10 bu/ac yield increased compared to the early seeding date. Due to dry spring conditions and a waiting population of flea beetles in Prince Albert, the early seeding date was not successful in reducing flea beetle damage. Intercropping appeared to be effective in reducing flea beetle damage in Redvers, but canola yields were drastically reduced, and pea yields were low due to unequal maturity in the intercrop. This demonstration investigated various methods to control flea beetles, but did not investigate any methods in combination. When managing flea beetles the recommended practice is to use a combination of cultural and chemical controls. The preferred strategy for chemical controls is to use a seed treatment because flea beetles can destroy plant stands quickly, before a post-emergence insecticide can be applied. This trial demonstrated that there are other methods available to control flea beetles should the preferred method of control be banned. However, there is a risk of not being able to apply foliar insecticides in time, and foliar insecticides are not flea beetle control specific. This trial was featured at the July 2019 CLC Field Day with approximately 50 people in attendance and the SERF tour of this trial on July 18 with 30 people in attendance.

15. Appendix

Sticky traps used in control plots to determine types of insects present before the foliar application of insecticides.




05218120