Insecticide Seed Treatments for Flea Beetle Control in Spring Canola, 2023

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Materials and Methods

The trial was conducted at three different locations; NDSU Campus Agronomy farm in Fargo, Langdon REC in Langdon, and North Central REC in Minot. In Table 1, the planting dates, trial design, seeding rates and other information for LREC are summarized.

Table 1. Location, experiment and agronomic information.

	Langdon
Trial Latitude (LLC)	48.750036
Trial Longitude (LLC)	-98.333301
Canola Variety	DKTFLL 21 SC
Previous Crop	HRSW
Planting Date	May 22
Emergence Date	May 28
Plot Size	3.5 ft x 20 ft
Row Spacing	6 inches
Seeding Depth	0.75 inch
Seeding Rate	14 seeds/ft^2
Experimental Design	RCBD, 4 reps
Harvest Date	September 18

Seed treatment efficacy was examined for control of crucifer and striped flea beetles in spring canola. Treatments, rates and active ingredients are listed in Table 2. Dekalb DKTFLL 21 SC canola seed was treated prior to planting. Two neonicotinoid seed treatments, Helix Vibrance (thiamethoxam) and Prosper Evergol (clothianidin) were tested alone and in combination with three rates of either Lumiderm or Fortenza (cyantraniliprole). Prosper Evergol also was tested in combination with two rates of Buteo Start (flupyradifurone) and in combination with the commercial rates of Lumiderm. In addition to testing seed treatment efficacy, we tested a single foliar application of bifenthrin at 2.6 fl oz per acre in combination with certain seed treatments (Treatments 6, 11 and 15) and compared these to the seed treatments alone. We attempted to make applications at the nominal threshold of 20 to 25% defoliation (approximately a rating of 2 on the 0-6 scale). At Langdon, the foliar application to Treatment 11 was made on June 1 at 4 days after emergence (DAE), to Treatment 6 on June 2 at 5 DAE, and to Treatment 15 on June 9 at 12 DAE. Foliar applications were made with a hand boom using TeeJeet 11015 flat fan nozzles at 40 PSI and a carrier volume of 20 GPA.

Plots were rated for flea beetle feeding injury using the 0-6 scale developed by Dr. Janet Knodel, with 0 = no feeding and 6 = dead plant. Within each plot, 10 randomly selected seedlings were rated. For analysis, the 10 ratings were averaged for a single rating value per plot. Feeding injury was rated at 3, 7, 10 and 14 DAE. Plant stand was measured after the last injury ratings were made by counting the number of live plants in three square feet at two locations within each plot, and calculating the number of plants per square foot. Plots were harvested at maturity by swathing prior to combining. Yield, percent moisture content, and test weight were collected via the onboard weigh systems on the plot combines. Yields were adjusted to 10% standard grain moisture. All data were analyzed using the GLM procedure in SAS version 9.4 statistical software. Fisher's LSD ($P<0.05$) was used to test for significance among treatment means. Sampling activities, dates and crop stages for the Langdon trial are given in Table 3.

Table 2. Treatments, active ingredients and rates used in the trial.

Treatment No.	Treatment Name	Product Rate(s)	Active Ingredient(s)	AI Rate(s)
1	Fungicide Check			
2	Helix Vibrance	23 fl oz/cwt	Thiamethoxam	400 g/100 kg
3	Helix Vibrance Fortenza[1,2]	23 fl oz/cwt 10.2 fl oz/cwt	Thiamethoxam Cyantraniliprole	400 g/100 kg 400 g/100 kg
4	Helix Vibrance Fortenza[1]	23 fl oz/cwt 15.4 fl oz/cwt	Thiamethoxam Cyantraniliprole	400 g/100 kg 600 g/100 kg
5	Helix Vibrance Fortenza[1]	23 fl oz/cwt 20.5 fl oz/cwt	Thiamethoxam Cyantraniliprole	400 g/100 kg 800 g/100 kg
6	Helix Vibrance Fortenza[1,2] Brigade 2EC	23 fl oz/cwt 10.2 fl oz/cwt 2.6 fl oz/acre	Thiamethoxam Cyantraniliprole Bifenthrin	400 g/100 kg 400 g/100 kg 18.4 g/acre
7	Prosper Evergol	21.5 fl oz/cwt	Clothianidin	400 g/100 kg
8	Prosper Evergol Lumiderm[2]	21.5 fl oz/cwt 9.8 fl oz/cwt	Clothianidin Cyantraniliprole	400 g/100 kg 400 g/100 kg
9	Prosper Evergol Lumiderm	21.5 fl oz/cwt 14.8 fl oz/cwt	Clothianidin Cyantraniliprole	400 g/100 kg 600 g/100 kg
10	Prosper Evergol Fortenza[1]	21.5 fl oz/cwt 20.5 fl oz/cwt	Clothianidin Cyantraniliprole	400 g/100 kg 800 g/100 kg
11	Prosper Evergol Lumiderm[2] Brigade 2EC	21.5 fl oz/cwt 9.8 fl oz/cwt 2.6 fl oz/acre	Clothianidin Cyantraniliprole Bifenthrin	400 g/100 kg 400 g/100 kg 18.4 g/acre
12	Prosper Evergol Buteo Start[3]	21.5 fl oz/cwt 9.6 fl oz/cwt	Clothianidin Flupyradifurone	400 g/100 kg 300 g/100 kg
13	Prosper Evergol Buteo Start	21.5 fl oz/cwt 16 fl oz/cwt	Clothianidin Flupyradifurone	400 g/100 kg 500 g/100 kg
14	Prosper Evergol Lumiderm[2] Buteo Start[3]	21.5 fl oz/cwt 9.8 fl oz/cwt 9.6 fl oz/cwt	Clothianidin Cyantraniliprole Flupyradifurone	400 g/100 kg 400 g/100 kg 300 g/100 kg
15	Prosper Evergol Buteo Start[3] Brigade 2EC	21.5 fl oz/cwt 9.6 fl oz/cwt 2.6 fl oz/acre	Clothianidin Flupyradifurone Bifenthrin	400 g/100 kg 300 g/100 kg 18.4 g/acre

[1]Fortenza substituted for Lumiderm, rate(s) adjusted to match Lumiderm cyantraniliprole concentration.
[2]Commercial Lumiderm rate when used in combination with a neonicotinoid.
[3]Commercial Buteo Start rate when used in combination with a neonicotinoid.

Results

Treatment means for response variables from the Langdon location are presented in Table 4 (data from Fargo and Minot locations is available in a detailed report available at the LREC website). Flea beetle density and feeding pressure at Langdon was moderately high. Both crucifer and striped flea beetles were present with crucifer flea beetles being the dominant species. While some significant differences exist among treatments and locations due to differences in flea beetle species and densities, and sampling timing among locations, we feel we can make valid inferences about treatment performance as a whole by combining the data from all locations (Table 5, Figure 1).

Table 3. Sampling activities, sampling dates, and crop stages.

	Langdon		
Activity	Date	DAE	Crop Stage
Injury Rating 1	May 31	3 DAE	Cotyledon
Injury Rating 2	June 4	7 DAE	1-leaf
Canopy Cover 1	---	---	---
Injury Rating 3	June 7	10 DAE	2-leaf
Canopy Cover 2	---	---	---

Injury Rating 4	June 11	14 DAE	3-leaf
Canopy Cover 3	---	---	---
Stand Counts	June 12	15 DAE	3-leaf

There were no significant differences for flea beetle injury, canopy cover and yield between Helix Vibrance and Prosper Evergol when used alone, or in combination with different rates of cyantraniliprole (Lumiderm / Fortenza). Increasing cyantraniliprole rates above the commercially available rate decreased flea beetle injury and increased yield, but the treatment means were not significantly different except for an increase in yield for Helix Vibrance + Fortenza at 20.5 fl oz/cwt at Langdon. Prosper Evergol combined with Buteo Start resulted in significantly less flea beetle injury and significantly higher yields compared to the neonicotinoids alone and in combination with all rates of cyantraniliprole (Lumiderm / Fortenza), except for yield when a neonicotinoid was combined with the 800 g ai/100 kg cyantraniliprole rate (Lumiderm / Fortenza). Increasing the Buteo Start rate did not give any improvement over the commercially available rate, nor did adding cyantranilprole (Lumiderm / Fortenza) to Buteo Start.

A single foliar application of Brigade 2EC at 2.6 fl oz/acre at the nominal threshold of 20 to 25% defoliation, in combination with a neonicotinoid plus the commercially available rates of cyantraniliprole or Buteo Start, generally resulted in significantly higher yields and lower flea beetle injury compared to all treatments without Brigade 2EC, except for treatments containing Prosper Evergol and Buteo Start, and Helix Vibrance plus Fortenza at 20.5 fl oz/cwt (yield only).

The addition of cyantraniliprole at the commercial rate of 400 g ai/100 kg to either neonicotinoid resulted in less flea beetle injury at 3 DAE compared to using a neonicotinoid alone, but not at 7 DAE or beyond. Nor did the addition of the commercial cyantraniliprole rate result in significantly higher yield compared to the neonicotinoids alone. The addition of Buteo Start at the commercial rate of 300 g ai/100 kg to Prosper Evergol resulted in significantly less flea beetle injury compared to neonicotinoids alone or in combination with cyantraniliprole at the commercial rate, and also resulted in significantly higher yield. The addition of cyantraniliprole to the Prosper Evergol/Buteo Start mix did not have a significant effect.

Using our yield results for treatments across locations, we constructed the following table to calculate profitability based on different commercially available seed treatment scenarios with and without a foliar insecticide application (Table 6). This assumes a canola market value of $28.10/cwt, a seed treatment cost of $8.00/acre/product, and a foliar insecticide application cost of $11.12/acre for a generic bifenthrin product at 2.6 fl oz/acre.

Conclusion

Based on our results, we recommend that canola producers take the following steps to maximize yield potential by protecting seedlings and maximizing seedling health through at least the 4 to 6 leaf growth stage.

- Use a base seed treatment of either Helix Vibrance (thiamethoxam) or Prosper Evergol (clothianidin) and combine with either Lumiderm or Fortenza (cyantraniliprole) at 400 g ai/100 kg or Buteo Start (flupyradifurone) at 300 g ai/100 kg.
- Scout for flea beetle injury frequently, especially from 3 DAE through 21 DAE.
- Budget for a foliar application of insecticide at highest labeled rate when defoliation is above 20 to 25% defoliation (Economic Threshold).
- Apply foliar insecticide quickly when above the Economic Threshold of 20 to 25% defoliation.
- A good weed control program will help seedling vigor and growth.
- Proper fertility, including sulfur, will help seedling vigor and growth.

Acknowledgements

We would like to thank the Northern Canola Growers Association and our field workers, Joslin Forness and Miro Herrera Grant. We also appreciate the untreated canola seed supplied by Jim Johnson of Star Specialty Seeds.

Table 4. Treatment means for flea beetle injury, plant stand, test weight, and grain yield at Langdon, 2023.

Trt. No.	Treatment	Injury 3 DAE	Injury 7 DAE	Injury 10 DAE	Injury 14 DAE	Plant Stand (plants/ft^2)	Test Weight (lbs/bu)	Grain Yield (lbs/acre)
1	Fungicide Check	4.5 a	5.2 a	4.8 a	4.9 a	3.8 d	51.4 bc	2,236.5 f
2	Helix Vibrance @ 23	1.5 bcd	4.1 bc	4.6 ab	4.5 ab	7.7 abc	51.7 abc	2,578.2 ef
3	Helix Vibrance @ 23 Fortenza @ 10.2	1 cde	3.4 b-e	4 c	4.1 bc	8.5 abc	51.7 abc	2,963.7 b-e
4	Helix Vibrance @ 23 Fortenza @ 15.4	0.9 c-f	3.1 de	3.9 c	4.2 bc	7.6 abc	51.6 abc	2,969.1 b-e
5	Helix Vibrance @ 23 Fortenza @ 20.5	0.8 def	2.6 e	4 c	4.2 abc	9.3 ab	52 ab	3,255.5 a-d
6	Helix Vibrance @ 23 Fortenza @ 10.2 Brigade 2EC @ 2.6	0.9 c-f	1.8 f	2.3 de	3.1 de	8.4 abc	52 ab	3,622.9 a
7	Prosper Evergol @ 21.5	2.3 b	4.2 c	4.3 ab	4.5 ab	7.3 bc	51.4 bc	2,728 ef
8	Prosper Evergol @ 21.5 Lumiderm @ 9.8	1.7 bc	3.7 bcd	4.1 bc	4.7 ab	7.1 bc	51.6 abc	2,839.1 de
9	Prosper Evergol @ 21.5 Lumiderm @ 14.8	1.2 cd	3.8 bcd	4 c	4.3 ab	9.9 a	52.1 a	3,014.4 b-e
10	Prosper Evergol @ 21.5 Fortenza @ 20.5	0.9 c-f	3.3 cde	4 c	4.4 ab	8.5 abc	51.8 ab	2,936.1 cde
11	Prosper Evergol @ 21.5 Lumiderm @ 9.8 Brigade 2EC @ 2.6	1.1 cd	1.6 fg	2.5 de	2.8 e	8.4 abc	51.4 abc	3,383.6 abc
12	Prosper Evergol @ 21.5 Buteo Start @ 9.6	0.3 ef	1.2 fg	2.8 d	3.4 de	7 c	51.8 ab	3,369.4 abc
13	Prosper Evergol @ 21.5 Buteo Start @ 16	0.1 f	0.9 g	2.1 e	2.9 de	8.3 abc	51.1 c	3,486.8 ab
14	Prosper Evergol @ 21.5 Lumiderm @ 9.8 Buteo Start @ 9.6	0.3 ef	1.4 fg	2.8 d	3.6 cd	7.6 abc	51.9 ab	3,655.3 a
15	Prosper Evergol @ 21.5 Buteo Start @ 9.6 Brigade 2EC @ 2.6	0.2 ef	1.2 fg	2.6 de	3 de	7.5 bc	51 c	3,386 abc
	F-value	**14.16**	**20.59**	**20.15**	**8.93**	**2.82**	**1.80**	**4.79**
	P-value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0047**	**0.0721**	**<0.0001**
	LSD	**0.82**	**0.84**	**0.57**	**0.68**	**2.32**	**0.67**	**526.84**

Means within a column that share the same letter are not significantly different (P<0.05).

Table 5. Treatment means for flea beetle injury, canopy cover, plant stand, test weight, and grain yield across locations, 2023.

Trt. No.	Treatment	Injury 3 DAE	Injury 7 DAE	Injury 10 DAE	Injury 14 DAE	Canopy 7 DAE	Canopy 10 DAE	Canopy 14 DAE	Plant Stand (plants/ft^2)	Test Weight (lbs/bu)	Grain Yield (lbs/acre)
1	Fungicide Check	4.1 a	4.4 a	4.3 a	3.8 a	4.9 a	14.9 c	41.1 c	6.7 e	52.1 e	1762.9 d
2	Helix Vibrance @ 23	2.4 bc	3.6 b	3.8 b	3.3 b	5.3 a	26.7 ab	53.1 ab	9.4 bcd	52.3 b-e	2195.1 c
3	Helix Vibrance @ 23 Fortenza @ 10.2	1.5 e	3 bcd	3.2 cde	3 bcd	6 a	23.4 ab	49.6 b	10.2 abc	52.6 a-e	2374.6 c
4	Helix Vibrance @ 23 Fortenza @ 15.4	1.6 de	2.8 cd	3.1 cde	3.2 b	5.8 a	26.8 ab	54.2 ab	9.2 cd	52.5 a-e	2394.1 c
5	Helix Vibrance @ 23 Fortenza @ 20.5	1.3 ef	2.5 de	3.2 cd	3.2 bcd	6.4 a	23.7 ab	52.8 ab	10.3 abc	52.9 a	2632.2 ab
6	Helix Vibrance @ 23 Fortenza @ 10.2 Brigade 2EC @ 2.6	1.4 ef	2 ef	1.9 gh	2.4 fg	6.1 a	23.8 ab	54.6 ab	10 a-d	52.8 ab	2841.4 a
7	Prosper Evergol @ 21.5	2.8 b	3.5 bc	3.8 ab	3.3 b	4.7 a	21.8 b	49.8 b	8.9 d	52.2 de	2281.4 c
8	Prosper Evergol @ 21.5 Lumiderm @ 9.8	2 cd	3.3 bc	3.4 bc	3.3 b	6.1 a	25.5 ab	54.4 ab	9.4 bcd	52.4 b-e	2347 c
9	Prosper Evergol @ 21.5 Lumiderm @ 14.8	1.6 de	3.2 bc	3.2 cde	3.1 bcd	6.9 a	27.8 ab	54.9 ab	10.6 a	52.7 abc	2382.2 c
10	Prosper Evergol @ 21.5 Fortenza @ 20.5	1.6 de	3.1 bcd	3 cde	3.2 bc	5.5 a	27.3 ab	54.3 ab	9.7 a-d	52.5 a-e	2416.6 bc
11	Prosper Evergol @ 21.5 Lumiderm @ 9.8 Brigade 2EC @ 2.6	1.5 e	2 ef	2 gh	2.1 gh	7.1 a	26.1 ab	56.2 a	10.4 ab	52.7 abc	2830.5 a
12	Prosper Evergol @ 21.5 Buteo Start @ 9.6	1.2 ef	1.7 f	2.9 de	2.8 de	6.4 a	24.5 ab	54.2 ab	9.3 bcd	52.8 abc	2638.9 ab
13	Prosper Evergol @ 21.5 Buteo Start @ 16	0.6 g	1.4 f	2.3 fg	2.6 ef	6.4 a	27.3 ab	54.9 ab	10 a-d	52.3 cde	2668.6 a
14	Prosper Evergol @ 21.5 Lumiderm @ 9.8 Buteo Start @ 9.6	0.9 fg	1.7 f	2.8 ef	2.8 cde	6 a	29.2 a	55.8 a	9.8 a-d	52.6 a-d	2732.6 a
15	Prosper Evergol @ 21.5 Buteo Start @ 9.6 Brigade 2EC @ 2.6	0.9 fg	1.5 f	1.9 h	2 h	6 a	28.2 ab	57.7 a	9.6 a-d	52.4 b-e	2849.2 a
	F-value	23.19	14.20	19.23	13.74	1.60	2.08	3.56	5.18	1.97	13.43
	P-value	<0.0001	<0.0001	<0.0001	<0.0001	0.12	0.02	<0.0001	<0.0001	0.03	<0.0001
	LSD	0.51	0.67	0.45	0.37	NS	6.82	5.90	1.13	0.45	225.09

Means within a column that share the same letter are not significantly different (P<0.05).

Table 6. Crop market values when using different insecticide seed treatment and foliar insecticide application options.

Treatment	Market Value (USD/cwt)	Yield (lbs/acre)	Crop Value (USD/acre)	ST Cost (USD/acre)	Foliar Cost (USD/acre)	Total Cost (USD/acre)	Net (USD/acre)
Fungicide Check	$28.10	1,762.9	$495.37	$-	$-	$-	$495.37
Helix Vibrance[1]	$28.10	2,195.1	$616.82	$8.00	$-	$8.00	$608.82
Helix Vibrance[1] Fortenza[3]	$28.10	2,374.6	$667.26	$16.00	$-	$16.00	$651.26
Helix Vibrance[1] Fortenza[3] Bifenthrin[5]	$28.10	2,841.4	$798.43	$16.00	$11.12	$27.12	$771.31
Prosper Evergol[2]	$28.10	2,281.4	$641.07	$8.00	$-	$8.00	$633.07
Prosper Evergol[2] Lumiderm[3]	$28.10	2,347	$659.51	$16.00	$-	$16.00	$643.51
Prosper Evergol[2] Lumiderm[3] Bifenthrin[5]	$28.10	2,830.5	$795.37	$16.00	$11.12	$27.12	$768.25
Prosper Evergol[2] Buteo Start[4]	$28.10	2,638.9	$741.53	$16.00	$-	$16.00	$725.53
Prosper Evergol[2] Buteo Start[4] Bifenthrin[5]	$28.10	2,849.2	$800.63	$16.00	$11.12	$27.12	$773.51

[1]Helix Vibrance at 23 fl oz/cwt (thiamethoxam at 400 g ai/100 kg)
[2]Prosper Evergol at 21.5 fl oz/cwt (clothianidin at 400 g ai/100 kg)
[3]Fortenza at 10.2 fl oz/cwt or Lumiderm at 9.8 fl oz/cwt (cyantraniliprole at 400 g ai/100 kg)
[4]Buteo Start at 9.6 fl oz/cwt (flupyradifurone at 300 g ai/100 kg)
[5]Bifenthrin 2EC at 2.6 fl oz/acre

Figure 1. Treatment means for flea beetle injury and yield across ND locations, 2023.