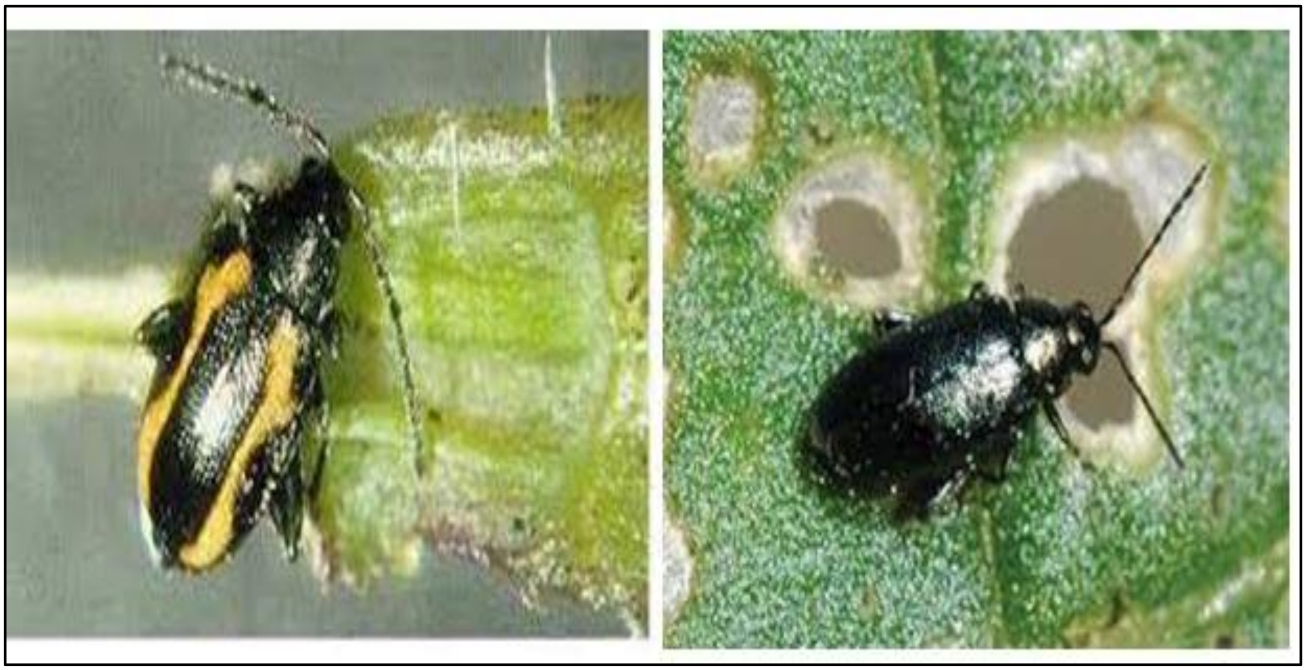
2015 Annual Report
for the
Agriculture Demonstration of Practices and Technologies
(ADOPT) Program



Project Title: Flea beetle control, plant emergence and seed yield response of canola to addition of Lumiderm to standard seed treatments

Project Number: 20140342

Producer Group Sponsoring the Project: Western Applied Research Corporation

Project Location: AAFC Scott Research Farm, R.M. #380, NE 17-39-21 W3

Project start and end dates: May 2015-February 2016

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Objectives and Rationale

Project Objectives

The objective of this demonstration was to determine if the addition of Lumiderm seed treatment to either Helix Vibrance or Prosper EverGol can reduce insect feeding from flea beetles and improve seedling establishment and seed yield at either low or recommended seeding rates.

Project Rationale

DuPont's studies have shown less flea beetle feeding on canola seedlings which received the Lumiderm seed treatment. On average, flea beetles feed on untreated and standard seed treated seedlings for 7 minutes and 42 seconds, respectively. In contrast, flea beetles ceased feeding in only 13 seconds on seedling which received the Lumiderm seed treatment. However, even in the absence of flea beetles DuPont has still observed greater plant vigor resulting from Lumiderm treated seed, the reason, however, is unknown. With the absence of flea beetles in the Laboratory, Dr. Bob Elliot (AAFC-Saskatoon) found instances where canola seed treated with Lumiderm + a standard seed treatment produced seedling biomass which was statistically greater than the standard seed treatment alone. Rapid stand establishment is key to producing a high yielding crop. Moreover, Lumiderm is the only seed treatment product registered to provide cutworm control. Often significant damage has occurred before cutworms are detected. A seed treatment with cutworm control will also be a great benefit to canola production. Using NDVI (Normalized Difference Vegetation Index) imagery from satellites and drones, DuPont has observed greater crop biomass production in field scale strips that were treated with Lumiderm + Helix Vibrance versus Helix Vibrance alone. Grain yields from these Lumiderm treated strips were also substantially greater. This demonstration will assist farmers in determining if Lumiderm provides an economic return (higher yields) over standard seed treatments.

Methodology and Results

Methodology

Two separate but simultaneous demonstrations were set up at the AAFC Scott Research Farm in 2015. Both trials were 2 x 2 factorials arranged as randomized complete block designs with four replicates. The first demonstration used Liberty Link (L252) canola with Proper EverGol as the standard seed treatment. The second demonstration used Roundup Ready canola (D3155C) and Helix Vibrance was the standard seed treatment. Each demonstration evaluated the respective standard seed treatments with and without the addition of Lumiderm and at two seeding rates - a "low" (60 seeds/m^2) and a "recommended" (120 seeds/m^2) rate. On May 13 and 14, L252 and D3155C varieties were seeded, respectively at the 'low' and 'recommended' seeding rates with seed treatment based on the treatment using an R-Tech drill seeder in 10 inch row spacing. Fertilizer was applied at seeding according to soil test recommendations (See Table 1 for detailed treatment list and Appendix and Table A.1 for complete details of field maintenance activities). Weeds were controlled using a pre-seed burndown and respective registered in-crop herbicides. No insecticide was applied.

Table 1. Detailed treatment list for the "*Flea beetle control, plant emergence and seed yield response of canola to addition of Lumiderm to standard seed treatments*" at Scott, Saskatchewan, 2015.

Treatments	Seeding Rate (seeds/m^2)	Seed Treatment (L252 variety)	Seed Treatment (D3155C variety)
1	60	Proper EverGol	Helix Vibrance
2	60	Proper EverGol + Lumiderm	Helix Vibrance + Lumiderm
3	120	Proper EverGol	Helix Vibrance
4	120	Proper EverGol + Lumiderm	Helix Vibrance + Lumiderm

Plant densities were assessed when there were visible rows to determine plant emergence among treatments in both trials at one and three leaf stages. These were assessed by counting two 1 m rows in the front and back of the plot for a total of four rows per plot. The average of the four rows was converted to plants per m^{-2} based on 10 inch row spacing. After the three leaf stage plant counts, both (same as those used for plant counts) rows in the front and back of each plot were harvested aboveground to determine the biomass yield. Percentage defoliation from flea beetles was visually assessed at the cotyledon and three leaf stages. Cutworm infection was assessed by pulling plants and observing the roots. Grain yields were determined after plots were mechanically harvested, cleaned and corrected to 10 % seed moisture.

Statistical Analysis

An analysis of variance (ANOVA) was conducted on all response variables using the PROC MIXED in SAS 9.3. Seeding rate and seed treatments were considered as fixed effect factors and replicates were considered a random effect factor. The assumptions of ANOVA (equal variance and normally distributed) were tested using Levene's test, and Shapiro-Wilks. The data fitted to the ANOVA assumptions. The data was normally distributed; therefore no data transformation was necessary. Treatment means were separated according to Tukey's Honestly Significant Difference (HSD) and considered significant at $P \leq 0.05$. Weather data was collected from the Scott Environment Canada weather station (Table 2).

Weather Conditions

In 2015, the early growing season was very dry with only 4.1 mm and 19.4 mm accumulated precipitation during the month of May and June, respectively. July received 36 % less rainfall compared to the long term average. However, August received 39 % more moisture compared to the long-term average. The mean monthly temperatures were comparable to previous years (Table 2).

Table 2. Mean monthly temperature, precipitation and growing degree day accumulated from May to September 2015 at Scott, SK

Year	**May**	**June**	**July**	**August**	**September**	**Average /Total**
			Temperature (°C)			
2015	9.3	16.1	18.1	16.8	10.9	14.24
Long-term^z	10.8	15.3	17.1	16.5	10.4	14.0
			Precipitation (mm)			
2015	4.1	19.4	46.4	74.5	49.6	194.0
Long-term^z	36.3	61.8	72.1	45.7	36.0	215.9
			Growing Degree Days			
2015	140.3	332	405.1	365.8	179.8	1423.0
Long-term^z	178.3	307.5	375.1	356.5	162.0	1379.4

^{z}Long-term average (1981-2010)

Table 3. Effects of seeding rate, seed treatment and their interactions on measured response variable in canola in both trials 1 and 2 at Scott, SK in the 2015 growing season.

	Trial 1 (L252 variety)			**Trial 2 (D3155C variety)**		
Effects	**Seeding Rate (SR)**	**Seed Treatment (ST)**	**SR x ST**	**Seeding Rate (SR)**	**Seed Treatment (ST)**	**SR x ST**
			P-values			
Plants/m^2 (@ one leaf stage)	*<.0001*	0.0874	0.7739	*<.0001*	0.1561	0.1139
Flea Beetle (%)	0.3087	0.1506	0.9079	0.4105	0.6774	0.6774
Plants/m^2 (@ three leaf stage)	*<.0001*	*0.0091*	0.8714	*0.0038*	0.6617	0.3804
Root Maggot (#)	0.2143	0.3336	0.2143	0.1582	0.5534	0.2495
Dry weight (kg/ha)	*0.0011*	0.0841	0.9993	*0.0035*	0.1289	0.3872
Yield (kg/ha)	0.6866	0.1034	0.7370	0.0744	0.6699	0.7156

Results

Effects of seeding rate on response variables

Generally, neither seed treatment nor seeding rate x seed treatment interaction had significant effects on plant population and dry weight, except in trial 1 where plant population at the third leaf stage was significantly affected by only seed treatment (P = 0.0091) (Table 3). In trial 1(L252 variety), both plant populations at the one and three leaf stages (P <.0001) and plant dry weight (P = 0.0011) were significantly affected by only seeding rate. In trial 2 (D3155C variety), the trend was the same with plant population at the one leaf stage (P <.0001), three leaf stage (P = 0.0038) and dry weight at the three stage (P = 0.0035) with all being significantly affected by seeding rate. Flea beetle damage, root maggot counts and grain yield were not affected by seeding rate in both trials 1 and 2 (Table 3).

Increasing the seeding rate from 60 seed/m^2 to 120 seed/m^2 in both trials resulted in a significant increase in plant population (Figures 1 and 2). The highest seeding rate of 120 seeds m^{-2} resulted in 76-85 plants m^{-2} and 66-69 plants m^{-2} at both plant density assessment periods, for trials 1 and 2, respectively. At the lowest seeding rate of 60 seeds m^{-2}, plant densities were 38-42 plants m^{-2} and 33-37 plants m^{-2} at both plant density assessment periods, for trials 1 and 2, respectively. There was a significant linear relationship between seeding rate and plant density (data not shown), which was expected as a higher seeding rate positively correlates to a higher plant population.

The significant difference in dry matter (Figure 3) between the 60 seed/m^2 and 120 seed/m^2 in both canola varieties may be because high seeding rates increase early dry matter accumulation and weed competitiveness (Park et al., 2003). Similarly, Harker et al. (2015) found that higher seeding rate of 150 seeds m^{-2} led to increased early crop biomass compared 70 seeds m^{-2}.

The lack of significant difference in grain yield between the 60 seed/m^2 and 120 seed/m^2 in both canola varieties may be because, despite high seeding rates increasing early dry matter accumulation and weed competitiveness, they may have negligible or negative impacts on grain yield due to increased inter-plant competition (Park et al., 2003). Again, it can explained by the fact that canola can compensate at very low plant populations, resulting in similar yield potential at both seeding rates. Furthermore, both Harker et al. (2015) and Kutcher et al. (2010) did not report a significant difference in yield between two seeding rates (70 and 150 seeds m^{-2}). In other research, higher seeding rates increased canola yield (Brandt et al. 2007; Hanson et al. 2008; Harker et al. 2012). However, Harker et al. (2003) found that a lower seeding rate of 100 seeds m^{-2} compared with higher seeding rates of 150 and 200 seeds m^{-2} reduced yields of both canola cultivars, InVigor 2153 and Exceed, by 7%. Results from this study, however, might indicate that perhaps the new varieties such as L130 may have improved genetics that allow for a lowered seeding rate compared to InVigor 2153 and Exceed without reducing grain yield.

Effects of seed treatment; seeding rate x seed treatment on response variables

Generally, there were no seed treatment effects on flea beetle damage and root maggot infection. This may be because of the dry period at the onset of the growing season, a condition not favorable for pest infestation.

Only plant density at the three leaf stage in trial 1 (P = 0.0091) was significantly affected by seed treatment (Table 3). Using Lumiderm + Helix Vibrance compared to Helix Vibrance alone on L252, resulted in plant density of 72 plants m^{-2} and 55 plants m^{-2}, respectively, a 31 % increase in plant density. This may suggest that, at the three leaf stage, the addition of Lumiderm to a standard seed treatment offered a protection for soil-borne pathogens. The response of L252 to Lumiderm on plant density relative D3155C may be a varietal effect which would require further studies. Flea beetle damage, root maggot counts and grain yield were all not affected by seed treatment. Also, seeding rate x seed treatment interaction did not have any significant effects on any response variable in both trials 1 and 2 (Table 3).

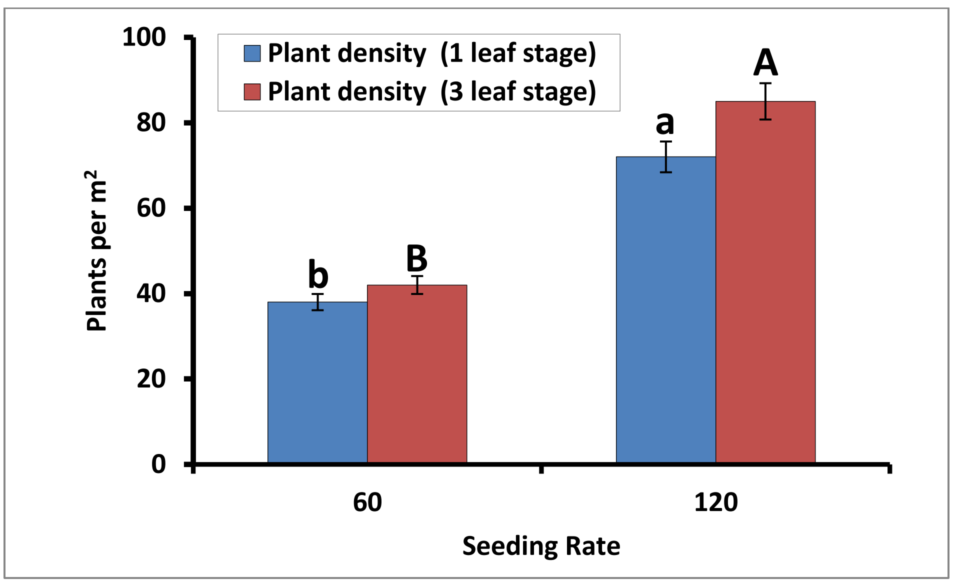

Figure 1. Effects of seeding rate on plant populations at one and three leaf stages in canola in trial 1 (L252) at Scott, SK in the 2015 growing season. Means followed by the same letters are not significantly different at P > 0.05 according to Tukey's Honestly Significant Difference (HSD).

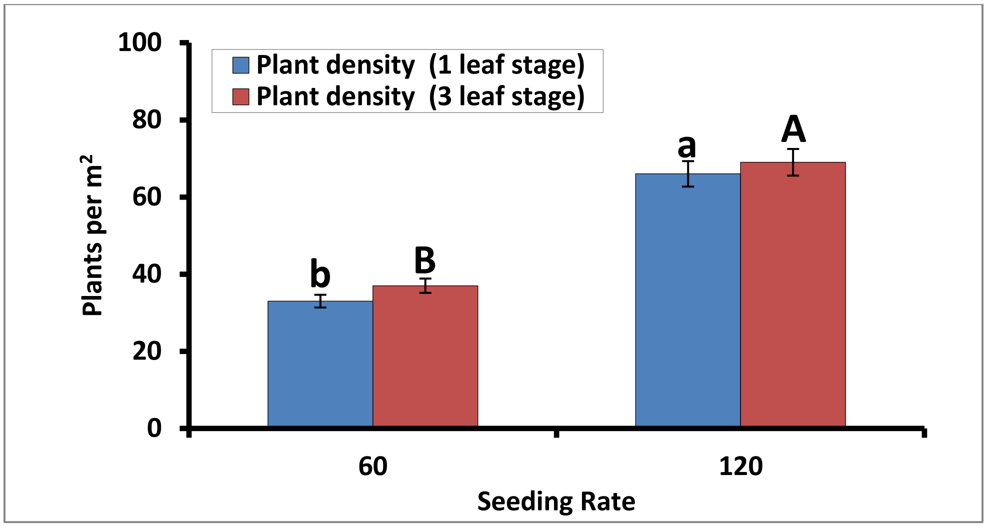

Figure 2. Effects of seeding rate on plant populations at one and three leaf stages in canola in trial 2 (D3155C) at Scott, SK in the 2015 growing season. Means followed by the same letters are not significantly different at P > 0.05 according to Tukey's Honestly Significant Difference (HSD).

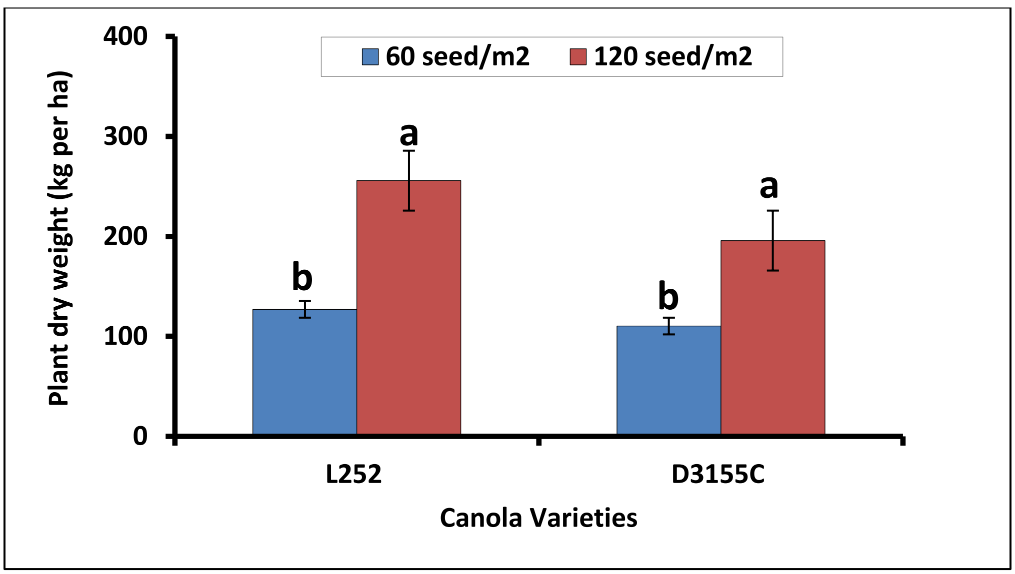

Figure 3. Effects canola variety on plant dry weight (kg/ha) at three leaf stage at Scott, SK in the 2015 growing season. Means followed by the same letters are not significantly different at P > 0.05 according to Tukey's Honestly Significant Difference (HSD).

Conclusions and Recommendations

From the study, it can be concluded that generally, neither seed treatment nor seeding rate x seed treatment interaction had significant effects on plant population and dry weight, except in trial 1 where plant population at the third leaf stage was significantly affected by only seed treatment (P = 0.0091). The trend is identical in both trials for both canola varieties. There was no seeding rate, seed treatment and seeding rate x seed treatment interaction effects on flea beetle infection, root maggot damage and grain yield. The general non-significant effects of seed treatment on both plant population and dry weight in both varieties suggests that in year like 2015 where initial soil moisture was low, application of additional seed treatment on top of a standard treatment might not be a worthwhile investment. However, based on the canola variety, there may be a non-disease benefit to the added seed treatment (such as plant vigor, etc.).

Based on the relative contributions seeding rate and seed treatment make to the competitiveness and yield of canola, treating seed may only be warranted when there is a high risk of heavy flea beetle infestation. Provided growing conditions are good and all other stress is minimal, canola may sustain considerable damage without losing substantial yield. At moderate to low flea beetle infestation levels, the added cost of Lumiderm in addition to a standard seed treatment may not be justifiable. Under that condition, however, producers may focus on seeding canola at the recommended or higher seeding rate with a standard seed treatment, provided the additional seed cost is less than that of the added seed treatment (Lumiderm). This is a one year study, so more studies is needed to ascertain the actual impact of Lumiderm, especially in wet years.

Supporting Information

Acknowledgements

We would like to thank the Ministry of Agriculture for the funding support on this project. We would also like to acknowledge the support of Herb Schell and our summer staff for their technical assistance with project development and implementation. This report will be distributed through WARC's website and included in WARC's annual report.

Appendices

Appendix A – Agronomic information for the demonstration

Abstract

Abstract/Summary

DuPont's studies have shown less flea beetle feeding on canola seedlings which received the Lumiderm seed treatment. Even in the absence of flea beetles DuPont has still observed greater plant vigor resulting from Lumiderm treated seed. To be able to demonstrate this to local farmers, two separate but simultaneous demonstrations were set up at the AAFC Scott Research Farm in 2015. Both trials were 2 x 2 factorials arranged as randomized complete block designs with four replicates. The factors were two seeding rates (low and recommended) and the two seed treatments (standard and standard + Lumiderm, on respective varieties). The first demonstration used Liberty Link (L252) canola with Proper EverGol as the standard seed treatment. The second demonstration used Roundup Ready canola (D3155C) and Helix Vibrance was the standard seed treatment.

From the study, it can be concluded that seeding rate affected plant density but not yield,

probably because canola can compensate at very low plant populations, resulting in similar yield potential at both seeding rates. Seed treatment significantly affected plant population at the three leaf stage in L252 only, however, there was generally no effects of seed treatment on flea beetle or root maggot infections.

Based on the relative contribution seeding rate and seed treatment make to the competitiveness and yield of canola, treating seed may only be warranted when there is a high risk of heavy flea beetle infestation. Provided growing conditions are good and all other stress is minimal, canola may sustain considerable damage without losing substantial yield. At moderate to low flea beetle infestation levels, the added cost of Lumiderm in addition to a standard seed treatment may not be justifiable. Under that condition, however, producers may focus on seeding canola at the recommended or higher seeding rate with a standard seed treatment, provided the additional seed cost is less than that of the added seed treatment (Lumiderm).

Appendix A
Agronomic information for 2015 demonstration

Table A.1. Selected agronomic information for the "*Flea beetle control, plant emergence and seed yield response of canola to addition of Lumiderm to standard seed treatments*" demonstration at Scott, Saskatchewan, 2015.

Seeding Information	2015
Seeder	R-Tech Drill, 10 inch row spacing, knife openers
Seeding Date	May 13 and 14, 2015
Cultivar	Canola – L252 and D3155C
Seeding Rate	60 and 120 seeds m^{-2}
Stubble Type	Wheat
Fertilizer applied	MAP (48.1 lb/ac side-band); AS (62.5 lb/ac) and Urea (199 lb/ac)-mid-row
Plot Maintenance Information	
Pre-plant herbicide	Roundup ¾ L/ac + Pardner 0.4 L/ac (May 8, 2015)
In-crop herbicide	Liberty @1.35L/ac on L252 and Roundup @180gae/ac on D3155C (June 15, 2015)
Desiccation	Reglone ion @ 0.8L/ac (August 31, 2015)
Emergence Counts	June 01, 2015

Harvest Date	September 10, 2015

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