2015 Annual Report

for the

Agricultural Demonstration of Practices and Technologies (ADOPT) Program

Project Title: Lumiderm Seed Treatment Effects on Canola Emergence, Flea Beetle Damage and Yield

(Project #20140435)

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Project Identification

1. **Project Title:** Lumiderm seed treatment effects on canola emergence, field beetle damage and yield.
2. **Project Number:** 20140435
3. **Producer Group Sponsoring the Project:** Indian Head Agricultural Research Foundation
4. **Project Location(s):** Indian Head, Saskatchewan, R.M. #156
5. **Project start and end dates (month & year):** April 2015 to January 2016
6. **Project contact person & contact details:**

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Objectives and Rationale

7. **Project objectives:**

The objective of this demonstration is 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 plant populations.

8. **Project Rationale:**

Rapid stand establishment is often a key factor in producing a high yielding and competitive canola crop. Virtually all commercial canola seed is treated with a seed treatment to control various seedling diseases and protect against flea beetle damage. In cool springs and under high insect pressure, the protection of the seed treatment often wears off while the plants are still small and foliar insecticide applications are frequently required at this critical time to prevent damage. While canola can recover well from defoliation as severe as 50%, damage can occur very quickly so spraying is usually recommended when defoliation has reached 25% and the insects are still present. In addition, striped flea beetles appear to be getting increasingly common and research suggests that they appear earlier and may do more feeding on seed-treated canola prior to control than a similar population of the unstriped crucifer type. Lumiderm seed treatment is a new group 28 product that is intended to provide superior, extended control over conventional canola seed treatments (i.e. Helix Vibrance, Prosper Evergol) applied on their own, particularly when soils are cool and wet. Moreover, Lumiderm appears to provide enhanced control against stripe flea beetles and is the only seed treatment product registered to control cutworm in canola which has potential to be a major benefit to canola growers in regions affected by this pest. In many cases, significant damage occurs before cutworms are detected and they are generally only active at night which can make spraying to control this insect difficult. There is evidence that, even in the absence of flea beetles, greater plant vigor may result from Lumiderm seed treatment; however, the reason why is unknown. With the absence of flea beetles and under laboratory conditions, Dr. Bob Elliot (AAFC-Saskatoon) found instances where canola seed treated with Lumiderm and a standard seed treatment produced seedling biomass which was statistically greater than the standard seed treatment alone. 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 and Helix Vibrance versus Helix Vibrance alone. Grain yields from these Lumiderm treated strips were also substantially greater. The intention of this demonstration was to assist farmers in determining if Lumiderm improves establishment and provides an economic return over standard seed treatments at both optimal and below optimal plant stands.

Methodology and Results

9. Methodology:

Two separate field trials with canola were established on a heavy clay soil east of Indian Head, Saskatchewan (R.M. #156; -103.56 W 50.56 N). For each trial, one with Roundup Ready® canola and the other with Liberty Link® canola, four treatments were arranged in a Randomized Complete Block Design and replicated four times. The treatments were comprised of standard seed treatment products (i.e. Helix Vibrance or Prosper Evergol) with and without Lumiderm (625 g Cyantraniliprole l^{-1}) and two seeding rates (60 versus 120 seeds m^{-2}).

Either L252 or D3155C canola were direct seeded into spring wheat stubble on May 15 using a SeedMaster plot drill with 8 openers spaced 30 cm apart and target seed depth of 1.9 cm. Urea, ammonium sulphate, monoammium phosphate and potash were side-banded to provide 130-30-15-15 kg N-P_2O_5-K_2O-S ha^{-1} for all treatments. Weeds were controlled using a pre-emergent application of 890 g glyphosate ha^{-1} combined with 74 ml ha^{-1} of Aim (May 9) plus an in-crop application on June 15 of either 4.0 l Liberty 150 SN ha^{-1} combined with 124 ml Centurion ha^{-1} (L252) or 1.23 l Roundup Transorb HC ha^{-1} (D3155C). To reduce the likelihood of sclerotinia stem rot becoming a potential yield limiting factor, 350 g Lance WDG ha^{-1} was applied on July 6. The plots were terminated with 69 g Heat WG ha^{-1} (September 1) and the centre five rows of each plot were straight-combined using a Wintersteiger plot combine on September 8.

Various data were collected over the course of the growing season. Emergence was assessed by marking four separate 1 m sections of crop row after seeding and counting the plants within the marked rows at both the 1 leaf (June 3) and 3-leaf stages (June 11) and converting the values to plants m^{-2}. At these times, percent defoliation was also rated on 10 plants from within the marked rows for each plot. Above-ground biomass was hand harvested from 4 x 0.5 m sections of crop row on June 15 and subsequently dried, weighed and converted to kg ha^{-1}. As an additional, indirect measure of above-ground biomass, normalized difference vegetation index (NDVI) was determined for each plot using a handheld GreenSeeker sensor on June 11 and again on June 18. Seed yields were corrected for dockage and to a uniform moisture content of 10%.

Response data were analysed using the GLM procedure of SAS 9.3 with separate analyses for each variety. Due to an error during seeding resulting in inaccurate seeding rates, data from one treatment (120 seeds m^{-2} – Helix Vibrance) had to be discarded. Individual treatment means were separated using Fisher's protected LSD test and contrasts were used to compare Prosper Evergol and Helix Vibrance to the dual seed treatments (Lumiderm) across seeding rates. All treatment effects and differences between means were considered significant at $P \leq 0.05$.

10. Results:

Mean monthly temperatures and precipitation amounts for the 2015 growing season at Indian Head are presented relative to long-term averages in Table 1. May was cooler and drier than average while June was warmer but also mostly dry. While the canola was seeded into adequate moisture, the spring as a whole was extremely dry with no significant precipitation events until late in the third week of June when canola was at the early bolting stage. From this point onwards, moisture was considered adequate and canola yields were above average overall. While there was substantial flea beetle pressure in the area and many early seeded fields were sprayed, damage on this specific test area and for most canola seeded in mid-May was relatively light. The predominant species observed early in the spring was the striped flea beetle which has been shown to appear and peak earlier than the crucifer flea beetle.

Table 1. Mean monthly temperatures and precipitation amounts along with long-term (1981-2010) averages for the 2015 growing season at Indian Head, SK.

Year	May	June	July	August	Avg. / Total
	---------- Mean Temperature (°C) ----------				
2015	10.3	16.2	18.1	17.0	15.4
Long-term	10.8	15.8	18.2	17.4	15.6
	---------- Precipitation (mm) ----------				
2015	15.6	38.3	94.6	58.8	207
Long-term	51.8	77.4	63.8	51.2	244

Treatment means and analyses of variance for canola emergence and percent defoliation by flea beetles are presented for Liberty Link® and Roundup Ready® in Tables 2 and 3, respectively. Focussing on emergence (plant density), there were no differences amongst seed treatments at either the 1-leaf or 3-leaf crop stages; however, as expected, increasing the seed rate consistently resulted in higher plant populations. Percent defoliation was extremely low at the 1-leaf stage (typically below 1%) and, while slightly higher at the 3-leaf stage (3-8%), still always well below the 25% threshold where foliar insecticides are typically recommended. Despite the relatively low flea beetle pressure, there was a tendency for less defoliation with the dual seed treatments (Prosper/Helix plus Lumiderm) relative to Prosper or Helix applied alone, particularly at the 3-leaf stage where overall damage was higher.

Table 2. Treatment means and analyses of variance for Liberty Link® canola emergence and percent defoliation.

Treatment	Emergence T1 (Jun-3)	Emergence T2 (Jun-11)	Defoliation T1 (Jun-3)	Defoliation T2 (Jun-11)
	---------- plants m^{-2} ----------		---------- % leaf area ----------	
Prosper Evergol 60 seeds m^{-2}	53.1 b	57.4 b	0.6 a	7.6 a
Prosper Evergol + Lumiderm 60 seeds m^{-2}	43.3 b	49.0 b	0.3 a	3.6 b
Prosper Evergol 120 seeds m^{-2}	81.6 a	86.9 a	0.9 a	4.2 b
Prosper Evergol + Lumiderm 120 seeds m^{-2}	86.1 a	95.4 a	0.1 a	2.9 b
S.E.M.	4.00	4.67	0.19	0.47
Pr > *F* [Z]	<0.001	<0.001	0.059	<0.001
C.V. (%)	12.1	12.9	80.0	20.4
Prosper vs Lumiderm [Z]	0.523	0.996	0.015	<0.001

[Z] p-values ≤ 0.05 indicate that a treatment effect was statistically significant and not due to random variability

Table 3. Treatment means and analyses of variance for Roundup Ready® canola emergence and percent defoliation.

Treatment	Emergence T1 (Jun-3)	Emergence T2 (Jun-11)	Defoliation T1 (Jun-3)	Defoliation T2 (Jun-11)
	---------- plants m^{-2} ----------		---------- % leaf area ----------	
Helix Vibrance 60 seeds m^{-2}	40.0 b	41.4 b	1.4 a	6.2 a
Helix Vibrance + Lumiderm 60 seeds m^{-2}	42.1 b	45.3 b	0.3 a	3.5 b
Helix Vibrance 120 seeds m^{-2}	—	—	—	—
Helix Vibrance + Lumiderm 120 seeds m^{-2}	81.0 a	85.5 a	0.8 a	3.0 b
S.E.M.	5.83	4.99	0.57	0.68
Pr > *F* [z]	<0.001	<0.001	0.278	0.026
C.V. (%)	21.2	16.7	93.2	31.9
Helix vs Lumiderm [z]	0.806	0.591	0.167	0.017

[z] p-values ≤ 0.05 indicate that a treatment effect was statistically significant and not due to random variability

Analyses of variance and treatment means for NDVI at two stages, above-ground biomass at the 3-leaf stage and seed yield are presented in Tables 4 and 5. Normalized difference vegetation index (NDVI) is an indirect measure of above-ground biomass which can also be used as an indicator of seedling vigor and/or plant density and was measured at both the 3-leaf stage and 1 week later at approximately the 4-leaf stage. As expected, NDVI was consistently higher at the higher seeding rates. When comparing seed treatments, NDVI also tended to be higher with the addition of Lumiderm to the standard seed treatments; however, this result was most pronounced and only significant with the Roundup Ready® canola where Helix Vibrance was the standard treatment.

Above-ground biomass at the 3-leaf stage was significantly higher with higher seeding rates but did not differ between the seed treatments. Seed yield was not affected by any of the treatments (*P* = 0.074-0.241), despite the fact that the 60 seeds m-2 rate was substantially below recommended seeding rates for canola. This is primarily due to the relatively low seedling mortality combined with abundant late-season moisture which allowed for the canola plants to compensate for the extra space at the lower rate. Considering the low level of flea beetle damage observed early in the season, seed treatment effects on seed yield were not necessarily expected in this particular case.

Table 4. Treatment means and analyses of variance for Liberty Link® canola NDVI, above-ground biomass and seed yield.

Treatment	NDVI (Jun-11)	NDVI (Jun-18)	Biomass (Jun-11)	Seed Yield
			---------- kg ha^{-1} ----------	
Prosper Evergol 60 seeds m^{-2}	0.138 b	0.223 b	137.1 b	3113 a
Prosper Evergol + Lumiderm 60 seeds m^{-2}	0.145 b	0.228 b	129.8 b	3153 a
Prosper Evergol 120 seeds m^{-2}	0.163 a	0.283 a	167.7 ab	3203 a
Prosper Evergol + Lumiderm 120 seeds m^{-2}	0.160 a	0.295 a	189.9 a	3214 a
S.E.M.	0.0025	0.0102	12.95	26.0
Pr > *F* [Z]	<0.001	0.001	0.032	0.074
C.V. (%)	3.3	8.0	16.6	1.6
Prosper vs Lumiderm [Z]	0.343	0.414	0.580	0.358

[Z] p-values ≤ 0.05 indicate that a treatment effect was statistically significant and not due to random variability

Table 5. Treatment means and analyses of variance for Roundup Ready® canola NDVI, above-ground biomass and seed yield.

Treatment	NDVI (Jun-11)	NDVI (Jun-18)	Biomass (Jun-11)	Seed Yield
			---------- kg ha^{-1} ----------	
Helix Vibrance[Z] 60 seeds m^{-2}	0.130 c	0.193 c	100.0 b	3035 a
Helix Vibrance + Lumiderm[Y] 60 seeds m^{-2}	0.143 b	0.218 b	103.3 b	3027 a
Helix Vibrance 120 seeds m^{-2}	—	—	—	—
Helix Vibrance + Lumiderm 120 seeds m^{-2}	0.155 a	0.270 a	170.3 a	3171 a
S.E.M.	0.003	0.0058	14.78	
Pr > *F* [Z]	<0.001	<0.001	0.005	0.241
C.V. (%)	4.4	5.0	23.7	3.0
Helix vs Lumiderm [Z]	0.016	0.010	0.878	0.897

[Z] p-values ≤ 0.05 indicate that a treatment effect was statistically significant and not due to random variability

Extension and Acknowledgement

This demonstration was a formal stop during the 2015 IHARF Crop Management Field Day which was held on July 21. The tour was attended by over 200 registered guests and signs were in place to acknowledge the support of the Agricultural Demonstrations of Technologies and Practices (ADOPT) program. Results from this project will be made available in the 2015 IHARF Annual Report (available online) and also through a variety of other media (i.e. oral presentations, popular agriculture press, fact sheets, etc.) as opportunities arise.

11. Conclusions and Recommendations

The intent of this project was to demonstrate the potential benefits of Lumiderm seed treatment combined with conventional seed treatments (Prosper Evergol or Helix Vibrance) relative to the conventional treatments on their own for enhanced protection of canola seedlings against flea beetle damage. Despite significant flea beetle pressure in the area for canola that was seeded very early (i.e. 1st week of May), pressure on this particular site was relatively low with <10% defoliation in all cases. The threshold where foliar insecticide applications are typically recommended is 25% defoliation. Canola can usually recover from defoliation as high as 50%. Under the conditions encountered, seed treatment did not affect plant populations at either the 1-leaf or 3-leaf stage; though, particularly at the 3-leaf stage, there was evidence of reduced defoliation with the addition of Lumiderm despite the relatively low levels. Normalized difference vegetation index (NDVI) was not affected by seed treatment for the Liberty Link® canola treated with Prosper Evergol but was significantly higher with Lumiderm in the Roundup Ready® variety treated with Helix Vibrance. Despite the observed differences in NDVI, above-ground biomass yields were not affected by seed treatment for either variety. Canola seed yield was not affected by seed treatments; however, yield benefits were unlikely considering the low levels of defoliation earlier in the season. It is important to recognize that crop protection products such as seed treatments only provide economic benefits when the pests they control are present at sufficiently high levels to inflict yield loss. In this particular case, the controls were still treated with products that are registered to control flea beetles and are effective under most environmental conditions. Research conducted by AAFC suggests that adding Lumiderm to conventional seed treatments provides the greatest benefits under cool, wet conditions while the spring conditions at Indian Head in 2015 were warm and dry. Unlike the standard seed treatments applied on their own, Lumiderm also provides protection against cutworms; therefore, growers who are experiencing losses from this pest are more likely to benefit from this product. Cutworms were not present on the site at Indian Head in 2015.

Supporting Information

12. Acknowledgements:

This project was financially supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canada-Saskatchewan Growing Forward 2 bi-lateral agreement. Acknowledgement of the Saskatchewan Ministry of Agriculture's support for this demonstration will be included as part of all written reports and oral presentations that arise from this work. Treated seed for the project was provided in-kind by Bayer CropScience and Dupont-Pioneer. The support and contributions of Christiane Catellier, Dan Walker, Carly Miller and Danny Petty are greatly appreciated.

13. Appendices

Abstract

14. Abstract/Summary:

A field trial with canola was conducted at Indian Head to demonstrate the potential benefits of Lumiderm seed treatment combined with Prosper Evergol or Helix Vibrance at high versus low plant populations relative to the standard products applied on their own. Although flea beetles were present, pressure was low and the weather was warm and dry while research has shown that the greatest benefits to Lumiderm generally occur under cool, wet conditions. Seed treatment did not affect plant populations or above-ground biomass yield; however, there was evidence of reduced defoliation and, for Roundup Ready® canola treated with Helix Vibrance, higher NDVI with the addition of Lumiderm. Seed yield was not affected by plant population or seed treatment. This was not unexpected considering the relatively low seedling mortality and abundant moisture conditions during the latter half of the season combined with minimal defoliation and flea beetle pressure early on.