ANNUAL REPORT
Canola Agronomic Research Program (CARP)

The Annual Final Report should fully describe the work completed for the year and note the personnel involved. It should also note any deviations from the original plan and next and/or corrective steps as may be required if deviations are noted. The report should also provide an update on the status of the Project including forecasted date of completion. A complete statement of expenses should be included. In the event major changes are anticipated within the budget supporting notes along with a proposed budget should also be included. The report should also capture a complete summary of activity for the year.

Title: Pre-harvest herbicide and desiccation options for straight-combining canola: Effects on plant and seed dry-drown, yield and seed quality

Research Team Information

Lead Researchers:		
Name	**Institution**	**Expertise Added**
Chris Holzapfel	IHARF	Responsible for project development, reporting and field trials at the Indian Head (SK) site.
Research Team Members		
Name	**Institution**	**Expertise Added**
Jessica Pratchler	NARF	Responsible for site management at Melfort (SK) site
Jessica Weber	WARC	Responsible for site management at Scott (SK) site
Scott Chalmers	WADO	Responsible for site management at Melita (MB) site
Danny Petty	IHARF	Responsible for project administration and sub-contracts with collaborating organizations

Project Start Date: April 2017 **Project Completion Date: March 2020**

Reporting Period: April 1, 2017 to March 31, 2019

CARP Project Number: 2017.9

Instructions: This Annual Report shall be completed and submitted on or about March 31st of each fiscal year that the agreement is in effect. The Lead Researcher of the project in question shall complete and submit the report on behalf of his/her complete research team.

This Report is a means by which to provide a detailed update on the status of the project and summarize project activities. Details may be general in nature unless major issues or changes arise (e.g., change of scientists, significant change or delay of activities) including impacts on budgets. Please note that financial reports of major impact on budgets.

The following template is provided to assist you in completing this task. Please forward the completed document electronically to your appropriate CCC contact.

1. Forecasted Date of Completion:

March 31, 2020

2. Status of Activity: (please check one)

_____ Ahead of Schedule __X___ On Schedule _____Behind Schedule _____ Completed

Comment: The first year of field trials and preliminary analyses and summarization of results have been completed on schedule. Preparations for the 2nd year of field trials are underway.

3. Completed actions, deliverables and results; any major issues or variance between planned and actual activities.

Objectives

The project objectives were to evaluate the effectiveness of pre-harvest herbicide/desiccant applications for assisting plant and seed dry-down for the two dominant herbicide systems (Liberty Link® and Roundup®). The options and relative performance for Clearfield® canola would presumably be similar to Liberty Link® canola.

Completed Actions / Methodology

Field trials were completed at four locations in the 2017 and 2018 growing seasons: Indian Head (SK), Melfort (SK), Scott (SK) and Melita (MB). In 2017, the varieties 233P (Liberty Link® - LL - glufosinate ammonium tolerant) and 45M35 (Roundup Ready® - RR - glyphosate tolerant) were seeded into cereal stubble in mid-May at a rate of 120 seeds/m^2. In 2018, 233P was replaced with 255PC under the expectation (based on consultations with BASF) that this would result in more similar maturity between the two hybrids; however, actual results varied. With the exception of 2017-Melfort where no herbicides were applied, weeds were controlled using registered pre-emergent and in-crop herbicides. At Indian Head and Melita, conventional canola products (i.e. Edge, Lontrel, Muster, Assure 2) were utilized while, at Scott in both years and Melfort in 2018, each variety was sprayed with its partner in-crop herbicide (i.e. glyphosate or glufosinate ammonium). The pre-harvest treatments were targeted for 60-75% seed colour change (glyphosate and saflufenacil) or approximately 90% seed colour change (glufosinate ammonium and diquat); however, maturity between the two hybrids differed at some sites. At the sites where the relative maturity of the hybrids differed, compromises were either made in crop stage where treatments were applied or the application dates were adjusted to better accommodate differences in maturity between hybrids. For all products, excluding glyphosate applied alone (where lower application volumes were permitted but not required), the minimum solution volume was 187 l/ha (20 U.S. gallons per acre). Treatment application dates and other agronomic information for each location-year are provided in the Appendices (Tables A1 and A2). A total of 10 treatments were arranged in a RCBD with four replicates (Table 1). Treatment 7 (RR – glufosinate ammonium) was not included at the 2017-Melfort site.

Table 1. Treatment list for Canola Pre-harvest Application Study (CARP 2017.9).

Treatment Name	
1) LL – untreated	**6)** RR – untreated
2) LL – glyphosate (890 g ai/ha) [Z]	**7)** RR – glufosinate ammonium (408 g ai/ha) [Y]
3) LL – saflufenacil (50 g ai/ha) [Z]	**8)** RR – saflufenacil (50 g ai/ha) [Z]
4) LL – glyphosate (890 g ai/ha) + saflufenacil (50 g ai/ha) [Z]	**9)** RR - glyphosate (890 g ai/ha) + saflufenacil (50 g ai/ha) [Z]
5) LL – diquat (40 g ai/ha) [Y]	**10)** RR – diquat (40 g ai/ha) [Y]

LL – glufosinate ammonium tolerant; RR – glyphosate tolerant
[Z] 60-75% seed colour change; [Y] 90% seed colour change

Various data were collected through the growing season, at the time of harvest, and during the winter months. To help understand overall environmental conditions and potential inconsistencies between hybrids, emergence was assessed at approximately 3-4 weeks after seeding by recording the number of plants in 2 x 1 m sections of crop row per plot and converting the values to average plants/m^2. Once the treatments were applied, visual assessments of stem / overall plant dry-down (rating scale of 0-100) were completed on weekly intervals starting on the day of application with a final set of ratings on all plots immediately prior to harvest. The visual assessments of crop dry-down were not completed at Melfort 2017 and, in general, were rather subjective but were considered necessary to provide information on the overall rate of crop dry down. The target harvest timing was before the crop dried down to the extent that treatment effects would no longer be evident but late enough that the canola could still be readily threshed and put through the combines without plugging or yield loss; however, all treatments within a given hybrid were always harvested on the same date. Both hybrids were combined on the same date for all location-years except Scott 2017 where the RR hybrid was harvested three days later than the LL hybrid, L233P in 2017. Immediately after harvest, percent seed moisture was determined by weighing minimum 100 g sub-samples fresh and again after being dried for at least 24 hours at 70 °C or higher. Whole plant (including seed) moisture was determined either immediately before or after harvest (depending on plot size/harvest area) by harvesting representative plants from each plot at ground level, determining their fresh versus dry weights and calculating percent gravimetric moisture content. Seed weight was determined by counting a minimum of 300 seeds for each plot using an automated seed counting machine, weighing the counted seeds to the nearest 0.00 g and calculating g/1000 seeds. Percent distinctly green seed was determined for each plot from a crushed 500 seed sample.

At this preliminary stage, response data have been analyzed and summarized on an individual location-year basis in order to assess data quality or importance differences in environmental conditions prior to any combined analyses. The response data analyzed were plant density, final visual dry down ratings (at harvest), seed moisture, whole plant moisture, seed yield, thousand seed weight, and percent green seed. A mixed model analyses (pre-harvest treatments fixed, replicate random) was used along with contrasts to compare pre-determined groups of treatments or, where applicable, individual treatments of interest. In addition to the contrasts, individual treatment means were separated using a multiple comparisons test (Fisher's protected LSD test). The specific contrast comparisons were: 1) untreated vs treated, 2) untreated vs glyphosate (LL only), 3) untreated vs glufosinate ammonium (RR only), 4) untreated vs saflufenacil; 5) untreated vs saflufenacil + glyphosate; 6) untreated vs diquat; 7) glyphosate vs saflufenacil + glyphosate; 8) glyphosate vs diquat (LL only); 9) glufosinate ammonium vs saflufenacil plus glyphosate (RR only), 10) glufosinate ammonium vs glyphosate (RR only); and 11) saflufenacil + glyphosate vs diquat.

<u>Pre-harvest Treatment Effects on Seed and Crop Dry Down</u>
Growing season weather information for the four locations is presented along with the long-term (1981-2010) averages in provided in Tables A-3 and A-4 of the Appendices. Overall, the weather tended to be both warmer and drier than average at all location and both years; however, September 2018 was relatively cold and wet. This affected harvest conditions and canola dry down at Scott and Melfort but not Indian Head or Melita where the canola was harvested in August. At Melita, hot dry conditions in August combined with coarser textured soils led to extremely rapid crop dry-regardless of hybrid or pre-harvest treatment.

Individual treatment means and the multiple comparisons are presented for visible stem dry down, seed moisture and whole plant moisture in Tables A5, A7, A9, A11 of the Appendices for Indian Head, Melfort, Melita, and Scott, respectively. To aid in the interpretation and discussion of results to date, a basic summary of pre-harvest treatment effects on the final visual dry down ratings is provided below in Figs. 1 and 2 for LL and RR canola, respectively. While values from the earlier ratings were not statistically analyzed, they are presented graphically in Figs. A1-12 of the Appendices.

While not analyzed in this manner, the overall visible dry-down ratings were notably lower at Indian Head relative to the other locations. In addition to environmental conditions, this may have been due in part to both the subjective nature of these ratings in addition to the relative timing of harvest. For LL canola, pre-harvest treatment differences in the final visual ratings were detected at six of eight location-years, the exceptions being Melfort 2018 and Melita 2018. At Indian Head in 2017, the greatest responses were with glyphosate (with or without saflufenacil) and diquat with relatively little visible benefit to saflufenacil alone with regard to stem dry down. At Indian Head in 2018, all products resulted in increased dry-down to some extent but, under the hot, dry conditions, diquat appeared to be the most effective. At Melita 2017, the responses were similar to Indian Head 2017 with good results for glyphosate (with or without saflufenacil) and diquat but relatively little visible stem dry down with saflufenacil alone. At Scott 2017, all options performed well but there was a slight advantage to glyphosate (with or without saflufenacil). At Scott 2018, all options increased visual stem dry down over the control as well; however, the best results were achieved with glyphosate plus saflufenacil in this case. Generally, the same location-years were responsive for glyphosate tolerant canola (Fig. 2). All options appeared to work reasonably at these responsive sites, diquat appeared to have the most consistent effect and frequently resulted in the strongest visual responses compared to glufosinate ammonium or saflufenacil (with or without glyphosate). Note that these ratings were subjective and can only be interpreted as a crude indication of canola stem dry down. For more powerful and direct comparisons of individual treatments to the control and between opposing treatments (averaged across hybrids where applicable), refer to Table 2.

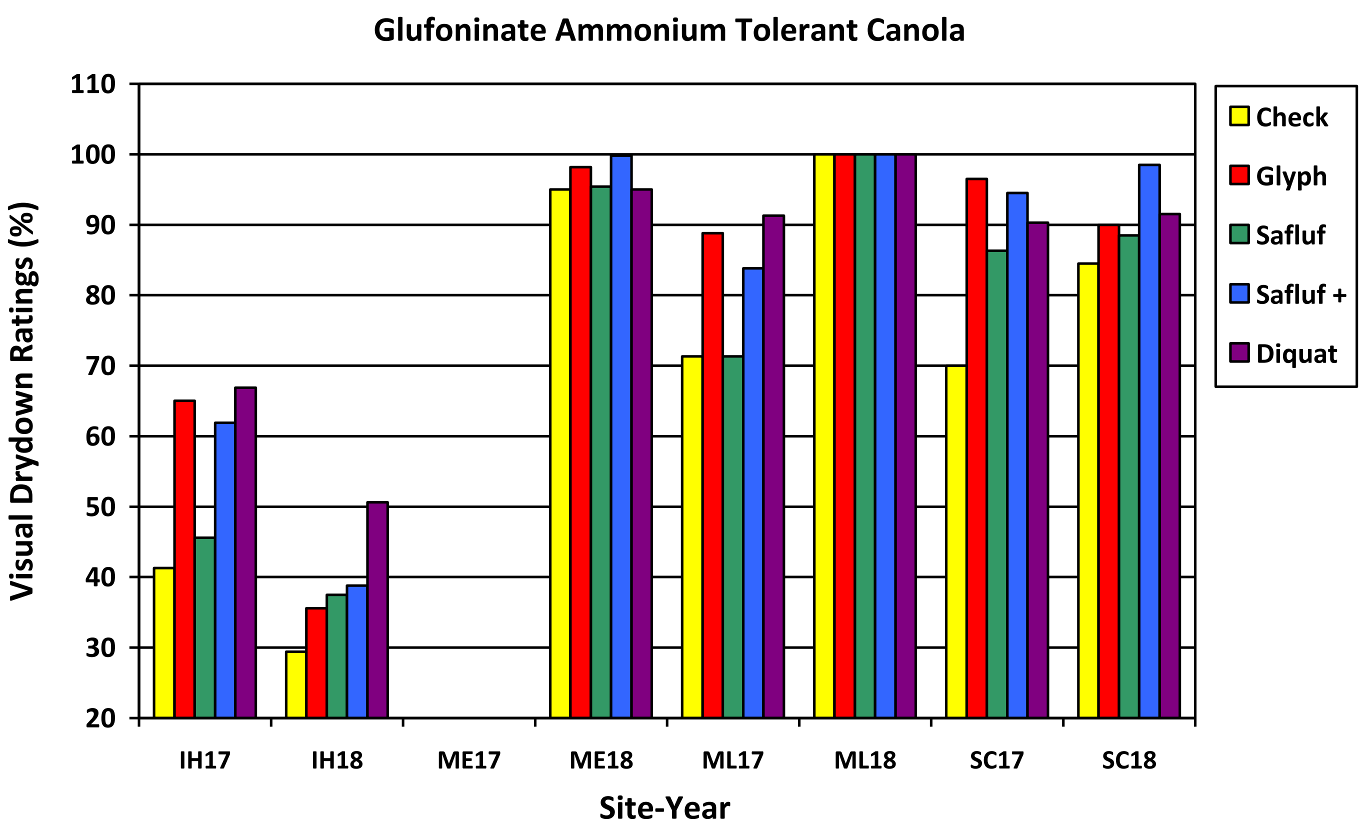

Figure 1. Pre-harvest treatment effects on visual stem dry down ratings for glufosinate ammonium resistant canola at four locations over two years. Pre-harvest treatment differences were significant at IH17, IH18, ME17, ML17, SC17 and SC18.

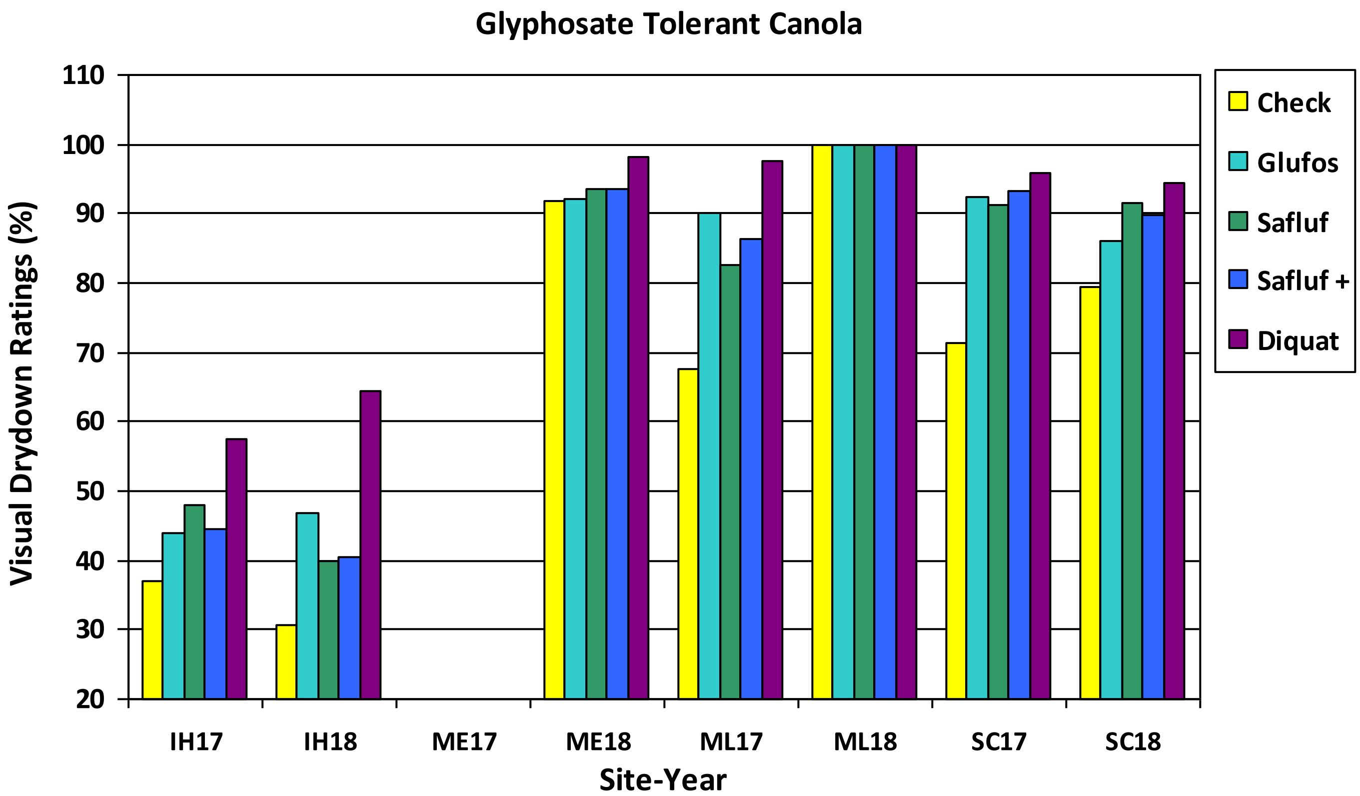

Figure 2. Pre-harvest treatment effects on visual stem dry down ratings for glyphosate resistant canola at four locations over two years. Pre-harvest treatment differences were significant (P < 0.001) at IH17, IH18, ME17, ML17, SC17, and SC18.

Table 2. Contrasts comparing the effects of canola desiccant options on visual plant dry down ratings (%) at the time of harvest for four locations over a two-year period (2017-18).

Contrast Comparison	Indian Head 2017	Indian Head 2018	Melfort 2017	Melfort 2018	Melita 2017	Melita 2018	Scott 2017	Scott 2018
	-------------------	-------------------	-------------------	p-value	-------------------	-------------------	-------------------	-------------------
Untreated vs treated	<0.001	<0.001	–	0.179	<0.001	–	<0.001	<0.001
Untreated vs Glyphosate (LL) [Z]	<0.001	0.061	–	0.324	0.007	–	<0.001	0.038
Untreated vs Glufosinate Ammonium (RR) [Y]	0.061	<0.001	–	0.922	0.001	–	<0.001	0.016
Untreated vs Saflufenacil	0.004	<0.001	–	0.622	0.089	–	<0.001	<0.001
Untreated vs Saflufenacil + Glyphosate	<0.001	<0.001	–	0.125	0.001	–	<0.001	<0.001
Untreated vs Diquat	<0.001	<0.001	–	0.143	<0.001	–	<0.001	<0.001
Glyphosate vs Saflufenacil + Glyph (LL) [Z]	0.381	0.337	–	0.595	0.413	–	0.308	0.002
Glyphosate vs Diquat (LL) [Z]	0.598	<0.001	–	0.292	0.681	–	0.003	0.557
Glufosinate vs Saflufenacil + Glyphosate (RR) [Y]	0.860	0.061	–	0.654	0.538	–	0.608	0.149
Glufosinate Ammonium vs Diquat (RR) [Y]	<0.001	<0.001	–	0.043	<0.001	–	<0.001	<0.001
Saflufenacil + Glyphosate vs Diquat	0.001	<0.001	–	0.984	0.036	–	0.586	0.534

[Z] Gravimetric water content of seed at harvest
[Y] Gravimetric water content of above-ground plant material at harvest

Treatment effects on seed moisture content at harvest are summarized for RR and LL canola in Figs. 3 and 4 below with contrast results in Table 3, and individual means separations and other statistics deferred to the Appendices. Values at Melfort 2017 and, to a lesser extent, Scott 2017 were unusually low; however, the relative differences between treatments appear to be consistent with other observations regarding dry down. Significant reductions in seed moisture with at least one pre-harvest option occurred at half of the location-years for LL canola and six of eight sites for RR canola. The trend at Indian Head was for drier LL seed with diquat but no other options and this was confirmed by the contrast comparisons ($P < 0.001$; Table 3). At Indian Head 2018, diquat also resulted in the greatest seed dry down by a substantial margin; however, glyphosate (with or without saflufenacil) also reduced seed moisture content of LL canola (Fig. 3). At Melfort 2017, all options evaluated for LL canola resulted in substantial seed moisture reductions with no treatment appearing particularly advantageous over the others. For LL canola at Scott 2018, all options except saflufenacil applied alone resulted in significantly drier seed than the control. For RR canola (Fig. 4), diquat again provided the most consistent and frequently strongest responses; however, other options were also effective at times. Glufosinate ammonium resulted in drier seed than the control at 38% of the location-years compared to 75% for diquat and 25% of the time for saflufenacil (with or without glyphosate). The lack of response at some locations can largely be explained by weather with late-season drought and rapid dry-down equalizing treatments at Melita 2018 and cool, wet conditions and harvest delays likely being a causal factor at Melfort 2018 and Scott 2018. It was also dry late in the season at Indian Head 2017 where greater treatment separation was observed with RR versus LL canola due to the former being later maturing.

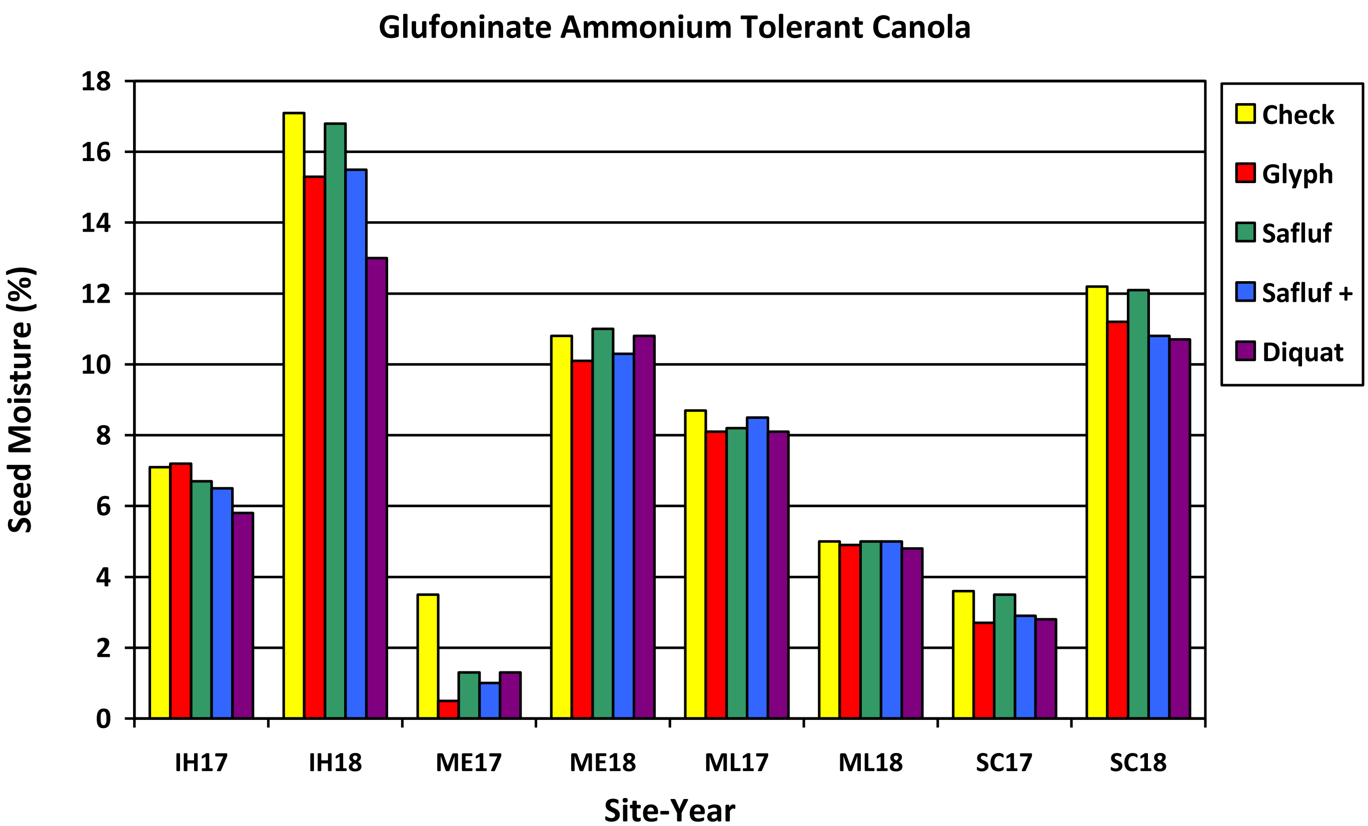

Figure 3. Pre-harvest treatment effects on seed moisture content for glufosinate ammonium resistant canola at four locations over two years. Individual pre-harvest treatment differences were significant at IH18, ME17, and SC18.

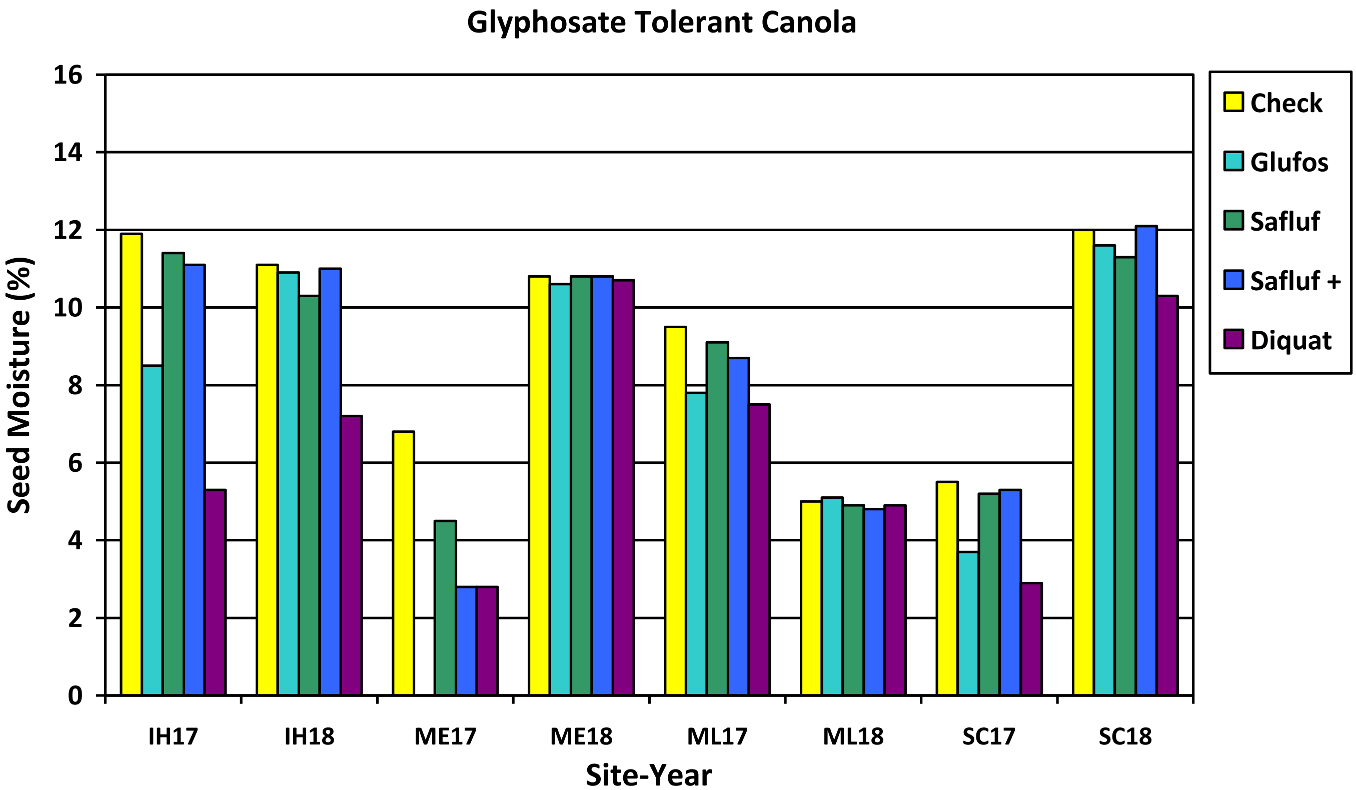

Figure 4. Pre-harvest treatment effects on seed moisture content for glyphosate resistant canola at four locations over two years. Individual pre-harvest treatment differences were significant (P < 0.001) at IH17, IH18, ME17, ML17, SC17, and SC18.

Table 3. Contrasts comparing the effects of canola desiccant options on seed moisture content (%) at the time of harvest for four locations over a two-year period (2017-18).

Contrast Comparison	Indian Head 2017	Indian Head 2018	Melfort 2017	Melfort 2018	Melita 2017	Melita 2018	Scott 2017	Scott 2018
	------------------	------------------	------------------	p-value	------------------	------------------	------------------	------------------
Untreated vs treated	<0.001	0.002	0.002	0.465	0.012	0.407	0.001	<0.001
Untreated vs Glyphosate (LL) Z	0.851	0.036	0.037	0.139	0.285	0.486	0.054	0.002
Untreated vs Glufosinate Ammonium (RR) Y	<0.001	0.765	0.368	0.668	0.005	0.250	0.001	0.113
Untreated vs Saflufenacil	0.371	0.325	0.027	0.829	0.284	0.622	0.611	0.061
Untreated vs Saflufenacil + Glyphosate	0.160	0.136	0.002	0.382	0.245	0.327	0.203	0.003
Untreated vs Diquat	<0.001	<0.001	0.003	0.810	0.002	0.146	<0.001	<0.001
Glyphosate vs Saflufenacil + Glyph (LL) Z	0.315	0.811	0.717	0.674	0.473	0.486	0.543	0.154
Glyphosate vs Diquat (LL) Z	0.040	0.011	0.587	0.166	1.000	0.486	0.740	0.096
Glufosinate vs Saflufenacil + Glyphosate (RR) Y	<0.001	0.929	0.054	0.668	0.096	0.015	0.002	0.068
Glufosinate Ammonium vs Diquat (RR) Y	<0.001	<0.001	0.007	0.893	0.001	0.486	<0.001	<0.001
Saflufenacil + Glyphosate vs Diquat	<0.001	<0.001	0.898	0.529	0.040	0.622	<0.001	<0.001

Z Gravimetric water content of seed at harvest
Y Gravimetric water content of above-ground plant material at harvest

Again, and as expected, overall plant moisture content at harvest and pre-harvest treatment effects appeared to vary with environment (Figs. 5 and 6). At Indian Head 2017 with LL canola, diquat, and to a lesser extent, glyphosate applied alone, provided the greatest whole plant moisture reduction. At Indian Head 2018, all pre-harvest options for LL canola reduced plant moisture; however, the largest reduction was with diquat while glyphosate and saflufenacil provided intermediate benefits. At Melfort 2017, all options provided similar and significant reductions in plant moisture content. At Melfort 2018, the values were variable and not significant according to the multiple comparisons test with all treatments; however, moisture content tended to be highest in the control and lowest with glyphosate applied alone ($P = 0.010$; Table 4). At Melita 2017, the best results were achieved with glyphosate (alone or with saflufenacil) and diquat but there was no benefit measured with saflufenacil alone for whole plant dry-down. There was no benefit to any options for LL canola at Melita 2018. At Scott, saflufenacil applied alone did not reduce whole plant moisture content in either year. Glyphosate (with or without saflufenacil) reduced plant moisture content both years, while diquat provided similar benefits to glyphosate at Scott 2018 and intermediate benefits in 2017. For RR canola, only diquat significantly reduced whole plant moisture in both years at Indian Head; however, there appeared to be a small benefit to saflufenacil in 2018. No RR canola options had a significant impact on plant moisture in either year at Melfort. For RR canola at Melita 2017, diquat, and to lesser extent glufosinate ammonium, reduced whole plant moisture content. Again, similar to the LL canola, there was no benefit to any RR canola pre-harvest options at Melita 2018 due to the crop essentially being desiccated by drought. At Scott in both years, diquat provided the greatest reduction in whole plant moisture content for RR canola. Glufosinate ammonium and saflufenacil (with or without glyphosate) reduced moisture content slightly but the reductions were not consistently significant.

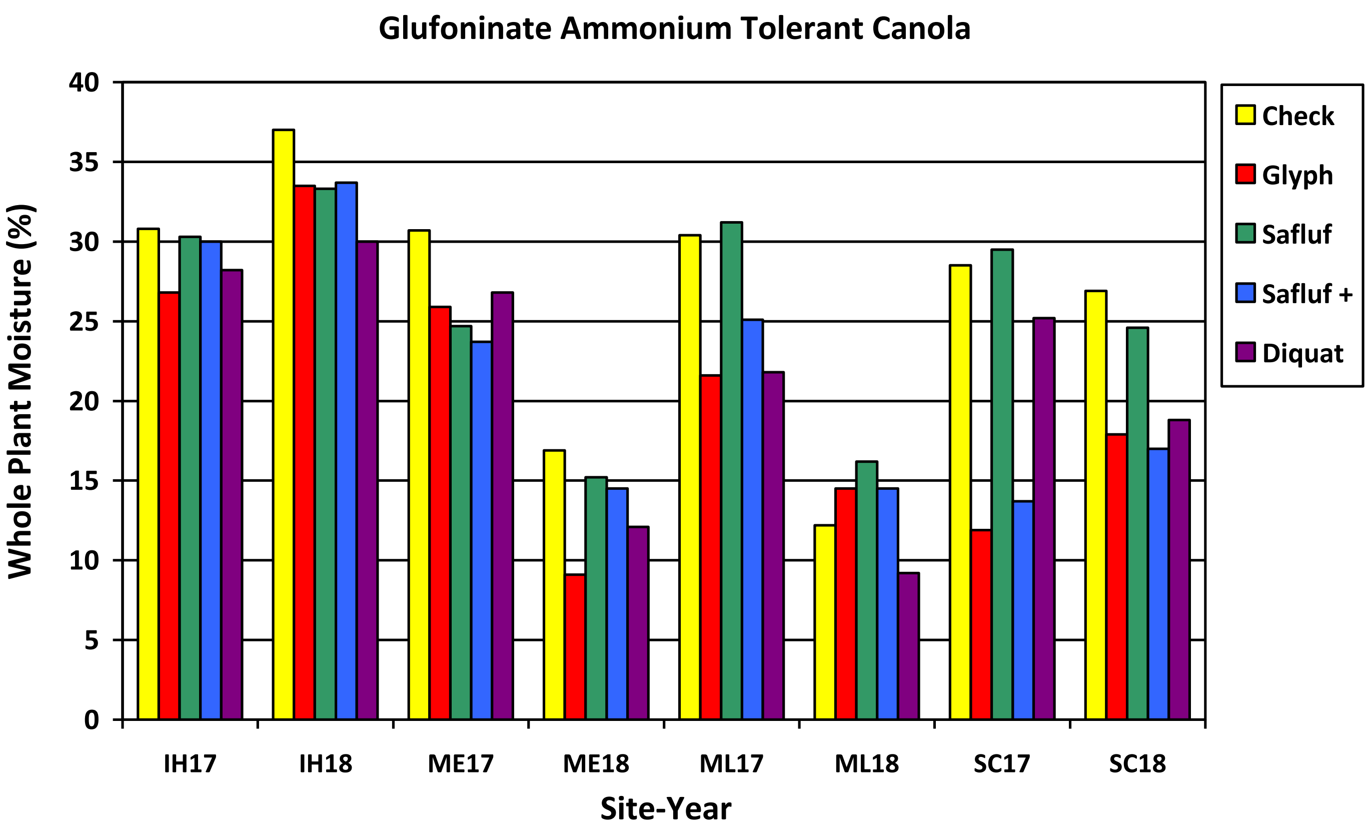

Figure 5. Pre-harvest treatment effects on whole plant moisture content for glufosinate ammonium resistant canola at four locations over two years. Individual pre-harvest treatment differences were significant at IH18, ME17, SC17, and SC18.

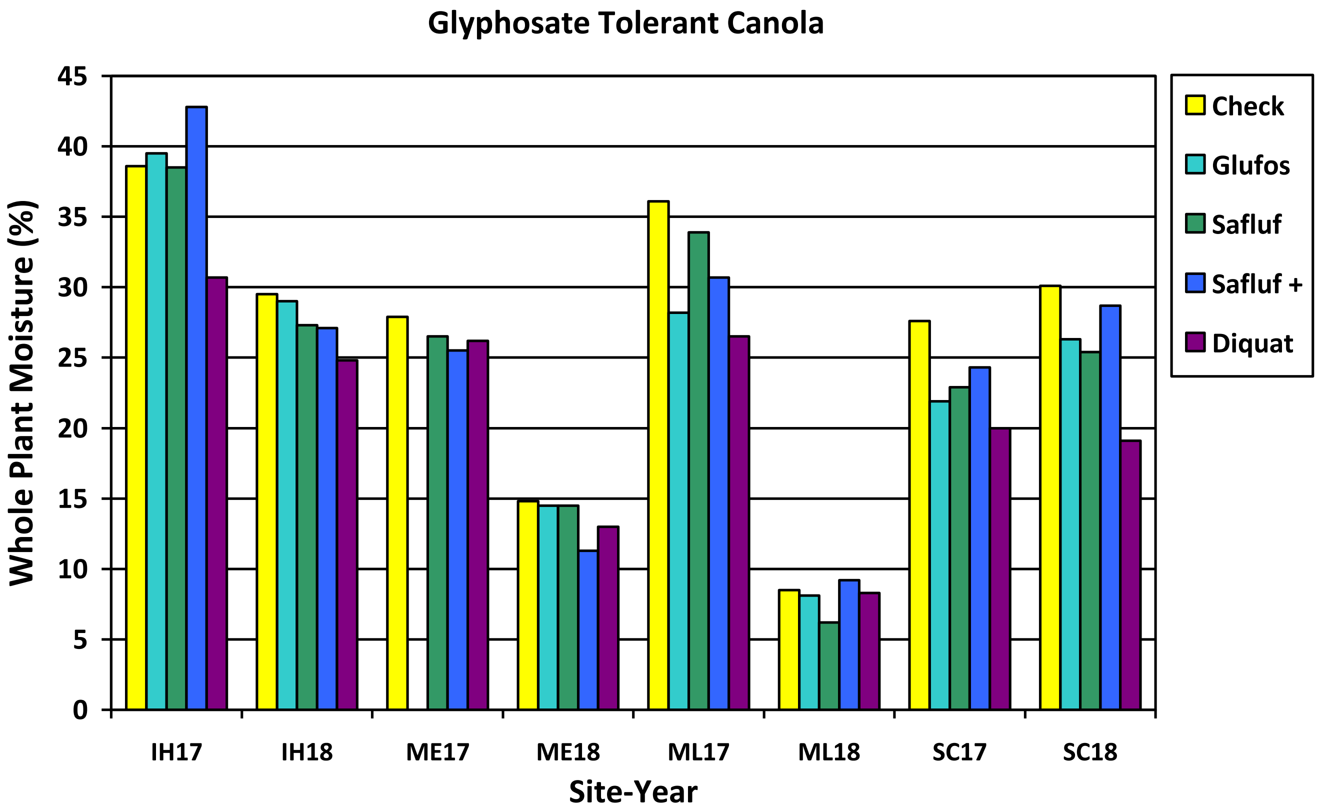

Figure 6. Pre-harvest treatment effects on whole plant moisture content for glyphosate resistant canola at 8 locations. Individual pre-harvest treatment differences were significant (P < 0.001) at IH17, IH18, ME17, ML17, SC17, and SC18.

Table 4. Contrasts comparing the effects of canola desiccant options on whole plant moisture content (%) at the time of harvest for four locations over a two-year period (2017-18).

Contrast Comparison	Indian Head 2017	Indian Head 2018	Melfort 2017	Melfort 2018	Melita 2017	Melita 2018	Scott 2017	Scott 2018
Contrast	----------	----------	----------	---------- p-value	----------	----------	----------	----------
Untreated vs treated	0.252	<0.001	0.024	0.062	0.022	0.830	<0.001	<0.001
Untreated vs Glyphosate (LL) [Z]	0.064	0.026	0.027	0.010	0.052	0.502	<0.001	<0.001
Untreated vs Glufosinate Ammonium (RR) [Y]	0.675	0.740	0.015	0.919	0.079	0.901	0.023	0.070
Untreated vs Saflufenacil	0.835	0.010	0.017	0.572	0.827	0.737	0.280	0.020
Untreated vs Saflufenacil + Glyphosate	0.261	0.012	0.003	0.107	0.092	0.536	<0.001	0.001
Untreated vs Diquat	0.001	<0.001	0.063	0.083	0.006	0.506	0.003	<0.001
Glyphosate vs Saflufenacil + Glyph (LL) [Z]	0.134	0.881	0.305	0.047	0.428	0.994	0.446	0.674
Glyphosate vs Diquat (LL) [Z]	0.496	0.028	0.658	0.258	0.956	0.127	<0.001	0.638
Glufosinate vs Saflufenacil + Glyphosate (RR) [Y]	0.125	0.213	0.001	0.218	0.562	0.747	0.322	0.250
Glufosinate Ammonium vs Diquat (RR) [Y]	<0.001	0.004	0.398	0.487	0.036	0.953	0.004	<0.001
Saflufenacil + Glyphosate vs Diquat	<0.001	0.009	0.203	0.838	0.235	0.204	0.042	0.010

[Z] Gravimetric water content of seed at harvest
[Y] Gravimetric water content of above-ground plant material at harvest

Pre-Harvest Treatment Effects on Seed Yield and Quality

Applied at the correct crop stages and according to label recommendations, none of the treatments were expected have any adverse impacts on canola seed yield or quality; however, these factors are important to provide insights into the relative crop stages when treatments were applied and to assess risks associated with the various pre-harvest applications if applied too early or harvest is delayed by unforeseen circumstances. For example, the diquat label specifically recommends harvesting canola within two weeks of application to reduce the risk of shattering losses and past, field-scale trials at Indian Head showed increase shattering and reduced yields with pre-harvest glyphosate (on LL canola) relative to the control when harvest was delayed due to wet weather. The risk of shattering losses has been greatly diminished with new varieties (including those used in this study); however, depending on the product, applications prior to the recommended crop stage could result in MRL issues, reduced seed size, and/or increased green seed. Individual treatment means for seed yield, seed weight (g/1000 seeds), and percent green seed are presented in Tables A-6, A-8, A10, and A12 of the Appendices for Indian Head, Melfort, Melita, and Scott, respectively. In the current study, no shattering was reported for any treatments at any locations despite substantial time and relatively poor weather sometimes occurring between the pre-harvest applications and harvest.

While seed yields varied with environment across location-years and, occasionally, between hybrids, there were no cases where any of the pre-harvest treatments significantly impacted yield.

For seed weight, there again appeared to be substantial variation across environments and frequent hybrid effects; however, differences amongst pre-harvest treatments within individual hybrids were rare and, where they did occur, inconsistent. At Melfort 2018 (Table A-8), the harvested LL seed was slightly smaller with saflufenacil plus glyphosate compared to the control (2.83 g versus 3.10 g/1000 seeds) while, for RR canola, seed size with diquat was reduced relative to the control (3.60 g versus 3.88 g/1000 seeds). In contrast, for RR canola at Scott 2017 (Table A-12), seed size with saflufenacil plus glyphosate was larger than with glufosinate ammonium (3.83 g versus 3.65 g/1000 seeds) and the remaining treatments were intermediate. The exact same trend was detected for RR canola at Scott 2018 with 3.74 g versus 3.57 g/1000 seeds for saflufenacil plus glyphosate and glufosinate canola, respectively, and intermediate values for the remaining treatments.

Percent green seed was significantly affected by the pre-harvest treatments at three of eight location-years with marginally significant variation at one location-year and no effect at the remaining 50% of the sites. At Indian Head 2017 (Table A-6), there were no differences for the earlier maturing LL canola; however, with RR canola the diquat application ahead of the recommended crop stage resulted in a dramatic increase in green seed at the time of harvest (13.2% versus 0.7-2.1%). At Melita in 2017 (Table A-10), a similar response occurred with RR canola; however, it was much less pronounced at 1.9% versus 0.2-0.9% green seed. At Melita 2018, the same effect was observed with RR canola (0.7% with diquat versus 0.2-0.3% green seed for the remaining treatments). For LL canola, percent green seed tended to be higher for saflufenacil compared with glyphosate applied alone or the control (0.7% versus 0.3%). Finally, at Scott 2018, percent green seed tended to be highest with diquat for both hybrids; however, the response was more pronounced with RR canola (3.0% versus 0.3-0.6%).

4. Significant Progress/Accomplishments

Field trials were completed at all four locations (Indian Head, Melfort, Scott, and Melita) in 2017 and 2018. Despite a few challenges and concerns identified in the first year of the project, progress is being made and is going fairly well considering the challenges of managing both genetic differences and variable weather/environmental conditions.

The trial was introduced to approximately 200 guests at the Indian Head Field Day with a broader discussion of straight-combining canola and considerations / past experiences with pre-harvest herbicide / desiccant options to potentially improve this practice. Due to logistic considerations, the field trials could not be shown during the primary IHARF field day in 2018. Additionally, at Indian Head, the project has been shown and discussed during smaller guided tours which IHARF hosted for FCL, Richardson Pioneer, and the Saskatchewan Ministry of Agriculture Ag Awareness Unit (approximately 125 guests in total). On February 7, 2019, Jessica Pratchler presented to approximately 120 attendees and highlighted that this work was in progress and being funded by canola growers through the CARP program.

All available results to date have been statistically analyzed, summarized, and interpreted. Preliminary results will be made publicly available to interested parties online (www.iharf.ca) and will continue to be incorporated into extension activities (i.e. oral presentations, crop tours, annual reports, popular press) where opportunities arise.

Key Findings and Observations to Date

1. With low weed populations, dry late season weather, and early maturity (i.e. LL canola at Indian Head and Melita 2017, Melita 2018) there was little benefit to pre-harvest applications. The risks associated with later harvest are (within reason) arguably much lower with modern shatter tolerant canola hybrids than previous straight-combining research that mostly preceded this trait have suggested. This is arguably more likely to be the case in southern environments where both seeding and harvest tend to be earlier and, in general, the growing seasons are longer. With this in mind, growers planning to straight-combine shatter tolerant canola hybrids who have seeded early, achieved uniform stands, kept things reasonably free of weeds, and have no reason to expect unusual harvest delays should consider not spraying a viable and preferable option. As further testament to the efficacy of modern shatter tolerant hybrids, no shattering whatsoever was reported for any treatments at any locations, despite the occurrence of occasional delays and unfavourable weather between the treatment applications and harvest.
2. Diquat performed consistently well for both herbicide systems with respect to reducing seed and/or whole plant moisture content. With some exceptions (i.e. Scott 2017), diquat result in equal to or greater reductions in whole plant moisture content than any other options, regardless of herbicide system. Averaged across hybrids, diquat reduced seed moisture content at harvest 75% of the time (6/8 site-years) and whole plant moisture 63% of the time (5/8 location-years). Furthermore, there was a tendency (significant at $P \leq 0.1$) for reduced whole plant moisture content at two of the three remaining location-years. Although it must be applied later to prevent yield and quality loss, visual stem dry down ratings and past experience indicate that diquat begins working more quickly than any of the other options evaluated. Waiting for the appropriate application stage is extremely important with this product. This was illustrated at multiple locations where percent green seed was significantly higher with diquat compared the other options, most notably for the RR hybrid at Indian Head 2017. No such effects were observed with any of the other pre-harvest options evaluated.
3. While not registered for this specific purpose, pre-harvest glyphosate reduced seed moisture content in LL canola 50% of the time (4/8 location-years) and reduced whole plant moisture content 75% of time (6/8 location-years). Despite the final reductions in seed and plant moisture frequently observed, glyphosate is initially slow and less likely to improve harvestability in dry falls or when applied at later crop stages. Consistent improvements in harvestability or earlier harvest cannot necessarily be expected when glyphosate is applied alone; however, our results show that such benefits can frequently occur with LL canola provided that the herbicide is given sufficient time to work.
4. Reductions in seed and crop moisture with saflufenacil have been somewhat less consistent and/or smaller than with diquat and, in certain cases with LL canola (i.e. seed moisture at Indian Head 2018, seed and whole plant moisture at Scott both years), it appeared that the glyphosate was having a greater impact on crop dry down than the saflufenacil in the tank mix. Overall, saflufenacil appeared to reduce seed moisture content 25% of the time (2/8 location-years) and whole plant moisture 38% of the time (3/8 location-years). While it appears that diquat is more effective from a strictly crop dry down perspective, a scenario where saflufenacil plus glyphosate tank mixes may be particularly beneficial is in the presence of substantial perennial weed (i.e. Canada thistle) populations for which the producer requires both long-term control and reasonably fast desiccation. Glyphosate alone is notoriously slow to dry down mature perennial weeds and, from a resistance management perspective, utilizing multiple modes of action against the same species is becoming a more frequently recommended practice. Saflufenacil may accelerate dry-down over glyphosate alone for many broadleaf weeds, with specific outcomes likely varying with weed species and growth stage.
5. Glufosinate-ammonium is not a registered pre-harvest option for canola and, to our knowledge, there is no indication that it will become one; however, it was registered for this purpose in the 1990s (i.e. Harvest, 1995 Saskatchewan Crop Protection Guide). The performance of this product was somewhat inconsistent with reductions in seed moisture 38% of the time (3/8 location-years) and whole plant moisture content 25% of the time (50% of the time at $P \leq 0.10$). It is probable that the relatively poor performance observed is due in part to the late application stage that was implemented for this project.

5. Research and Action Plans/Next Steps

Preparations for the final year of field trials are underway. The required seed is in inventory but will be subjected to quality testing (percent germination) prior to being distributed to collaborators. There are no changes to the protocols being considered going into the final year of the study. Upon conclusion of the final year of field trials, options for combining data across locations for statistical analyses will be explored; however, given the specific nature of this trial and results to date, unless they can be grouped in a logical and meaningful manner, individual location-year analyses may be the most appropriate option for this data.

6. Budget impacts in the event major issues or variance between planned and actual is noted:

There were no major issues or deviation from the originally proposed activities or anticipated impacts on budget requirements.

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6. Appendices

Table A-1. Selected agronomic information for canola desiccation trials at four Western Canadian locations in 2017.

Factor / Operation	Location (2017)			
	Indian Head, SK	**Melfort, SK**	**Scott, SK**	**Melita, MB**
Previous Crop	Wheat	Wheat	Wheat	Rye
Variety	L233P (LL) / 45M35 (RR)	L233P (LL) / 45M35 (RR)	L233P (LL) / 45M35 (RR)	L233P (LL) / 45M35 (RR)
Pre-emergent Herbicide	890 g glyphosate/ha (May-10) 24 kg Edge/ha (May-14)	none	980 g glyphosate/ha + 280 g bromoxynil/ha (May-6)	890 g glyphosate/ha + 185 ml Centurion/ha (Apr-20)
Seeding Date	May-17	May-19	May-15	May-12
Seeding Rate	120 seeds/m^2	120 seeds/m^2	120 seeds/m^2	120 seeds/m^2
Row spacing	30 cm	30 cm	25 cm	24 cm
Fertility (kg N-P_2O_5-K_2O-S/ha)	140-35-18-18	134-56-0-28	81-22-0-25	126-35-25-10
In-crop Herbicide	561 ml Lontrel 360/ha (Jun-10) 30 g Muster/ha + 741 ml Assure 2/ha (Jun-18)	none	2 l Liberty 150 SN/ha (Jun-7) + 1.5 l Liberty/ha + 185 ml Centrurion/ha (Jun-20) 300 g glyphosate/ha (Jun-7) + 445 g glyphosate/ha (Jun-21)	20 g Muster/ha + 741 ml Assure 2/ha (Jun-7)
Fungicide	350 g Lance WDG/ha + 395 ml Headline E.C. (Jul-12)	865 ml Acapela/ha (Jul-18)	445 ml Priaxor/ha (Jul-8)	none
Insecticide	none	none	none	none
Pre-harvest Applications	Trt 2, 3, 4, 8, 9 (Aug-23) Trt 5, 7, 10 (Aug-28)	Trt 2, 3, 4, 8, 9 (Aug-29) Trt 5, 7, 10 (Sep-5)	Trt 2, 3, 4 (Aug-22) Trt 5, 7, 8, 9 (Aug-25) Trt 10 (Aug-28)	Trt 2, 3, 4, 8, 9 (Aug-16) Trt 5, 7, 10 (Aug-22)
Harvest date	Sep-8 (all treatments)	Sep-12 (all treatments	Sep-8 (LL) Sep-11 (RR)	Sep-1 (all treatments)

Table A-2. Selected agronomic information for canola desiccation trials at four Western Canadian locations in 2018.				
Factor / Operation	**Location (2018)**			
	Indian Head, SK	**Melfort, SK**	**Scott, SK**	**Melita, MB**
Previous Crop	Wheat	Wheat	Wheat	Soybean
Variety	L255PC (LL) / 45M35 (RR)	L255PC (LL) / 45M35 (RR)	L255PC (LL) / 45M35 (RR)	L255PC (LL) / 45M35 (RR)
Pre-emergent Herbicide	890 g glyphosate/ha (May-14) 26 kg Edge/ha (May-13)	667 g glyphosate/ha (May-18)	980 g glyphosate/ha + 62 ml Aim/ha (May-15)	none
Seeding Date	May-19	May-17	May-18	May-9
Seeding Rate	125 seeds/m^2	125 seeds/m^2	120 seeds/m^2	120 seeds/m^2
Row spacing	30 cm	30 cm	25 cm	24 cm
Fertility (kg N-P_2O_5-K_2O-S/ha)	135-35-18-18	196-61-0-17	95-23-0-22	124-39-27-10
In-crop Herbicide	830 ml Lontrel 360/ha + 30 g Muster/ha + 749 ml Assure 2/ha (Jun-13)	3.34 l Liberty 150 SN/ha + 196 ml Centurion/ha (Jun-7) 681 g glyphosate/ha (Jun-7) 494 ml Asssure 2/ha (Jun 25)	4.0 l Liberty 150 SN/ha + 190 ml Centurion/ha (Jun-18) 894 g glyphosate/ha (Jun-18)	494 ml Assure 2/ha (Jun-6)
Fungicide	350 g Lance WDG/ha + 395 ml Headline E.C. (Jul-6 and Jul-9)	1.2 l Acapela/ha (Jul-9)	445 ml Priaxor/ha (Jul-12)	none
Insecticide	none	none	148 ml Decis/ha (Aug 13)	158 ml Pounce/ac (Jun-5)
Pre-harvest Applications	Trt 2, 3, 4 (Aug-18) Trt 8, 9 (Aug-15) Trt 7, 10 (Aug-20) Trt 5 (Aug-22)	Trt 2, 3, 4, 8, 9 (Aug-24) Trt 5, 7, 10 (Sep-5)	Trt 2, 3, 4, 8, 9 (Aug-20) Trt 5, 7, 10 (Aug-31)	Trt 2, 3, 4, 8, 9 (Aug-3) Trt 5, 7, 10 (Aug-8)
Harvest date	Aug-29 (all treatments)	Oct-3 (all treatments	Sep-26 (all treatments)	Aug-23 (all treatments)

Table A-3. Mean monthly temperatures for the 2017and 2018 growing seasons relative to the long-term averages (1981-2010) at four locations in western Canada.

		Mean Monthly Temperature					
Location	**Year**	**May**	**June**	**July**	**August**	**September**	**Average**
		ºC					
Indian Head	2017	11.6	15.5	18.4	16.7	11.3	14.7
	2018	13.9	16.5	17.5	17.6	7.6 [Z]	14.6
	LT	10.8	15.8	18.2	17.4	11.5	14.7
Melfort	2017	10.8	15.2	18.7	17.2	12.5	14.9
	2018	13.9	16.8	17.5	15.9	6.9	14.2
	LT	10.7	15.9	17.5	16.8	10.8	14.3
Scott	2017	11.5	15.1	18.3	16.6	11.5	14.6
	2018	13.6	16.6	17.5	15.9	6.4	14.0
	LT	10.8	15.3	17.1	16.5	10.4	14.0
Melita	2017	12.2	16.7	20.1	17.4	13.8 [Z]	16.0
	2018	15.1	19.1	19.4	18.9	10.0 [Z]	16.5
	LT	10.7	16.1	19.3	18.4	12.8	15.5

[Z] All plots were harvested in August therefore September weather is irrelevant to results/harvest conditions

Table A-4. Mean monthly precipitation amounts for the 2017 and 2018 growing seasons relative to the long-term averages (1981-2010) at 4 locations in western Canada.

		Total Monthly Precipitation					
Location	**Year**	**May**	**June**	**July**	**August**	**September**	**Average**
		mm					
Indian Head	2017	10.4	65.6	15.4	25.2	12.4	129
	2018	23.7	90.0	30.4	3.9	39.6 [Z]	188
	LT	51.8	77.4	63.8	51.2	35.3	280
Melfort	2017	46.4	44.1	33.3	3.1	13.2	140
	2018	38.5	46.6	69.5	43.2	42.0	240
	LT	42.9	54.3	76.7	52.4	38.7	265
Scott	2017	69.0	34.3	22.4	53.0	18.9	198
	2018	29.6	58	85.8	20.2	57.3	251
	LT	36.3	61.8	72.1	45.7	36.0	252
Melita	2017	6.1	64.2	44.8	39.5	52.0 [Z]	207
	2018	11.4	100.8	54.1	23.5	55.4 [Z]	245
	LT	61.9	76.4	56.9	43.2	32.0	270

[Z] All plots were harvested in August therefore September weather is irrelevant to results/harvest conditions

Additional Results Tables – Indian Head

Table A-5. Treatment means and tests of fixed effects for stem, seed, and whole plant dry-down at Indian Head, Saskatchewan. The treatments were pre-harvest / desiccation options for glufosinate ammonium (LL) and glyphosate (RR) tolerant canola. Means within a column followed by the same letter do not significantly differ (Fisher's protected LSD test; *P* ≤ 0.05).

	Indian Head - 2017			Indian Head – 2018		
Treatment	**Visual Dry-down** [Z]	**Seed Moisture** [Y]	**Plant Moisture** [X]	**Visual Dry-down** [Z]	**Seed Moisture** [Y]	**Plant Moisture** [X]
	%			%		
1) LL – Control	41.3 cd	7.1 cd	30.8 c	29.4 e	17.1 a	37.0 a
2) LL – Glyphosate	65.0 a	7.2 bc	26.8 c	35.6 de	15.3 b	33.5 b
3) LL – Saflufenacil	45.6 c	6.7 cde	30.3 c	37.5 d	16.8 ab	33.3 b
4) LL – Safl + Glyph	61.9 ab	6.5 cde	30.0 c	38.8 d	15.5 ab	33.7 b
5) LL – Diquat	66.9 a	5.8 de	28.2 c	50.6 b	13.0 c	30.0 c
6) RR – Control	36.9 d	11.9 a	38.6 ab	30.6 e	11.1 d	29.5 c
7) RR – Gluf. Amm.	43.8 cd	8.5 b	39.5 ab	46.9 bc	10.9 d	29.0 c
8) RR – Saflufenacil	48.1 c	11.4 a	38.5 b	40.0 d	10.3 d	27.3 c
9) RR – Safl + Glyph	44.4 c	11.1 a	42.8 a	40.6 cd	11.0 d	27.1 cd
10) RR – Diquat	57.5 b	5.3 e	30.7 c	64.4 a	7.2 e	24.8 d
S.E.M.	3.01	0.47	1.47	2.46	1.00	1.27
LSD [X]	7.20	1.35	4.24	6.55	1.70	3.05
Pr > *F* (p-value)	**< 0.001**	**< 0.001**	**< 0.001**	**<0.001**	**<0.001**	**<0.001**

[Z] Final ratings completed just prior to harvest [Y] Gravimetric water content of seed at harvest
[X] Gravimetric water content of above-ground plant material at harvest

Table A-6. Treatment means and tests of fixed effects for seed yield, thousand seed weight, and percent green seed at Indian Head, Saskatchewan. The treatments were pre-harvest / desiccation options for glufosinate ammonium (LL) and glyphosate (RR) tolerant canola. Means within a column followed by the same letter do not significantly differ (Fisher's protected LSD test; *P* ≤ 0.05).

	Indian Head - 2017			Indian Head – 2018		
Treatment	**Seed Yield**	**Seed Weight**	**Green Seed**	**Seed Yield**	**Seed Weight**	**Green Seed**
	----- kg/ha -----	g/1000 seeds	------- % -------	----- kg/ha -----	g/1000 seeds	------- % -------
1) LL – Control	3226 a	3.28 bcd	0.1 b	2498 d	2.74 b	0.3 a
2) LL – Glyphosate	3222 a	3.19 d	0.1 b	2564 cd	2.69 b	0.3 a
3) LL – Saflufenacil	3275 a	3.26 bcd	0.0 b	2532 d	2.70 b	0.2 a
4) LL – Safl + Glyph	3217 a	3.24 bcd	0.1 b	2657 bcd	2.74 b	0.2 a
5) LL – Diquat	3204 a	3.22 cd	0.5 b	2618 bcd	2.71 b	0.2 a
6) RR – Control	3098 a	3.36 ab	1.7 b	2707 abc	2.94 a	0.2 a
7) RR – Gluf. Amm.	3306 a	3.33 abc	0.7 b	2787 ab	3.04 a	0.2 a
8) RR – Saflufenacil	3196 a	3.35 ab	1.8 b	2728 abc	3.00 a	0.1 a
9) RR – Safl + Glyph	3225 a	3.42 a	2.1 b	2668 a-d	3.02 a	0.1 a
10) RR – Diquat	3263 a	3.32 a-d	13.2	2835 a	3.03 a	0.1 a
S.E.M.	72.0	0.048	0.97	85.5	0.041	0.10
LSD [X]	ns	0.134	2.78	172.4	0.105	ns
Pr > *F* (p-value)	0.691	0.038	< 0.001	0.007	<0.001	0.586

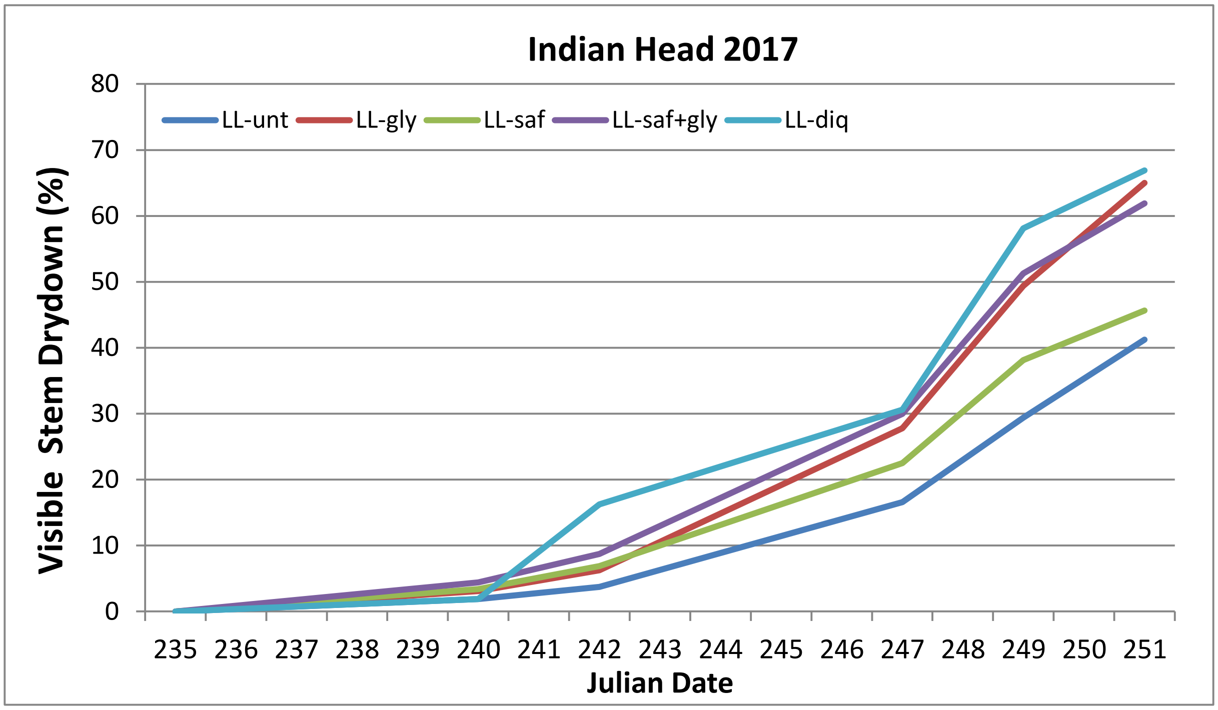

Figure A-1. Rate of visible stem down for various pre-harvest treatments in glufosinate ammonium tolerant canola (Indian Head 2017).

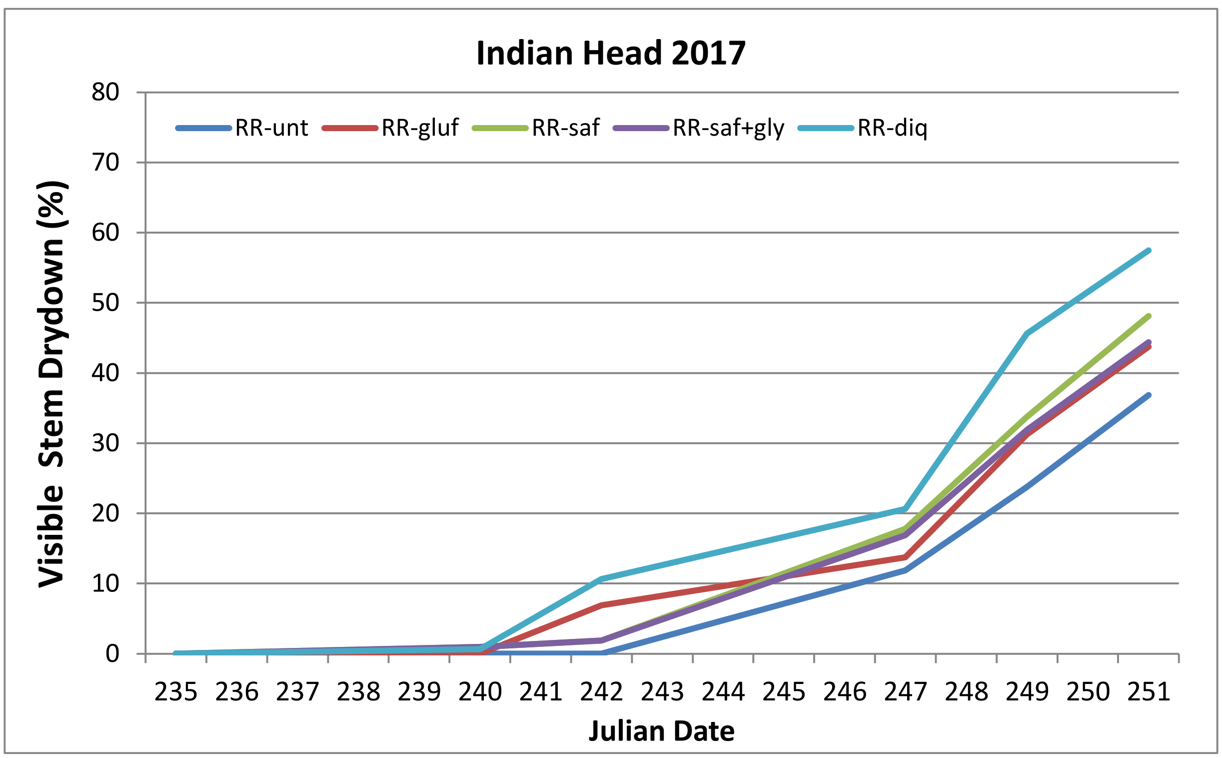

Figure A-2. Rate of visible stem down for various pre-harvest treatments in glyphosate tolerant canola (Indian Head 2017).

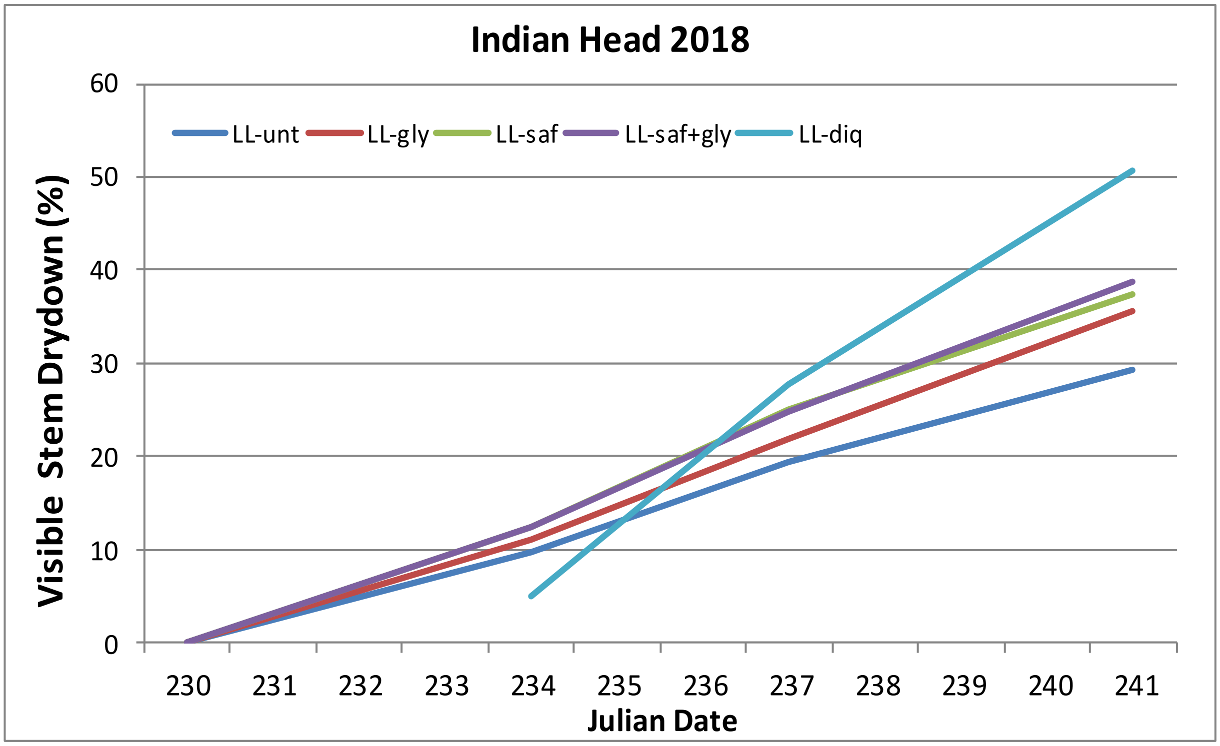

Figure A-3. Rate of visible stem down for various pre-harvest treatments in glufosinate ammonium tolerant canola (Indian Head 2018).

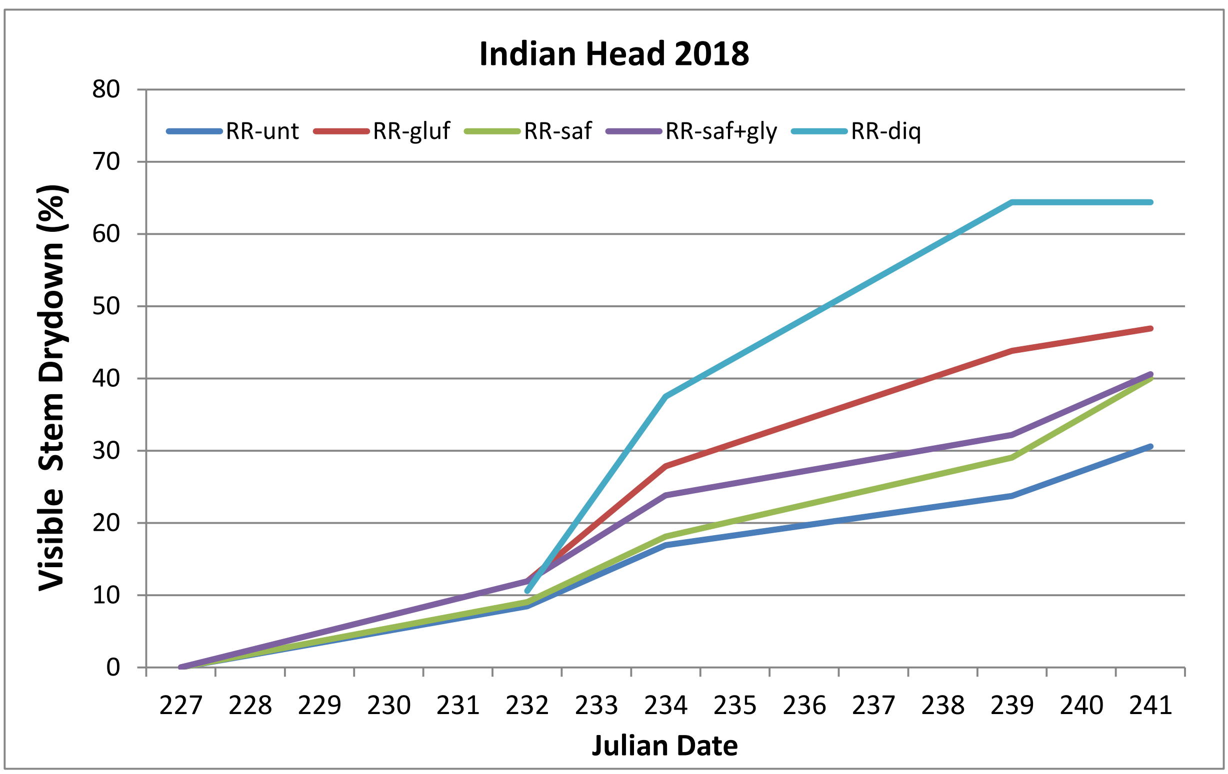

Figure A-4. Rate of visible stem down for various pre-harvest treatments in glyphosate tolerant canola (Indian Head 2018).

Additional Results Tables – Melfort

Table A-7. Treatment means and tests of fixed effects for stem, seed, and whole plant dry-down at Melfort, Saskatchewan. The treatments were pre-harvest / desiccation options for glufosinate ammonium (LL) and glyphosate (RR) tolerant canola. Means within a column followed by the same letter do not significantly differ (Fisher's protected LSD test; *P* ≤ 0.05).

	Melfort – 2017			Melfort – 2018		
Treatment	**Visual Dry-down** [Z]	**Seed Moisture** [Y]	**Plant Moisture** [X]	**Visual Dry-down** [Z]	**Seed Moisture** [Y]	**Plant Moisture** [X]
	------------------------------ % ------------------------------			------------------------------ % ------------------------------		
1) LL – Control	–	3.5 bc	30.7 a	95.0 a	10.8 a	16.9 a
2) LL – Glyphosate	–	0.5 d	25.9 b	98.2 a	10.1 a	9.1 a
3) LL – Saflufenacil	–	1.3 cd	24.7 b	95.4 a	11.0 a	15.2 a
4) LL – Safl + Glyph	–	1.0 cd	23.7 b	99.8 a	10.3 a	14.5 a
5) LL – Diquat	–	1.3 cd	26.8 ab	95.0 a	10.8 a	12.1 a
6) RR – Control	–	6.8 a	27.9 ab	91.9 a	10.8 a	14.8 a
7) RR – Gluf. Amm.	–	–	–	92.2 a	10.6 a	14.5 a
8) RR – Saflufenacil	–	4.5 ab	26.5 bc	93.5 a	10.8 a	14.5 a
9) RR – Safl + Glyph	–	2.8 bcd	25.5 b	93.5 a	10.8 a	11.3 a
10) RR – Diquat	–	2.8 bcd	26.2 b	98.2 a	10.7 a	13.0 a
S.E.M.	–	1.16	1.94	2.04	0.32	1.80
LSD [X]	–	2.80	4.22	ns	ns	ns
Pr > *F* (p-value)	–	**< 0.001**	**0.003**	0.137	0.692	0.220

[Z] Final ratings completed just prior to harvest [Y] Gravimetric water content of seed at harvest
[X] Gravimetric water content of above-ground plant material at harvest

Table A-8. Treatment means and tests of fixed effects for seed yield, thousand seed weight, and percent green seed at Melfort, Saskatchewan. The treatments were pre-harvest / desiccation options for glufosinate ammonium (LL) and glyphosate (RR) tolerant canola. Means within a column followed by the same letter do not significantly differ (Fisher's protected LSD test; *P* ≤ 0.05).

	Melfort – 2017			Melfort – 2018		
Treatment	**Seed Yield**	**Seed Weight**	**Green Seed**	**Seed Yield**	**Seed Weight**	**Green Seed**
	----- kg/ha -----	g/1000 seeds	------- % -------	----- kg/ha -----	g/1000 seeds	------- % -------
1) LL – Control	3596 a	3.55 a	0.4 cd	3101 a	3.10 c	0.1 a
2) LL – Glyphosate	3715 a	3.55 a	0.4 d	2840 a	3.07 cd	0.0 a
3) LL – Saflufenacil	3849 a	3.50 a	0.3 d	3083 a	3.05 cd	0.1 a
4) LL – Safl + Glyph	3805 a	3.61 a	0.4 cd	2768 a	2.83 d	0.1 a
5) LL – Diquat	4059 a	3.56 a	0.4 cd	3027 a	3.05 cd	0.2 a
6) RR – Control	3517 a	3.66 a	1.1 a-c	2644 a	3.88 a	0.3 a
7) RR – Gluf. Amm.	–	–	–	2676 a	3.83 ab	0.3 a
8) RR – Saflufenacil	3673 a	3.66 a	0.7 bcd	2708 a	3.70 ab	0.2 a
9) RR – Safl + Glyph	3705 a	3.67 a	0.8 bcd	2610 a	3.75 ab	0.1 a
10) RR – Diquat	4233 a	3.69 a	1.5 a	2541 a	3.60 b	0.4 a
S.E.M.	271.1	0.051	0.23	167.3	0.091	0.10
LSD [X]	ns	ns	0.66	ns	0.267	ns
Pr > *F* (p-value)	0.207	0.159	**0.003**	0.127	<0.001	0.237

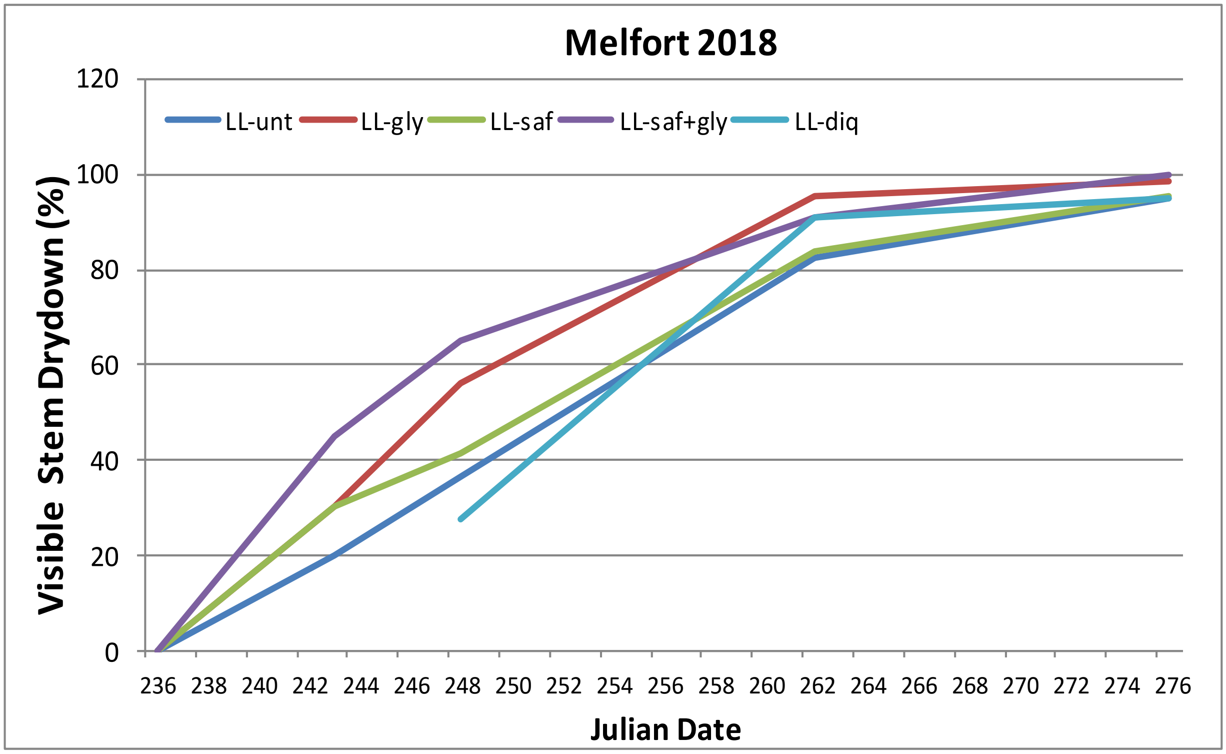

Figure A-5. Rate of visible stem down for various pre-harvest treatments in glufosinate ammonium tolerant canola (Melfort 2018).

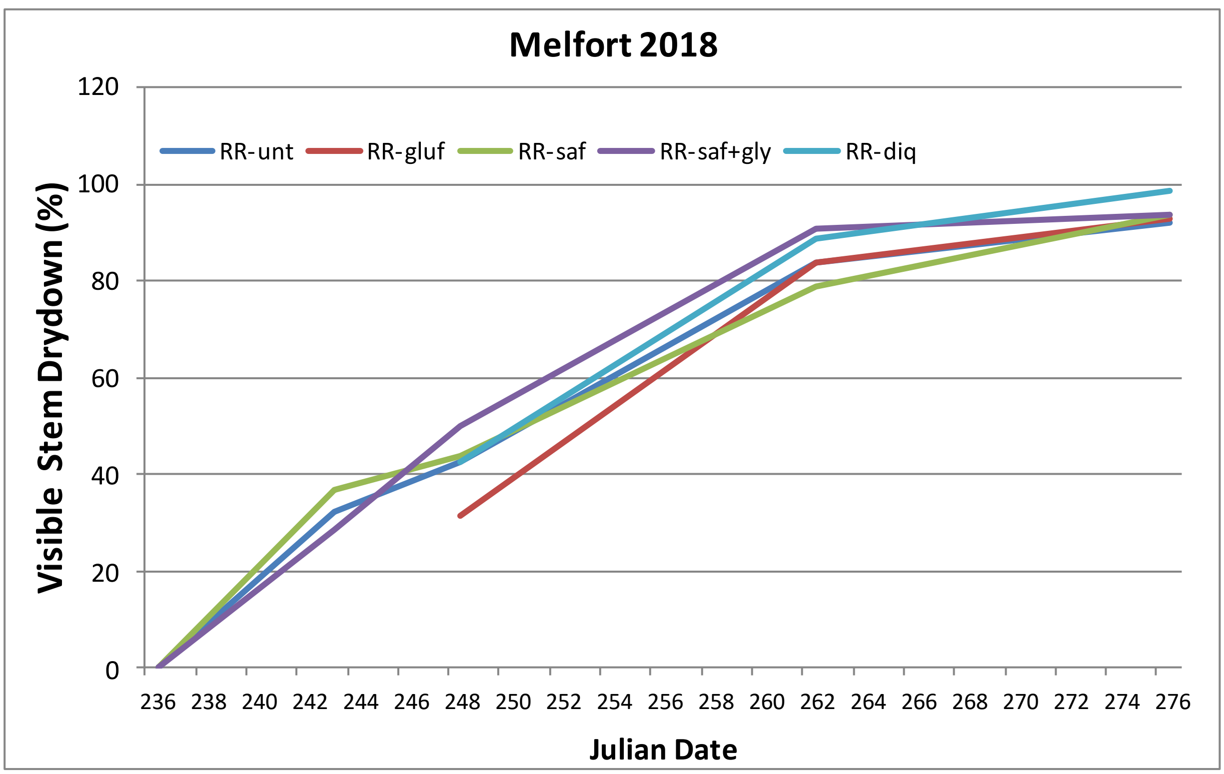

Figure A-6. Rate of visible stem down for various pre-harvest treatments in glyphosate tolerant canola (Melfort 2018).

Additional Results Tables – Melita

Table A-9. Treatment means and tests of fixed effects for stem, seed, and whole plant dry-down at Melita, Manitoba. The treatments were pre-harvest / desiccation options for glufosinate ammonium (LL) and glyphosate (RR) tolerant canola. Means within a column followed by the same letter do not significantly differ (Fisher's protected LSD test; *P* ≤ 0.05).

	Melita – 2017			Melita – 2018		
Treatment	**Visual Dry-down** [Z]	**Seed Moisture** [Y]	**Plant Moisture** [X]	**Visual Dry-down** [Z]	**Seed Moisture** [Y]	**Plant Moisture** [X]
	------------------------------- % -------------------------------			------------------------------- % -------------------------------		
1) LL – Control	71.3 cd	8.7 abc	30.4 a-d	100	5.0 a	12.2 a
2) LL – Glyphosate	88.8 ab	8.1 bcd	21.6 d	100	4.9 a	14.5 a
3) LL – Saflufenacil	71.3 cd	8.2 bcd	31.2 ab	100	5.0 a	16.2 a
4) LL – Safl + Glyph	83.8 b	8.5 a-d	25.1 bcd	100	5.0 a	14.5 a
5) LL – Diquat	91.3 ab	8.1 bcd	21.8 cd	100	4.8 a	9.2 a
6) RR – Control	67.5 d	9.5 a	36.1 a	100	5.0 a	8.5 a
7) RR – Gluf. Amm.	90.0 ab	7.8 cd	28.2 a-d	100	5.1 a	8.1 a
8) RR – Saflufenacil	82.5 bc	9.1 ab	33.9 ab	100	4.9 a	6.2 a
9) RR – Safl + Glyph	86.3 ab	8.7 abc	30.7 abc	100	4.8 a	9.2 a
10) RR – Diquat	97.5 a	7.5 d	26.5 bcd	100	4.9 a	8.3 a
S.E.M.	5.23	0.43	3.06	–	0.08	2.59
LSD [X]	12.34	1.13	8.89	–	ns	ns
Pr > *F* (p-value)	<0.001	0.033	0.032	–	0.264	0.079

[Z] Final ratings completed just prior to harvest [Y] Gravimetric water content of seed at harvest
[X] Gravimetric water content of above-ground plant material at harvest

Table A-10. Treatment means and tests of fixed effects for seed yield, thousand seed weight, and percent green seed at Melita, Manitoba. The treatments were pre-harvest / desiccation options for glufosinate ammonium (LL) and glyphosate (RR) tolerant canola. Means within a column followed by the same letter do not significantly differ (Fisher's protected LSD test; *P* ≤ 0.05).

	Melita – 2017			Melita – 2018		
Treatment	**Seed Yield**	**Seed Weight**	**Green Seed**	**Seed Yield**	**Seed Weight**	**Green Seed**
	----- kg/ha -----	g/1000 seeds	------- % -------	----- kg/ha -----	g/1000 seeds	------- % -------
1) LL – Control	3584 a	3.28 a	0.3 bc	2219 a	2.25 b	0.3 bc
2) LL – Glyphosate	3496 a	3.21 a	0.1 c	2123 a	2.27 b	0.3 c
3) LL – Saflufenacil	3502 a	3.20 a	0.1 c	2088 a	2.25 b	0.7 ab
4) LL – Safl + Glyph	3689 a	3.18 a	0.4 bc	2171 a	2.28 b	0.4 abc
5) LL – Diquat	3648 a	3.21 a	0.1 c	2025 a	2.31 b	0.5 abc
6) RR – Control	3613 a	3.24 a	0.9 b	2145 a	2.57 a	0.2 c
7) RR – Gluf. Amm.	3524 a	3.21 a	0.7 bc	2278 a	2.59 a	0.2 c
8) RR – Saflufenacil	3436 a	3.27 a	0.5 bc	2248 a	2.57 a	0.3 c
9) RR – Safl + Glyph	3304 a	3.27 a	0.2 bc	2237 a	2.58 a	0.2 c
10) RR – Diquat	3577 a	3.29 a	1.9 a	2127 a	2.52 a	0.7 a
S.E.M.	122.4	0.073	0.24	77.2	0.037	0.13
LSD [X]	ns	ns	0.71	ns	0.091	0.38
Pr > *F* (p-value)	0.070	0.864	< 0.001	0.422	<0.001	0.054

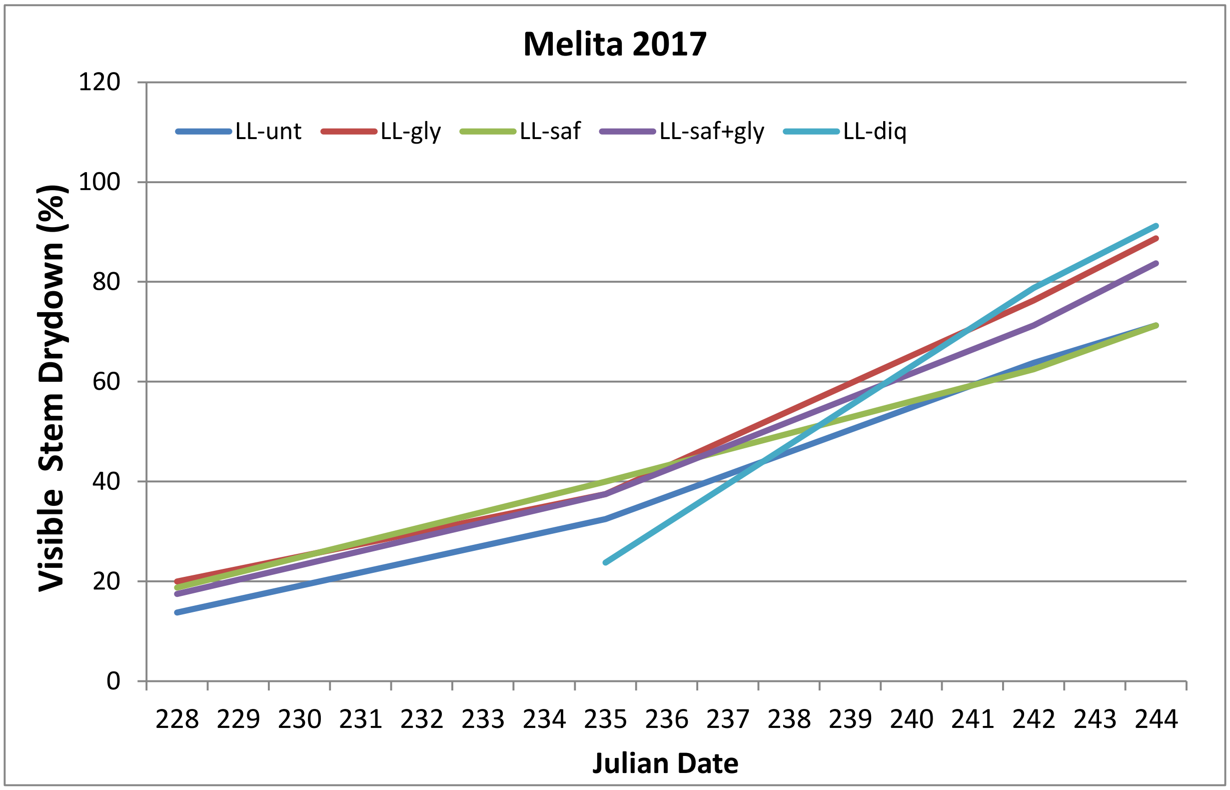

Figure A-7. Rate of visible stem down for various pre-harvest treatments in glufosinate ammonium tolerant canola (Melita 2017).

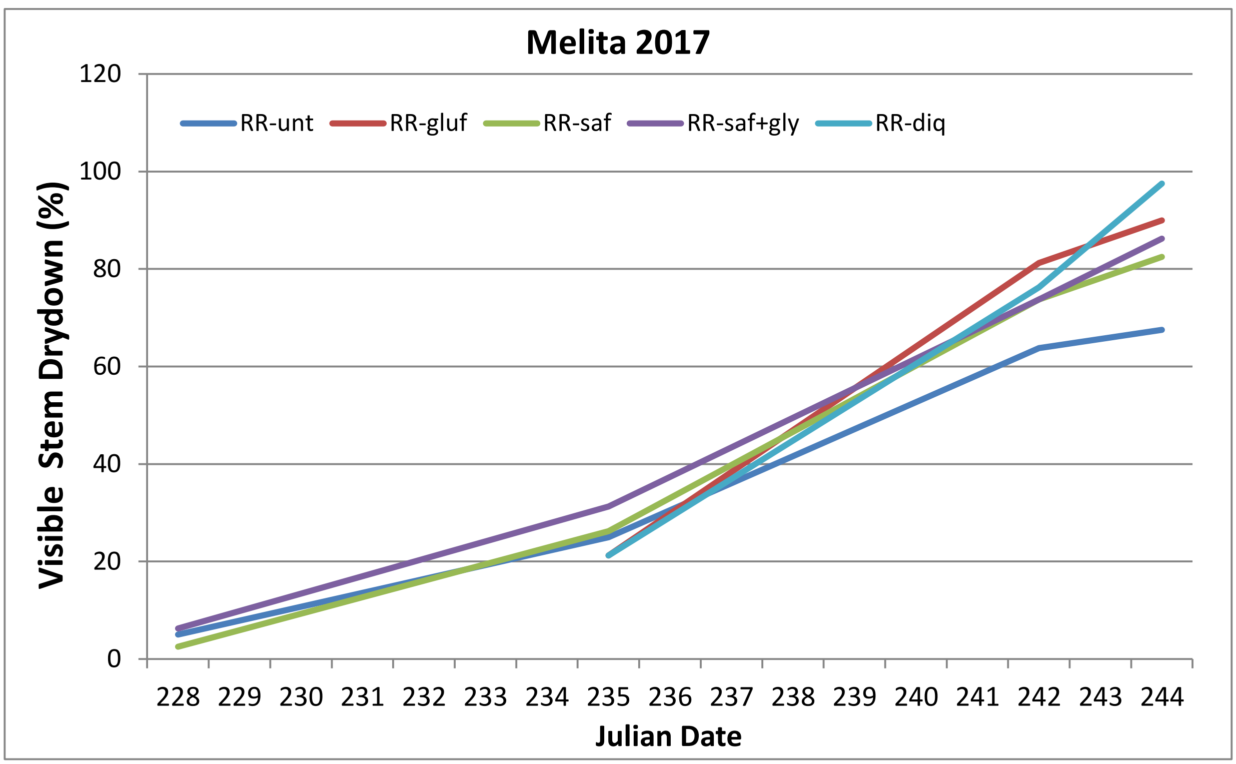

Figure A-8. Rate of visible stem down for various pre-harvest treatments in glyphosate tolerant canola (Melita 2017).

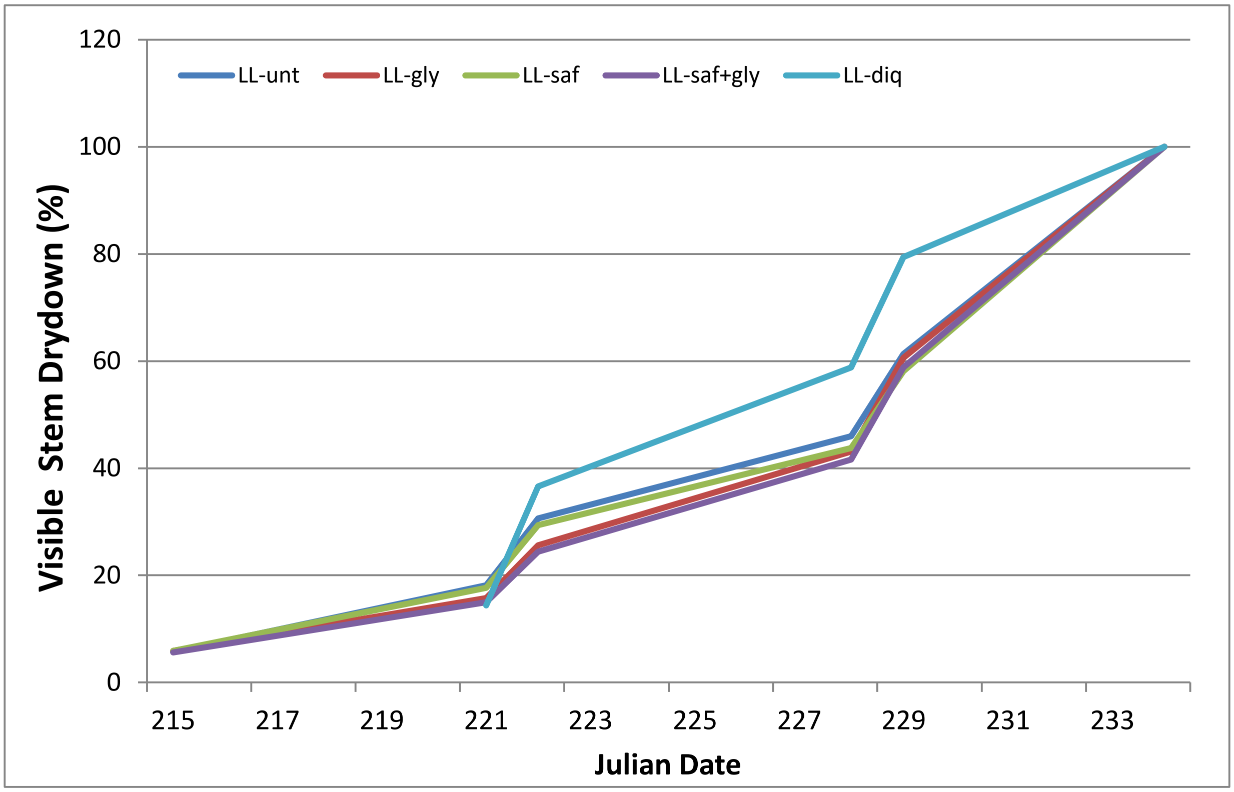

Figure A-9. Rate of visible stem down for various pre-harvest treatments in glufosinate ammonium tolerant canola (Melita 2018).

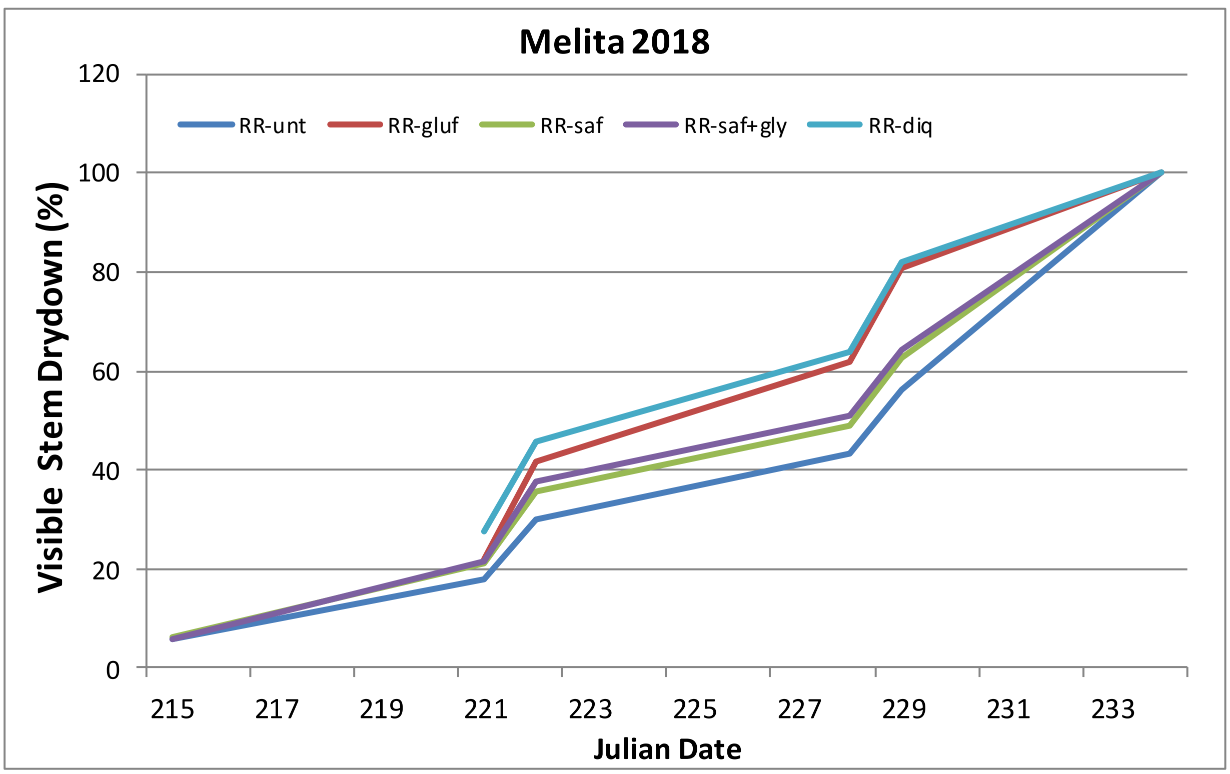

Figure A-10. Rate of visible stem down for various pre-harvest treatments in glyphosate tolerant canola (Melita 2018).

Additional Results Tables – Scott

Table A-11. Treatment means and tests of fixed effects for stem, seed, and whole plant dry-down at Scott, Saskatchewan. The treatments were pre-harvest / desiccation options for glufosinate ammonium (LL) and glyphosate (RR) tolerant canola. Means within a column followed by the same letter do not significantly differ (Fisher's protected LSD test; *P* ≤ 0.05).

	Scott – 2017			Scott – 2018		
Treatment	**Visual Dry-down** Z	**Seed Moisture** Y	**Plant Moisture** X	**Visual Dry-down** Z	**Seed Moisture** Y	**Plant Moisture** X
	%			%		
1) LL – Control	70.0 f	3.6 bc	28.5 ab	84.5 ef	12.2 a	26.9 ab
2) LL – Glyphosate	96.5 a	2.7 c	11.9 f	90.0 bcd	11.2 cde	17.9 c
3) LL – Saflufenacil	86.3 e	3.5 bc	29.5 a	88.5 cde	12.1 ab	24.6 b
4) LL – Safl + Glyph	94.5 abc	2.9 bc	13.7 f	98.5 a	10.8 def	17.0 c
5) LL – Diquat	90.3 d	2.8 c	25.2 a-d	91.5 bc	10.7 ef	18.8 c
6) RR – Control	71.3 f	5.5 a	27.6 abc	79.5 f	12.0 ab	30.1 a
7) RR – Gluf. Amm.	92.3 bcd	3.7 b	21.9 de	86.0 de	11.6 bc	26.3 ab
8) RR – Saflufenacil	91.3 cd	5.2 a	22.9 cde	91.5 bc	11.3 cd	25.4 b
9) RR – Safl + Glyph	93.3 a-d	5.3 a	24.3 b-e	89.8 bcd	12.1 ab	28.7 ab
10) RR – Diquat	96.0 ab	2.9 bc	20.0 e	94.5 ab	10.3 f	19.1 c
S.E.M.	1.94	0.33	1.92	1.78	0.25	1.41
LSD X	3.95	0.92	4.88	5.18	0.59	4.10
Pr > *F* (p-value)	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**	**<0.001**	**<0.001**

Z Final ratings completed just prior to harvest Y Gravimetric water content of seed at harvest
X Gravimetric water content of above-ground plant material at harvest

Table A-12. Treatment means and tests of fixed effects for seed yield, thousand seed weight, and percent green seed at Scott, Saskatchewan. The treatments were pre-harvest / desiccation options for glufosinate ammonium (LL) and glyphosate (RR) tolerant canola. Means within a column followed by the same letter do not significantly differ (Fisher's protected LSD test; *P* ≤ 0.05).

	Scott – 2017			Scott – 2018		
Treatment	**Seed Yield**	**Seed Weight**	**Green Seed**	**Seed Yield**	**Seed Weight**	**Green Seed**
	kg/ha	g/1000 seeds	%	kg/ha	g/1000 seeds	%
1) LL – Control	3450 a	3.40 c	0.3 a	3304 a	3.06 c	0.2 bc
2) LL – Glyphosate	3440 a	3.40 c	0.4 a	3248 a	2.99 c	0.2 bc
3) LL – Saflufenacil	3482 a	3.37 c	0.3 a	3180 ab	3.00 c	0.3 bc
4) LL – Safl + Glyph	3385 a	3.40 c	0.3 a	3266 a	2.97 c	0.2 c
5) LL – Diquat	3563 a	3.39 c	0.5 a	3182 abc	2.99 c	0.7 b
6) RR – Control	3712 a	3.77 ab	0.2 a	2994 d	3.64 ab	0.5 bc
7) RR – Gluf. Amm.	3743 a	3.65 b	0.2 a	3079 bcd	3.57 b	0.4 bc
8) RR – Saflufenacil	3992 a	3.77 ab	0.5 a	2953 d	3.64 ab	0.3 bc
9) RR – Safl + Glyph	3908 a	3.83 a	0.3 a	2998 d	3.74 a	0.6 bc
10) RR – Diquat	3487 a	3.78 ab	1.9 a	3009 cd	3.62 ab	3.0 a
S.E.M.	234.5	0.079	0.40	72.7	0.055	0.18
LSD X	530.8	0.166	1.10	170.2	0.13	0.52
Pr > *F* (p-value)	0.267	**< 0.001**	0.108	<0.001	<0.001	<0.001

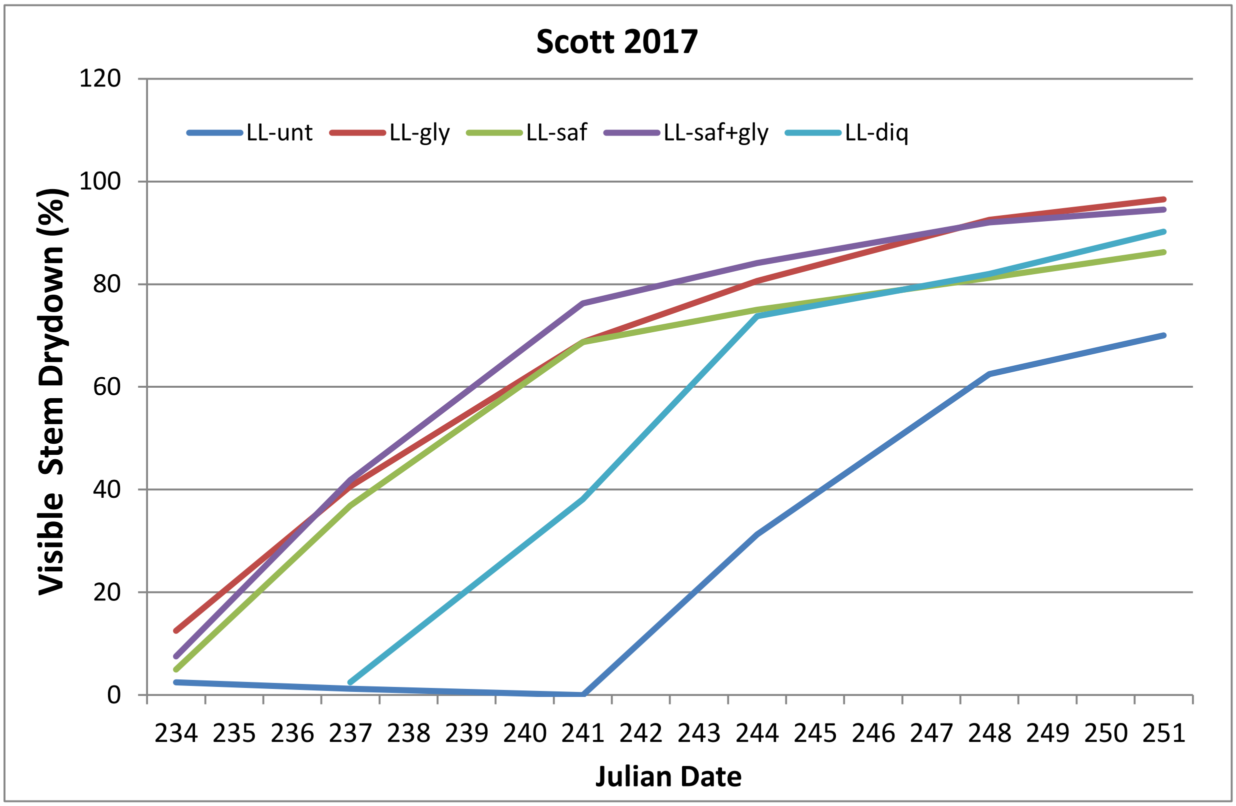

Figure A-11. Rate of visible stem down for various pre-harvest treatments in glufosinate ammonium tolerant canola (Scott 2017).

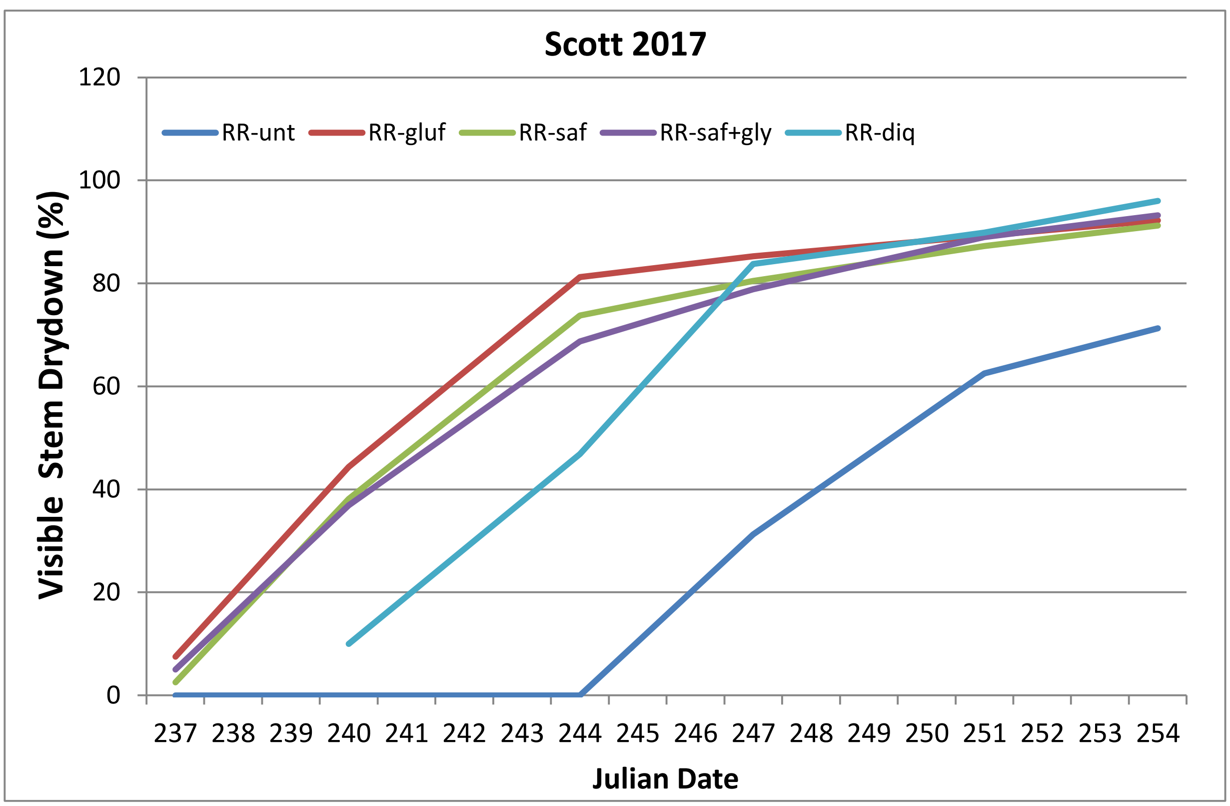

Figure A-12. Rate of visible stem down for various pre-harvest treatments in glyphosate tolerant canola (Scott 2017).

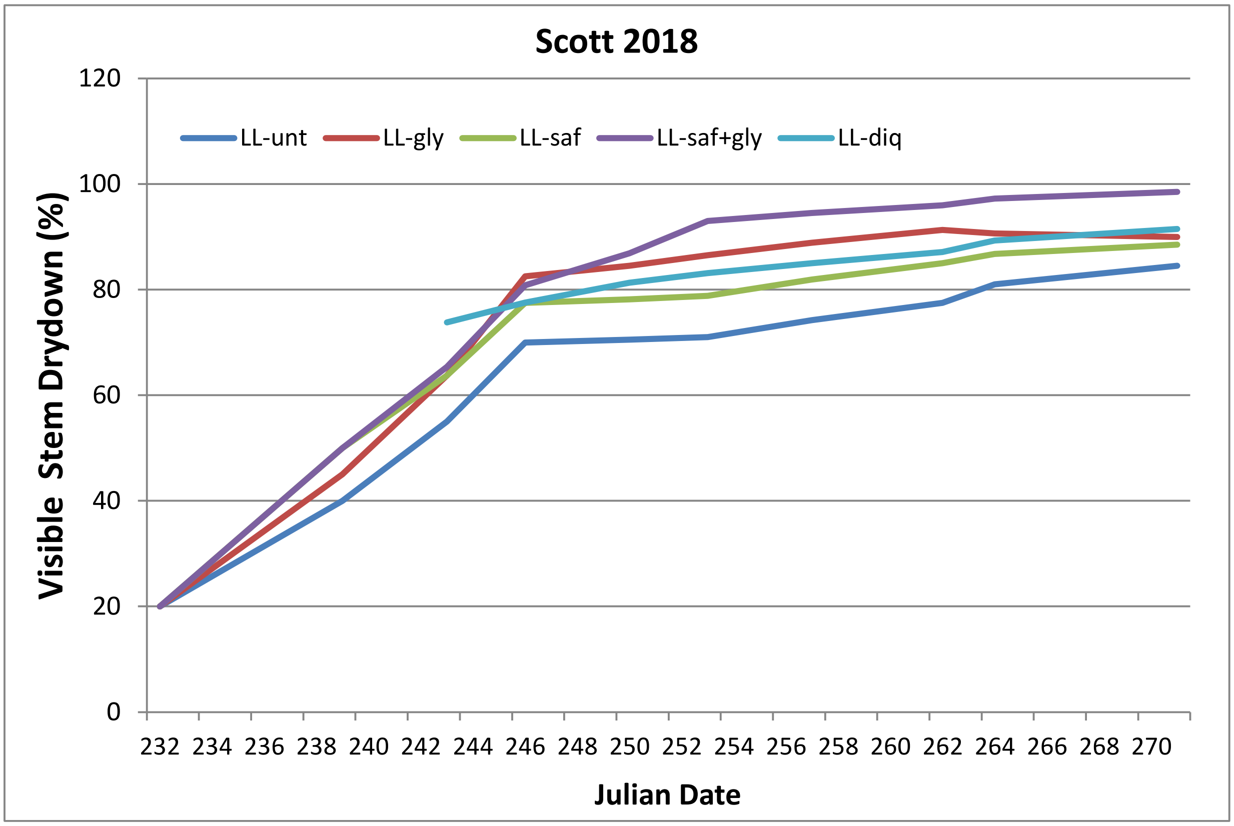

Figure A-13. Rate of visible stem down for various pre-harvest treatments in glufosinate ammonium tolerant canola (Scott 2018).

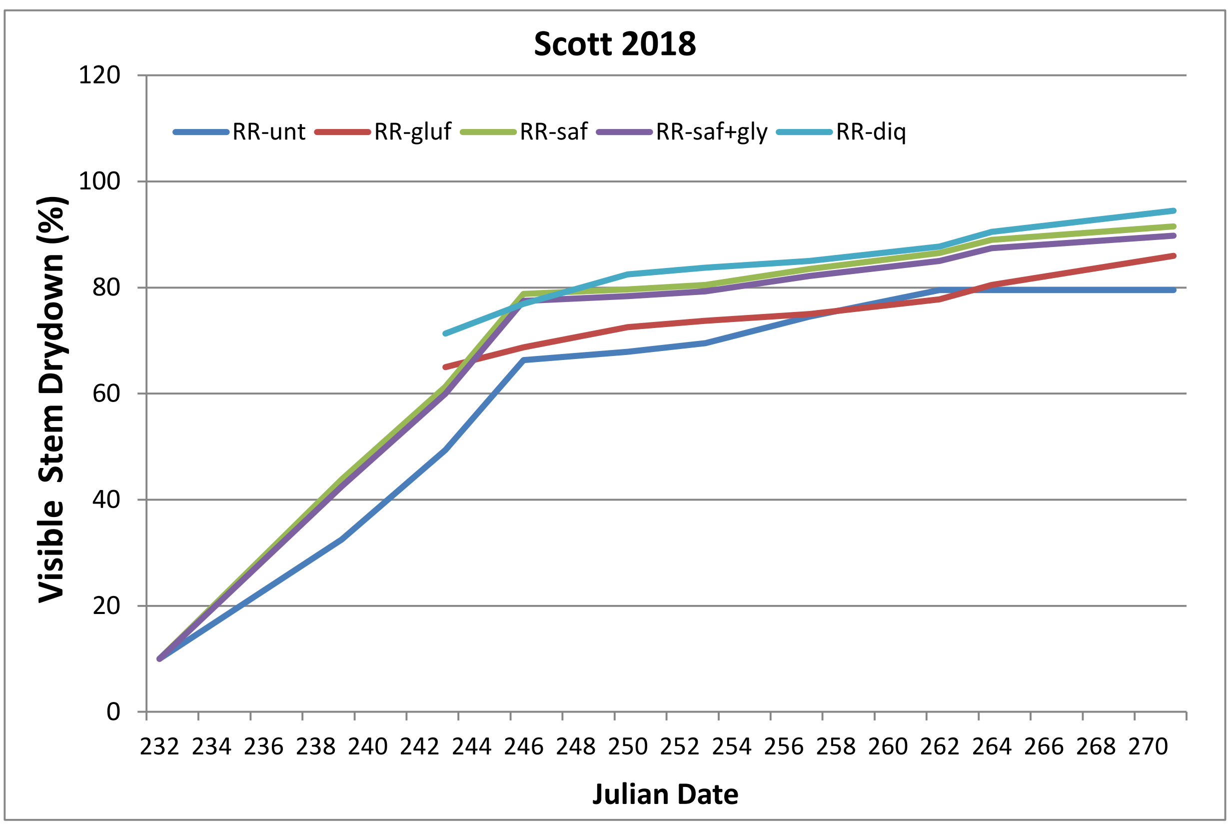

Figure A-14. Rate of visible stem down for various pre-harvest treatments in glyphosate tolerant canola (Scott 2018).