

Evaluation of desiccants to facilitate straight combining canola

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The concept of straight combining canola is gaining favor among growers in North Dakota. The majority of canola acres are swathed; however, it has been estimated that at least 15% were straight combined in 2006. Some growers have indicated they would consider increasing their canola acres if they could eliminate swathing, which is very time consuming and leaves the crop susceptible to strong winds for 2-4 weeks depending on weather conditions and work load.

As shown in Canola Digest, a series of field studies conducted by NDSU's Kent McKay in 2005 and 2006 demonstrated that timely straight combining can achieve similar or better canola yields compared to swathing. Straight-combined canola tended to have lower harvest moisture, darker seed color, lower green seed, and higher test weight. Under optimal conditions and management, it appears that straight combining is a feasible option for many growers.

However, under certain environmental conditions such as the very cool, wet conditions we experienced in 2004 in North Dakota, straight combining may not be advisable without the assistance of a desiccant to help dry down the crop. In 2004, we experienced record cool temperatures that significantly delayed maturity and the dry-down of many crops. In this case, swathing helped to dry down the pods, branches, and stalks. Growers that might have planned to straight combine may have found the crop too immature or wet to cut. However, applying a desiccant could accelerate dry down and allow growers to straight combine within 7-10 days. Following the cold 2004 season in North Dakota, the 2005 season was among the wettest on record. In 2005, a Section 18 emergency exemption was approved allowing growers to use Reglone as a canola pre-harvest desiccant. Reglone was selected as the desiccant of choice over Gramoxone by the manufacturer. However, essentially no Reglone was used due to cost, lack of information, and experience with applying a desiccant followed by straight combining.

Currently, there are no herbicides labeled for use as a canola desiccant in the U.S. Reglone is labeled for use in Canada, but not Gramoxone. Currently, Gramoxone is significantly less expensive than Reglone. Given that a desiccant will be labeled in the coming years, there are questions to be answered regarding its use. For example, what is the proper canola stage to apply the desiccant? After the application, how many days must one wait to harvest the canola? Will a desiccant increase shattering potential or pod drop? Does application timing or harvest date affect green seed count, yield, test weight, oil content, or grade? How does canola overall yield and seed quality compare when using a desiccant vs. swathing?

These questions were addressed in a three-year study (2005-2007) conducted at Minot and Langdon, ND and Bozeman, MT. Only the ND data will be presented here.

OBJECTIVES

- Determine the effect of Gramoxone and Reglone applied pre-harvest at three timings on canola yield, seed moisture, and seed quality.
- Compare Gramoxone and Reglone-treated canola to swathed canola.
- Determine the effect of harvest timing following a Gramoxone or Reglone application on canola yield, seed moisture, and seed quality.

PROCEDURES USED

Gramoxone (paraquat) and Reglone (diquat) were applied pre-harvest at three timings approximately as outlined in Tables 1 and 2. Gramoxone was applied at 1.3 pt/A with NIS at 0.25% v/v. Reglone was applied at 1.5 pt/A with NIS at 0.25% v/v. One treatment was swathed with a plot swather on the same days the Gramoxone and Reglone treatments were applied as a comparison to current grower practices. The Gramoxone, Reglone, and swath treatments were harvested approximately 7 and 14 days after treatment (DAT).

The pictures below show the approximate canola stages that desiccants were applied in Langdon. Each picture shows, from left to right, open pods from the top-, middle-, and bottom-third of canola plants for each application timing. For example, on August 5, seed in the bottom-third of the plants are just starting to turn color, while seed in the top- and middle-third of the plants are still green. On August 8, seed in the bottom-third are mostly turned, while the middle-third is just beginning to turn color, and so on. At Minot in 2005, desiccant applications were made slightly later compared to Langdon, as Minot timing 1 would have been equivalent to timing 3 in Langdon. At Minot in 2006, the applications stages were similar to Langdon in 2006.



The study evaluated three factors (desiccant, timing, harvest date) and was arranged in a randomized complete block design. Individual plots were 10 by 30 ft with four replications. Data collected included seed loss due to shattering prior to harvest, canola yield, test weight, seed moisture content at harvest, percent oil content, green count, seed damage, and grade. Four sticky cards (6-inch by 12-inch) were placed on the ground under the canopy just prior to or following the desiccant treatment (see picture below). Sticky cards were collected just prior to harvest and seeds were counted and the numbers converted to estimate yield loss per acre. Plots were harvested with a plot combine to determine canola yield and test weight. Samples from all locations were analyzed for oil content in Minot, then sent to Archer Daniels Midland, Velva, ND for green count, seed damage and grade analyses.



Sticky card to catch seed shatter

Table 1. Target canola stages for pre-harvest Gramoxone and Reglone applications.

Canola seed color	Application #1	Application #2	Application #3
Top 1/3	Green	Green to light green	Light green to yellow
Middle 1/3	Light green with a few just starting to turn reddish brown	Fewer light green with most light brown or reddish brown	Some light brown, but most reddish brown
Bottom 1/3	Light brown to reddish brown, some purple	Fewer light brown, mostly reddish brown to purple	Reddish brown or purple

Table 2. Actual desiccant application dates for Langdon and Minot, ND.

	Langdon			Minot		
	2005	2006	2007	2005	2006	2007
Timing 1	August 5	July 27	July 30	August 2	July 24	July 20
Timing 2	August 8	August 1	Aug 3	August 5	July 27	July 27
Timing 3	August 15	August 7	Aug 9	August 9	July 28	July 30

RESULTS

Desiccant comparison:

Gramoxone- and Reglone-treated plots produced similar results to swathing when comparing canola yield and seed quality parameters, with the exception of green seed content. Swathing generally (not always) had lower green content and thus less total damage. Higher green content was more related to lodging, early application, and high harvest moisture. Severe lodging in some plots inhibited canopy penetration by the desiccant. Crop lodging resulted in the upper portion of the canopy being desiccated, while the underside of the canopy remained green and resulted in higher green content. There was generally less lodging at Minot compared to Langdon, but lodging was a contributing factor in the high green content of some plots in 2005, especially the early Reglone treatment harvested 7 DAT (Tables 5 and 6). The very early applications at Langdon in all years and Minot in 2007, where there was very little seed color change in the bottom or middle pods, resulted in higher green count. Canola is considered dry enough to store when seed contain 10% moisture. At Langdon in 2005 and 2007, canola harvested at 7 DAT with high moisture content generally resulted in higher green count (Tables 3 and 10). Green count was generally lower when 1) plants were not lodged, 2) desiccants were applied when seeds in middle pods had started to turn, and 3) harvest moisture was near 10%.

Timing comparison:

One of the major objectives of this study was to determine the correct crop stage to safely apply a desiccant so there would be little or no effect on crop yield or quality. Desiccant-treated plots generally produced similar canola yield, test weight, and oil content to swathing at all timings at both locations in both years. However, at Langdon in 2005, swathing or desiccating at timing 1 and 2 resulted in lower yield and test weight. This was likely due to the plants being too green with high harvest moisture. In 2006, desiccant applications and swathing were done slightly later and did not affect yield or test weight. It should be noted that conditions were very wet in 2005, while 2006 was very dry. As would be expected, green content generally was slightly lower at timing 3 compared to timings 1 and 2. At Minot in 2007, yield was slightly lower for the desiccant treatments compared to swathing, again at the very early application. However, there was no difference in yield at the later timings.

Based on these data, it appears that optimal timing for a desiccant may be when seeds in the middle pods have started to turn in color. Application prior to color-turn in seeds of the middle pods with high seed moisture may result in lower yield and seed quality.

Harvest date comparison:

There was minimal seed lost due to shattering at either harvest date at either location. Statistically, there was more seed lost at 14 DAT compared to 7 DAT, but the loss was minimal from an agronomic standpoint, generally being less than 50 lb/A. Delaying the harvest date until 14 DAT did not affect yield at Minot in any year. Canola yield was actually higher at Langdon in 2005 when harvested 14 DAT compared to 7 DAT. This may be due, in part, to the fact that the desiccation, swathing, and harvest in timings 1 and 2 were done when plants were still considerably green. Unfortunately, data from the 2nd harvest date in Langdon in 2006 was lost to a hail storm. In 2007, canola yield at Langdon was similar at 7 and 14 DAT. At Minot and Langdon, both desiccated and swathed canola harvested 14 DAT had lower green count and less total damage than canola harvested 7 DAT. Thus, leaving the crop in the field allowed the seeds to continue maturing and drying.

Conclusions:

Based on this three-year study, there may be potential to successfully use a desiccant such as Gramoxone or Reglone to desiccate canola without suffering drastic losses due to shattering or lower seed quality. In these studies, if the desiccant or swathing operations were done when seed in the middle pods had started to turn color, crop quality parameters including canola yield, test weight, oil content, seed loss, green count, and grade were generally similar for desiccant treatments compared to swathing. However, the data indicate that very early applications could result in lower yield and seed quality, most specifically higher green content. Regarding efficacy, Gramoxone and Reglone appeared to dry down the crop equally fast. The treatments could not be distinguished three days after treatment (see pictures below).

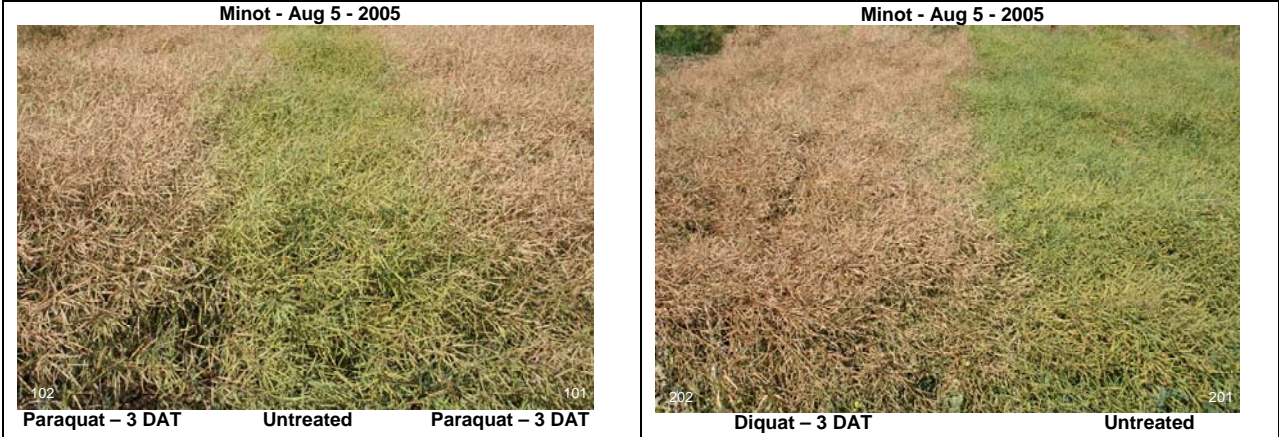


Figure 1. Paraquat- and diquat-treated canola compared to untreated three days after treatment.

Table 3. Effect of desiccation vs. swathing on canola yield and seed quality. Harvested 7 days after treatment (Langdon, ND 2005).

	Timing	Harvest Moisture	Yield	Kernel weight	Oil content	Seed loss	Green count	Total damage	Grade
		%	lb/A	g/1000	%	lb/A	%	%	
Gramoxone	1	28.3 a	2160 a	3.10 a	45.5 a	3 b	3.7 a	4.0 a	2.0 a
Reglone	1	24.1 b	2271 a	3.08 a	45.7 a	15 b	2.3 a	2.4 a	1.5 a
Swath	1	21.1 c	2352 a	3.05 a	45.1 a	54 a	2.7 a	2.8 a	1.5 a
Gramoxone	2	24.3 a	2315 a	3.28 a	47.4 a	19 ab	7.6 a	8.3 a	2.5 a
Reglone	2	22.3 ab	2600 a	3.25 a	47.2 a	14 b	9.2 a	9.6 a	2.5 a
Swath	2	21.5 b	2511 a	3.28 a	46.2 a	36 a	1.9 b	1.9 b	1.3 b
Gramoxone	3	16.1 a	2922 a	3.60 a	46.6 a	12 ab	2.4 a	2.5 a	1.7 a
Reglone	3	18.1 a	3053 a	3.70 a	46.4 a	3 b	3.7 a	4.4 a	1.8 a
Swath	3	16.6 a	3066 a	3.55 a	45.9 a	21 a	1.5 a	1.9 a	1.0 b

*Means followed by same letter within each timing do not significantly differ (P=0.05, LSD)

Table 4. Effect of desiccation vs. swathing on canola yield and seed quality. Harvested 14 days after treatment (Langdon, ND 2005).

	Timing	Harvest Moisture	Yield	Kernel weight	Oil content	Seed loss	Green count	Total damage	Grade
		%	lb/A	g/1000	%	lb/A	%	%	
Gramoxone	1	11.3 a	2286 a	3.05 a	46.3 a	28 b	0.8 a	1.2 a	1.0 a
Reglone	1	9.6 a	2342 a	2.95 ab	46.0 a	65 a	0.8 a	0.9 a	1.0 a
Swath	1	11.2 a	2178 a	2.88 b	44.5 b	42 b	2.2 a	2.5 a	1.3 a
Gramoxone	2	10.4 a	2735 a	3.35 a	45.6 b	26 a	4.2 a	4.7 a	2.0 a
Reglone	2	8.5 a	2736 a	3.28 a	47.0 a	42 a	3.9 a	3.9 a	2.0 a
Swath	2	8.8 a	2409 b	3.38 a	46.3 ab	37 a	0.4 b	0.4 b	1.0 b
Gramoxone	3	8.6 a	3153 a	3.88 a	45.8 a	13 b	1.9 a	1.9 a	1.5 a
Reglone	3	8.4 a	3228 a	3.75 a	46.3 a	12 b	1.1 a	1.8 a	1.0 a
Swath	3	6.7 a	3374 a	3.88 a	45.7 a	41 a	0.7 a	0.7 a	1.0 a

*Means followed by same letter within each timing do not significantly differ (P=0.05, LSD)

Table 5. Effect of desiccation vs. swathing on canola yield and seed quality. Harvested 7 days after treatment (Minot, ND 2005).

	Timing	Harvest Moisture	Yield	Test weight	Oil content	Seed loss	Green count	Total damage	Grade
		%	lb/A	lb/bu	%	lb/A	%	%	
Gramoxone	1	11.9 a	2750 a	53.3 a	46.0 a	13 a	1.0 b	1.1 b	1.3 a
Reglone	1	9.1 c	2616 a	53.8 a	45.5 a	15 a	5.6 a	5.7 a	2.3 a
Swath	1	10.4 b	2656 a	53.5 a	45.4 a	9 a	0.8 b	0.8 b	1.0 a
Gramoxone	2	11.6 a	2238 a	53.6 a	45.9 a	10 a	0.6 a	0.8 a	1.8 a
Reglone	2	10.8 a	2081 a	54.0 a	44.8 a	12 a	0.5 a	0.5 a	1.3 a
Swath	2	11.0 a	2289 a	53.7 a	45.4 a	5 a	1.0 a	1.1 a	1.3 a
Gramoxone	3	9.5 a	2760 a	53.6 a	45.1 a	48 a	1.0 a	1.1 a	1.5 a
Reglone	3	9.5 a	2576 a	53.5 a	45.4 a	36 a	1.4 a	1.5 a	1.8 a
Swath	3	9.7 a	2582 a	53.5 a	45.1 a	25 a	0.6 a	0.7 a	1.0 a

*Means followed by same letter within each timing do not significantly differ (P=0.05, LSD)

Table 6. Effect of desiccation vs. swathing on canola yield and seed quality. Harvested 14 days after treatment (Minot, ND 2005).

	Timing	Harvest Moisture	Yield	Test weight	Oil content	Seed loss	Green count	Total damage	Grade
		%	lb/A	lb/bu	%	lb/A	%	%	
Gramoxone	1	9.4 a	2502 a	53.6 a	45.3 a	36 a	0.7 ab	0.7 a	1.0 a
Reglone	1	9.0 a	2464 a	53.5 a	45.8 a	29 a	1.5 a	1.5 a	1.3 a
Swath	1	7.6 b	2447 a	53.6 a	45.2 a	27 a	0.4 b	0.6 a	1.5 a
Gramoxone	2	12.8 a	2480 a	53.6 a	45.4 a	37 a	0.4 a	0.7 a	1.8 a
Reglone	2	12.6 a	2576 a	53.6 a	45.9 a	26 a	0.4 a	0.4 a	1.0 a
Swath	2	12.1 a	2324 a	53.4 a	45.1 a	13 a	0.3 a	0.3 a	1.0 a
Gramoxone	3	9.0 a	2421 a	53.8 a	44.8 a	75 a	0.3 a	0.7 a	2.0 a
Reglone	3	9.4 a	2800 a	53.6 a	45.2 a	29 b	0.3 a	0.7 a	1.5 a
Swath	3	9.2 a	2859 a	53.5 a	45.1 a	27 b	0.2 a	0.3 a	1.3 a

*Means followed by same letter within each timing do not significantly differ (P=0.05, LSD)

Table 7. Effect of desiccation vs. swathing on canola yield and seed quality. Harvested 7 days after treatment (Langdon, ND 2006).

	Timing	Harvest Moisture	Yield	Test weight	Oil content	Seed loss	Green count	Total damage	Grade
		%	lb/A	lb/bu	%	lb/A	%	%	
Gramoxone	1	9.6 b	1613 a	53.6 a	47.7 a	58 ab	2.3 ab	2.4 a	1.5 a
Reglone	1	9.3 b	1728 a	53.5 a	48.4 a	71 a	4.0 a	4.0 a	1.8 a
Swath	1	14.2 a	1750 a	52.9 b	47.0 a	26 b	0.8 b	1.1 a	1.0 a
Gramoxone	2	11.5 a	1778 a	53.4 ab	48.4 a	68 a	1.4 a	1.7 a	1.3 a
Reglone	2	11.5 a	1858 a	53.6 a	47.6 a	63 a	2.2 a	2.6 a	1.5 a
Swath	2	10.7 a	1920 a	52.8 b	49.7 a	14 b	1.0 a	1.1 a	1.0 a
Gramoxone	3	12.6 a	1750 a	52.6 a	47.8 a	19 b	0.1 a	0.3 a	1.0 a
Reglone	3	12.8 a	1840 a	52.6 a	47.8 a	41ab	0.0 a	0.8 a	1.0 a
Swath	3	13.5 a	1720 a	52.3 a	47.7 a	71 a	0.2 a	1.1 a	1.0 a

*Means followed by same letter within each timing do not significantly differ (P=0.05, LSD)

**The 14 DAT harvest data from Langdon in 2006 is not available due to hail.

Table 8. Effect of desiccation vs. swathing on canola yield and seed quality. Harvested 7 days after treatment (Minot, ND 2006).

	Timing	Harvest Moisture	Yield	Test weight	Oil content	Seed loss	Green count	Total damage	Grade
		%	lb/A	lb/bu	%	lb/A	%	%	
Gramoxone	1	9.7 a	2325 a	52.6 a	46.1 a	4 a	1.5 a	1.7 a	1.0 a
Reglone	1	9.9 a	2452 a	52.6 a	46.6 a	2 a	1.2 a	1.3 a	1.0 a
Swath	1	10.5 a	2294 a	52.9 a	44.8 a	12 a	0.8 a	1.0 a	1.0 a
Gramoxone	2	9.8 b	2571 a	53.1 a	45.3 a	7 a	0.8 b	1.2 a	1.0 a
Reglone	2	9.9 b	2481 a	53.0 a	46.6 a	8 a	2.1 a	2.2 a	1.5 b
Swath	2	11.0 a	2223 a	52.9 a	46.1 a	7 a	0.6 b	0.8 a	1.0 a
Gramoxone	3	8.2 b	2415 a	53.2 a	46.2 a	9 a	0.8 a	1.1 a	1.0 a
Reglone	3	8.8 b	2608 a	53.3 a	46.6 a	7 a	1.1 a	1.5 a	1.3 a
Swath	3	10.1 a	2453 a	53.0 a	46.8 a	10 a	0.5 a	0.9 a	1.0 a

*Means followed by same letter within each timing do not significantly differ (P=0.05, LSD)

Table 9. Effect of desiccation vs. swathing on canola yield and seed quality. Harvested 14 days after treatment (Minot, ND 2006).

	Timing	Harvest Moisture	Yield	Test weight	Oil content	Seed loss	Green count	Total damage	Grade
		%	lb/A	lb/bu	%	lb/A	%	%	
Gramoxone	1	8.2 a	2368 a	53.4 a	45.1 a	45 a	0.6 a	0.8 a	1.0 a
Reglone	1	7.9 a	2403 a	53.4 a	45.9 a	22 b	0.6 a	1.0 a	1.0 a
Swath	1	7.7 a	2407 a	52.7 b	45.0 a	16 b	0.4 a	0.6 a	1.0 a
Gramoxone	2	8.1 a	2345 a	53.3 a	46.3 a	25 a	0.3 a	0.7 a	1.0 a
Reglone	2	8.3 a	2396 a	53.3 a	46.3 a	32 a	0.5 a	0.9 a	1.0 a
Swath	2	8.3 a	2459 a	52.9 a	45.7 a	34 a	0.7 a	1.0 a	1.0 a
Gramoxone	3	8.1 a	2379 a	53.5 a	46.0 a	24 a	0.1 a	0.5 a	1.0 a
Reglone	3	8.2 a	2678 a	53.5 a	46.9 a	34 a	0.7 a	1.1 a	1.0 a
Swath	3	8.2 a	2274 a	52.9 b	46.1 a	39 a	0.1 a	0.4 a	1.0 a

Table 10. Effect of desiccation vs. swathing on canola yield and seed quality. Harvested 7 days after treatment (Langdon, ND 2007).

	Timing	Harvest Moisture	Yield	Test weight	Oil content	Seed loss	Green count	Total damage	Grade
		%	lb/A	lb/bu	%	lb/A	%	%	
Paraquat	1	23.1 a	1918 a	52.8 a	39.9 a	2 a	9.3 a	12.5 a	3.8 a
Diquat	1	20.2 b	1849 a	53.4 a	40.6 a	4 a	9.2 a	10.6 a	3.0 a
Swath	1	22.0 ab	1734 a	51.8 b	39.1 a	6 a	3.9 b	5.5 b	2.8 a
Paraquat	2	17.5 b	1747 a	53.7 a	39.8 a	6 a	5.3 a	8.6 a	3.8 a
Diquat	2	17.1 b	1866 a	53.8 a	40.1 a	5 a	6.9 a	9.4 a	3.5 a
Swath	2	20.2 a	1894 a	53.0 a	40.7 a	8 a	1.4 b	3.1 b	3.0 a
Paraquat	3	9.9 a	1932 a	53.9 a	40.2 a	5 b	2.3 a	4.4 a	3.3 a
Diquat	3	10.4 a	1951 a	53.8 a	40.3 a	13 ab	2.5 a	5.2 a	3.0 a
Swath	3	11.5 a	1873 a	53.2 a	40.0 a	22 a	3.2 a	6.0 a	3.3 a

Table 11. Effect of desiccation vs. swathing on canola yield and seed quality. Harvested 14 days after treatment (Langdon, ND 2007).

	Timing	Harvest Moisture	Yield	Test weight	Oil content	Seed loss	Green count	Total damage	Grade
		%	lb/A	lb/bu	%	lb/A	%	%	
Paraquat	1	9.9 a	1806 a	54.0 a	40.2 a	9 a	2.8 b	4.8 b	3.0 a
Diquat	1	10.3 a	1800 a	54.2 a	38.3 a	11 a	7.4 a	9.4 a	3.0 a
Swath	1	11.7 a	1700 a	53.2 b	39.2 a	13 a	2.4 b	5.5 b	3.5 a
Paraquat	2	7.5 a	1835 a	54.1 a	40.2 a	16 a	3.9 ab	6.6 a	3.3 a
Diquat	2	7.2 a	1947 a	53.7 ab	40.8 a	13 a	4.5 a	6.8 a	3.3 a
Swath	2	7.4 a	1922 a	53.1 b	40.7 a	16 a	1.1 b	3.9 a	3.0 a
Paraquat	3	8.8 a	1989 a	53.7 a	40.0 a	15 b	3.3 a	5.4 a	3.0 a
Diquat	3	8.9 a	1882 a	53.9 a	41.0 a	16 b	0.9 a	2.0 a	3.0 a
Swath	3	9.4 a	1742 a	53.3 a	39.8 a	39 a	2.3 a	4.3 a	2.8 a

Table 12. Effect of desiccation vs. swathing on canola yield and seed quality. Harvested 7 days after treatment (Minot, ND 2007).

	Timing	Harvest Moisture	Yield	Test weight	Oil content	Seed loss	Green count	Total damage	Grade
		%	lb/A	lb/bu	%	lb/A	%	%	
Paraquat	1	12.3 a	1136 b	52.0 a	38.7 a	2 a	2.8 b	3.7 b	2.3 a
Diquat	1	10.3 b	1179 b	51.2 b	38.4 a	4 a	4.3 a	5.7 a	2.5 a
Swath	1	12.8 a	1396 a	51.9 a	38.4 a	4 a	2.5 b	4.0 b	3.0 a
Paraquat	2	8.1 a	1388 a	51.7 a	39.7 a	4 a	0.9 a	2.3 a	2.8 a
Diquat	2	8.8 a	1437 a	52.0 a	39.4 a	4 a	0.6 a	2.0 a	3.0 a
Swath	2	7.3 a	1414 a	52.1 a	38.8 a	11 a	0.9 a	3.0 a	3.3 a
Paraquat	3	9.7 a	1499 a	52.6 a	38.6 a	10 a	0.4 a	1.9 a	3.0 a
Diquat	3	10.3 a	1596 a	52.9 a	39.2 a	10 a	0.7 a	2.7 a	3.3 a
Swath	3	8.8 b	1468 a	52.9 a	39.5 a	7 a	0.3 a	1.4 a	2.8 a

Table 13. Effect of desiccation vs. swathing on canola yield and seed quality. Harvested 14 days after treatment (Minot, ND 2007).

	Timing	Harvest Moisture	Yield	Test weight	Oil content	Seed loss	Green count	Total damage	Grade
		%	lb/A	lb/bu	%	lb/A	%	%	
Paraquat	1	7.9 ab	1191 ab	52.2 a	38.5 a	4 a	2.0 a	4.5 a	3.5 a
Diquat	1	8.1 a	1128 b	52.3 a	38.6 a	1 a	1.8 a	3.5 a	3.3 a
Swath	1	7.2 b	1384 a	51.5 b	38.1 a	12 a	1.3 a	3.2 a	3.0 a
Paraquat	2	8.6 a	1523 a	53.1 a	39.1 a	49 a	0.6 a	2.3 a	3.0 a
Diquat	2	8.8 a	1457 a	53.2 a	38.7 a	32 b	0.3 a	2.0 a	3.0 a
Swath	2	7.5 b	1348 a	53.1 a	39.1 a	15 b	0.3 a	1.9 a	2.8 a
Paraquat	3	11.1a	1285 a	53.4 a	38.8 a	84 a	0.4 a	1.4 a	3.0 a
Diquat	3	11.2 a	1346 a	53.4 a	38.7 a	52 b	0.3 a	2.4 a	3.5 a
Swath	3	9.5 b	1281 a	53.1 a	38.3 a	51 b	0.4 a	1.8 a	3.0 a

