GLUFOSINATE AMMONIUM (HOE 039866) AS A HARVEST AID IN CANOLA

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INTRODUCTION

Canola is a special crop that is becoming increasingly more important to western Canadian agriculture. However, it is a relatively new crop, and the optimal agronomic practices involved in producing canola are still being developed.

The current standard practice of harvesting canola is to swath the crop at 30-40% seed turn and to combine the swath when dry about 10 days later. Swathing later than 30-40% seed turn or straight combining when the crop is mature are not accepted practices due to potential yield losses associated with pod shattering. Thus, the standard practice is to swath the crop while it is still green and to allow it to dry in the swath to avoid shattering losses.

However, there are problems associated with this practice. One is that canola swaths are relatively light and fluffy and are susceptible to being lost in high winds. To combat this problem, producers usually compress the swath with a swather-pulled packer. Another problem associated with swathing green canola is that the crop will often wrap around the swather reel, forcing the operator to continually stop to unplug the reel. This is accentuated when the crop is lodged, causing further delays and inconvenience.

It is difficult to obtain canola seed that has a low content of green seed when swathing prior to combining. Swathing essentially kills the plants immediately and relies on drying in the swath to ripen the seeds. Ripening in this fashion is highly dependent on the environment, and if unfavorable, the green seed content can be relatively high. Canola is down-graded from number 1 to number 2 if it has more than a 2% green seed content, and from number 2 to number 3 if it has more than a 6% green seed content (Canola Council of Canada 1991). The lower the grade, the lower the price paid to the producer.

There has been a recent increase in the number of farmers who straight combine their crops when possible. Aside from saving time and money by avoiding a swathing operation, straight combining can also reduce the incidence of weathered and poor quality seed that often occurs in swathed crops. However, as stated above, canola is rarely straight combined because of yield losses associated with shattering. This is especially a problem in Argentine canola (<u>Brassica napus</u>), as the standard variety Westar is particularly prone to shattering.

Polish canola (<u>Brassica campestris</u>) is more resistant to shattering than Westar, as are some of the newer varieties of Argentine canola. <u>Brassica campestris</u> is, therefore, more suited to straight combining than is <u>Brassica napus</u>.

Currently, diquat (trade name "Reglone" by ICI Chipman) is the only desiccant registered for use in canola in western Canada. It is used to facilitate straight combining canola by desiccating both the crop and weeds prior to harvesting. Diquat is primarily a contact desiccant that enables harvesting within one week of application. However, diquat is not widely used in canola because of perceived losses that can occur due to shattering.

Glufosinate ammonium is a non-selective herbicide/desiccant that was discovered by Hoechst AG of Frankfurt, Germany, in the 1970's. It has been tested in North America in a wide variety of applications since the early 1980's. Glufosinate ammonium has potential commercial application for non-selective weed control in orchards, chemfallow, home and garden uses, industrial applications and as a crop desiccant or senescent.

Glufosinate ammonium has both contact the translocative activity. It is considered to be less translocative than glyphosate, but more than diquat. Similarly, glufosinate ammonium has faster activity than glyphosate, but slower activity than diquat. For this reason, the application timing of glufosinate ammonium as a desiccant is usually earlier than the timing recommended for diquat.

Because glufosinate ammonium causes relatively slow crop dry down, it is theorized that shattering losses in canola sprayed with glufosinate ammonium will not be severe. Concurrently, the translocative properties of glufosinate ammonium should be sufficiently diminutive to not result in excess seed residues, or to inhibit germination of the seed.

For these reasons, Hoechst Canada Inc. began investigating the use of glufosinate ammonium as a desiccant in canola in 1985. The methodology and results of these studies are described below.

MATERIALS AND METHODS

A total of nine trials were conducted in western Canada between 1985 and 1990 in Brassica campestris, variety (v.) Tobin. Four of these trials were applied by air while the other five were applied by ground.

Each trial consisted of glufosinate ammonium applied at 400 and 500 g active ingredient (a.i.)/ha. In the final four experiments, glufosinate ammonium was also applied at 300 g a.i./ha. These applications were compared to a standing and to a swathed control, and to a 400 g a.i./ha application of diquat applied at 70-80% seed turn. The glufosinate ammonium applications and swathing occurred at 30-40% seed turn.

In the aerial trials, the chemical treatments were applied at a water volume of 35 L/ha in plots that were typically 2 ha in size (50 X 400 m). Swathing and harvesting were conducted using commercial equipment. The treatments were replicated twice.

In the ground trials, the plots were typically 6 X 10 m in size and were replicated three times. Applications were either conducted using a truck mounted sprayer or hand-held booms equipped with flat fan nozzles. Both methods applied the treatments in 110 L/ha water. Swathing was conducted using a commercial swather, while harvesting was conducted using a small plot combine.

Percent pod turn and percent stem desiccation were assessed visually every 2-3 days until harvest. Weed desiccation was also reported when possible.

Individual plots were harvested when mature and when seed moisture was 9-10%. In the aerial trials, yield values were obtained by transferring seed from the harvested area into a weigh wagon. These samples were weighed and yields were converted into kg/ha. In the ground trials, seed from the harvested area was cleaned with a commercial seed cleaner when necessary, and the samples were weighed using a 10 kg manual scale. The yield data was again converted into kg/ha. All yield values were corrected to 10% moisture to account for seed moisture differences between treatments.

Seed samples from the harvested areas were retained for analysis of moisture and green seed content. Seed moisture was tested immediately after harvest using commercial moisture testers. Green seed content was determined using the crushing method, where 100 seeds per sample are selected at random, rolled and the number of crushed seeds counted. Seeds that are crushed are considered green. In most cases, experienced elevator agents were solicited to test for green seed content.

In some of these trials and in other experiments using different canola varieties, seed chlorophyll, oil content and percent germination were determined for each treatment by university, government or commercial laboratories.

Each experiment was conducted as a randomized complete block design. An analysis of variance (ANOVA) procedure was conducted for yield and green seed content in each experiment, and Duncan's mean comparison procedure was employed when significant differences between treatments occurred. For the purposes of this paper, each experiment was treated as a replicate within a randomized complete block design. Thus, the mean value for yield and green seed content was obtained in each experiment, and these values served as the data for one replicate. An ANOVA procedure was conducted for yield and green seed content on this data, and Duncan's mean comparison procedure was used when significant differences between treatments occurred ($P > 0.05$). These results are presented below.

RESULTS AND DISCUSSION

In most cases, the swathed and treated plots were harvestable 10-14 days after swathing or glufosinate ammonium applications (Figures 1 and 2). The standing check was typically harvestable 2-3 days after the other treatments. In individual experiments, some treatments may have been harvestable 1-3 days prior to the other treatments, but overall, there were no substantial differences in the days to harvest between treated plots or between the treated and swathed plots.

Because glufosinate ammonium is a slower working chemical than diquat, it is applied about 5 days earlier than diquat. Thus, glufosinate ammonium is applied at 30-40% seed turn and plants are harvestable 10-14 days later. Diquat is typically applied at 75% seed turn, and plants are usually harvestable 5-8 days later, so the actual harvest day is about the same for plants treated with glufosinate ammonium or diquat. In Figures 1 and 2, the number of days after treatment refers to days after glufosinate ammonium treatment.

Overall, there was little difference in pod and stem turn between plants sprayed with glufosinate ammonium or diquat. The pods and upper stems of plants treated with diquat were typically more thoroughly dried than plants treated with glufosinate ammonium. However, glufosinate ammonium generally desiccated the lower stem better than diquat. This is attributed to the fact that glufosinate ammonium is translocated to a greater extent than diquat.

It was found that 300 g a.i./ha glufosinate ammonium was usually sufficient to adequately desiccate the crop. However, the trend in these and in experiments in other crops was for 500 g a.i./ha glufosinate ammonium to be required to adequately desiccate weeds such as redroot pigweed (Amaranthus retroflexus), lambsquarters (Chenopodium album) and wild buckwheat (Polygonum convovulus; data not reported here).

There were no significant differences in yields between the treatments (Table 1). It was somewhat surprising that the standing checks yielded as well as the swathed and desiccated treatments because straight combining canola is thought to result in severe shattering losses. This is especially true with the Argentine variety "Westar". However, shattering losses are perceived to be lower with Polish varieties of canola, and these results support that theory.

Applications with glufosinate ammonium resulted in a significantly lower level of green seed content compared to the untreated and swathed checks and to applications with diquat (Table 2). For example, glufosinate ammonium applied at 400 g a.i./ha resulted in a mean green seed content of 4.2%, while diquat application resulted in a mean green seed content of 6.6%, and swathing produced an average green seed content of 6.3%. A sample having a green seed content in excess of 6% is graded as number 3 canola, while a sample in the range of 2-6% is graded as number 2 (Canola Council of Canada 1991).

All samples treated with glufosinate ammonium had an average grade of number 2, while the seed from the other treatments had a mean grade of number 3. A number 2 grade of canola yielding 1400 kg/ha and priced at $275/tonne is worth $385.00/ha, while the same yield of a number 3 grade canola priced at $250/tonne is only worth $350.00/ha, a significant difference indeed.

It is theorized that the slow acting nature of glufosinate ammonium is responsible for the relatively low green seed content. Because glufosinate ammonium takes up to two weeks to completely desiccate canola, there is sufficient time for the seeds to mature naturally. Diquat application and swathing kills the plants rapidly, and the seeds have less time in which to mature, resulting in a higher green seed content. Seed from the standing checks does not ripen as well as seed treated with glufosinate ammonium, resulting in a higher green seed content compared to seed treated with glufosinate ammonium.

Canola seed from some of these and other experiments using different varieties of canola were also analyzed for chlorophyll content, oil content and germination. The results of these tests are not included here because of limited data. However, based on the limited results, the tendency is for seed treated with glufosinate ammonium to have an equal or lower chlorophyll content than the other treatments. There does not appear to be a treatment effect on oil content or seed germination.

CONCLUSIONS

The results of these studies indicate that glufosinate ammonium can be an effective management tool in canola production, particularly in Brassica campestris, v. Tobin. From the results of nine studies, it was determined that swathed canola or canola desiccated with glufosinate ammonium or diquat was harvestable at about the same time, or about 2-3 days prior to untreated standing canola. Applications of glufosinate ammonium did not effect yield compare to applications with diquat or to the standing and swathed checks. However, glufosinate ammonium applications resulted in significantly lower levels of green seed relative to these other treatments. This lower green seed content resulted in an average number 2 grade of canola in seed treated with glufosinate ammonium compared to an average grade of 3 in untreated seed or in seed treated with diquat. This improved grade of seed can be of substantial economic benefit to producers (approximately $25/tonne).

From limited data in experiments studying Tobin and other varieties of canola, glufosinate ammonium application resulted in seed having equal or lower levels of chlorophyll relative to untreated seed or to seed treated with diquat. Glufosinate ammonium application had no effect on seed oil content or germination.

REFERENCES

1. Canola Council of Canada. 1991. GRADES OF CANOLA (Canada) PRIMARY GRADE DETERMINATES. Fax communication.

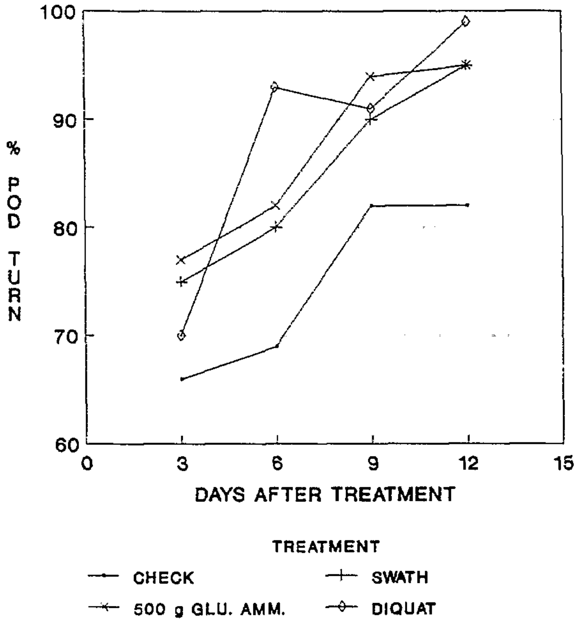

Fig. 1. Percent pod turn by treatment.

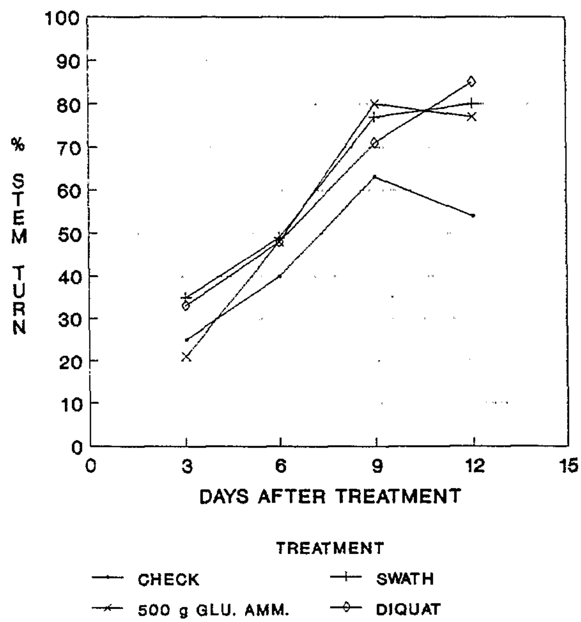

Fig. 2. Percent stem turn by treatment.

Table 1. Mean Canola Yield by Treatment.

Treatment	Rate (g a.i./ha)	Yield (kg/ha)*
Diquat	400	1479
Swath Check	-	1442
Glufosinate Ammonium	500	1436
Glufosinate Ammonium	400	1387
Standing Check	-	1331
Glufosinate Ammonium	300	1261

* No significant difference between treatments according to analysis of variance, P > 0.05.

Table 2. Mean Green Seed Content by Treatment.

Treatment	Rate (g a.i./ha)	Green Seed Content	Grade
Standing Check	-	6.6 A *	3
Diquat	400	6.6 A	3
Swath Check	-	6.3 A	3
Glufosinate Ammonium	500	4.3 B	2
Glufosinate Ammonium	400	4.2 B	2
Glufosinate Ammonium	300	3.6 B	2

* Means having the same letter are not significantly different according to Duncan's mean comparison procedure, P > 0.05.