

Herbicide Screening for Established Red Clover Grown for Seed

For: Saskatchewan Forage Seed Development Commissions



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Objective/Rationale: To evaluate the crop tolerance and weed control efficacy of spring-applied herbicides to Red clover, in support of registration under the Minor Use Program.

Methodology: This small plot research trial was conducted in a randomized complete block design with 4 replicates. Each plot was 2m by 7m with borders on each replicate end. There were 3 treatments consisting of an untreated control and Viper ADV tank-mixed with Assure II at 1X and 2X of the recommended application rate (Table 1).

Table 1: Treatments used in Herbicide Screening for Established Red Clover Grown for Seed in Melfort, SK 2019.

TRT #	Product	Rate	Timing
1	Untreated		
2	Viper ADV + Assure II	1x (0.404 L/ac + 300 mL/ac)	Early Stage (2-6 leaf stage)
5	Viper ADV + Assure II	2x (0.808 L/ac + 600 mL/ac)	Early Stage (2-6 leaf stage)

On June 13, 2018 Red clover (var. Belle) was seeded into wheat stubble at a 0.5-inch depth. All plots were seeded using a ConservaPak airseeder on 9-inch row spacing at 2.5 lb/ac. The only fertilizer applied to this trial was 15 kg/ha of seed-placed P that was applied in the form of 11-52-0.

This trial received crop protection products as required, outside of the 2019 herbicide treatments. In 2018, Odyssey was applied for broadleaf weed control, while Assure II was applied for grassy weed control. In addition, prior to weed seed set, all weeds above the crop canopy were mowed for additional weed control. In 2019, the herbicide treatment applications were completed on May 31st using the rates and products listed in Table 1. All herbicide applications were made using a CO2 propelled sprayer mounted on an ATV. No fungicides, insecticides, or seed treatments were used, in either year. All plots were desiccated with Reglone at 1.09 L/ac on September 6th and were harvested on October 11th, 2019.

Data collection consisted of establishing baselines, crop tolerance and weed control ratings, yield, and quality. Baselines were established by noting the weed species present prior to herbicide application, as well as crop health. Crop tolerance was rated at 4-7 days and again at 28-35 days post herbicide application on a 0-100% scale. Weed control was determined by noting the major weed species and determining the level of broadleaf control both 4-7 days and 28-35 days after treatment applications. Yield was determined by cleaning and weighing each harvested plot. Clean weights were then converted into kg/ha and lbs/ac equivalents while correcting to a consistent moisture. Quality was accounted for by sending composite samples of each treatment away for purity and germination levels. Lastly, statistical analysis was completed using a One-way ANOVA in Statistix 10.

Results:

Environmental Conditions: May through August were cooler than normal, while September was warmer (Table 3). Both May and August were 1.9°C cooler, while June, July, and September were within 0.4 to 0.6°C of the long-term climate normal for each respective month. May, July, and August received less precipitation than normal, while June and September had more than normal (Table 2). However, both July and September were within 4 mm of the long-term climate normal, while May, June, and August were within 21 to 33 mm of their normal. Due to the cool, dry conditions in May, seedling germination was slow and sporadic. The wet conditions in June, assisted in plant establishment, but also resulted in more

seedling germination. This caused for multiple growth stages within a small area, ultimately leading to increased variability within and between plots. This inevitably led to delays in maturity and harvesting. Overall, the growing season was slightly cooler and drier than the long-term climate normal.

Table 2: Mean temperatures and precipitation collect from the Environment Canada Weather Station at Melfort SK., from May to September 2019.

	May	June	July	August	September	Average/Total
--- Mean Temperature (°C) ---						
2019	8.8	15.3	16.9	14.9	11.2	13.4
Long-Term ^x	10.7	15.9	17.5	16.8	10.8	14.3
--- Total Precipitation (mm) ---						
2019	18.8	87.4	72.7	30.7	43.0	252.6
Long-Term ^x	42.9	54.3	76.7	52.4	38.7	265.0

^x Long-term climate normal from Environment Canada Weather Station located at Melfort SK., from 1981-2010

Baseline: On the day of treatment application (May 31) Perennial sow thistle was the only weed present. The density of Perennial Sow thistle throughout the trial was very low, with only 1 noted in the entire testing area. Overall, the crop stand was full and had good vigour in early spring 2019 (Figure 1). Individual plants were between 3.5 to 5.5 inches tall, with some bottom leaves having a slight yellow colour, which may have been due to some early season frost damage.



Figure 1: 2019 Red clover crop, prior to herbicide application. Note the good stand and crop vigor, with minor and sporadic yellowing of some individual plants.

Crop Tolerance: 4 to 7 days after application there were significant differences between in the amount of crop damage caused by the treatments (Table 3). When the 2x application rate was used, the crop damage that occurred was significantly greater than what occurred in the 1x rate and untreated control treatments. The 1X rate did result in some crop damage, however these effects were not considered significantly different from the control. At this time, crop damage exhibited as narrower, more hairy leaflets (Figure 2). At 28 to 35 days post application all crop tolerance issues had been diluted as newly emerging plant tissues did not exhibit any crop damage symptoms. Thus, all plots were rated 100% crop tolerance, as symptoms were contained to those tissues which would have been directly affected by the herbicide application.



Figure 2: *Left photo:* Left row untreated plot with broad leaflets; right row Viper ADV + Assure II 2x rate with some smaller hairier leaflets. *Right photo:* Closer look at the altered leaflets due to the higher application rate.

Weed Control: Neither Viper ADV or Assure II are registered for the control of Perennial sow thistle, the only weed species noted prior to herbicide application. Furthermore, due to the relatively absent initial weed pressure prior to herbicide application, there was no weed control noted at 4 to 7 days and 28 to 35 days after application. As weed control was not recorded at the suggested times, a weed survey took place in early August, and only found 1 volunteer Alsike clover and 1 volunteer alfalfa in addition to the Perennial sow thistles. This confirms that weed pressure was minimal in the 2019 crop year, thus making it nearly impossible to conduct the weed control rating that were required.

Yield: There were no significant differences between the seed yield of each treatment (Table 3). Overall, the control treatment had the highest average yield. This suggests that the crop damage caused by the

herbicide treatments did have a slight effect on yield. However, these effects were not great enough to demonstrate any statistically significant yield losses. Overall, Red clover seed yield in 2019 was similar to those found in other years.

Table 3: Statistical analysis of treatment factors for Herbicide Screening for Established Red Clover Grown for Seed in Melfort, SK 2019.

One-way ANOVA

Source	Crop Tolerance ^y		Weed Control ^y		Yield ^y (kg/ha)	Yield ^y (lbs/ac)
	4-7 days	28-35 days	4-7 days	28-35 days		
One-way ANOVA	0.0007**	--	--	--	0.9149	0.9149
Grand Mean	93.8	--	--	--	738.8	658.6
CV	3.9	--	--	--	12.2	12.2
Control	100.0a	100.0a	NA	NA	754.3a	672.4a
Viper ADV+ Assure II 1X	96.3a	100.0a	NA	NA	729.4a	650.2a
Viper ADV+ Assure II 2X	85.0b	100.0a	NA	NA	732.7a	653.1a

*** highly significant at p<0.0001; * significant at p<0.05

^y letters signify values that are significantly different at p<0.05

Quality: Due to only 3 composite samples sent away for purity and germination determination, the results were not statistically analyzed. Despite not being statistically analyzed, it is quite clear that any treatment differences had very negligible effects to both the purity and germination of Red clover seed (Figure 3). All values fell within a very small range and were above 92% for germination and 98% for purity. All of these values are considered excellent for any type of crop grown for seed production.

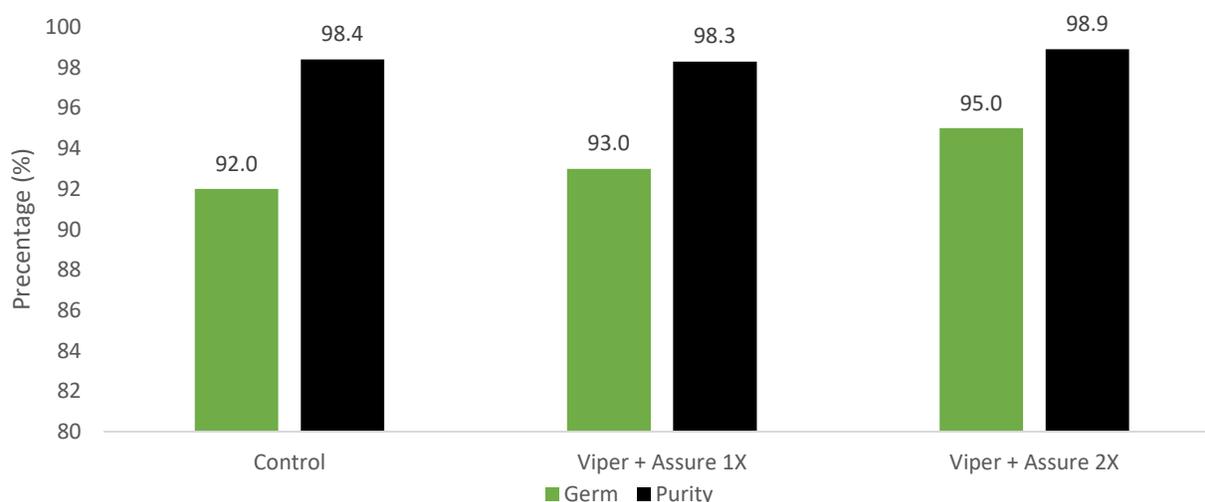


Figure 3: Purity and Germination (%) of harvested seed from Herbicide Screening for Established Red Clover Grown for Seed in Melfort, SK 2019.

Conclusion: When considering all variables, Red clover grown for seed exhibits very good tolerance to Viper ADV tank-mixed with Assure II. Although both rates demonstrated an initial decrease in crop tolerance, and even more so with a 2X rate, the level of damage that occurred was equal to or above the industry allowance of 15%. Furthermore, the decrease in crop tolerance did not correlate into reduced yields, as all yields were comparable to the control. Furthermore, there was no evidence that the harvested seed was impacted by any treatment differences. One of the limiting factors in 2019 was reduced weed pressure, and thus weed control was not evaluated and compared amongst treatments. Overall, this data set can be confidently used to support registration of Viper ADV + Assure II tank-mix under the minor use program.