

2020 Research Report for the Saskatchewan Forage Seed Development Commissions
20-101&102: Tolerance of Established Red and Alsike Clover to Valtera and Authority



Project location: RM no. 428 near Melfort, Saskatchewan

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Project objective/rationale: To evaluate the crop tolerance and weed control efficacy of spring applied Authority and Valtera with and without Viper, on established red clover and alsike clover grown for seed production

Methodology: The small plot research trials were conducted in a randomized complete block design with 4 replicates. Each plot was 2m by 7m with borders on the ends of each replicate. There were 8 treatments consisting of an untreated control, Valtera and Authority at 1X and 2X rates, Viper ADV in addition to both Valtera and Authority 1X applications, and a Viper ADV application on its own (Table 1).

Table 1. Treatments used in Tolerance of Established Red and Alsike Clover to Valtera and Authority

Treatment #	Product	Product Rate	Timing
1	Authority 1X	292mL/ha	Early Spring
2	Authority 2X	584mL/ha	Early Spring
3	Valtera 1X	224mL/ha	Early Spring
4	Valtera 2X	448mL/ha	Early Spring
5	Authority 1X + Viper ADV	292mL/ha + 988mL/ha	Early Spring + prior to bud
6	Valtera 1X + Viper ADV	224mL/ha + 988mL/ha	Early Spring + prior to bud
7	Viper ADV	988mL/ha	Prior to bud
8	Check	--	--

Both red and alsike clover were seeded on June 19th, 2019. Red Clover (var. Altaswede) was seeded at 2.4 lbs/ac and Alsike Clover (var. Dawn) was seeded at 2.1 lbs/ac. At the time of seeding, fertilizer nor inoculant was used. Both clovers were seeded into wheat stubble between 0.25 and 0.5 inches deep, using a Conserva-Pak air seeder on 9-inch row spacing. Prior to seeding on May 28th, 1 L/ac of Roundup Transorb was applied for broad spectrum pre-emergent weed control. In-crop weed control consisted of Odyssey at 16.3 g/ac on August 1st, when the clovers were in at the 2 to 4 leaf stage. Late in the growing season, weeds above the crop canopy were mowed for additional weed control. In 2020, early spring applications of Authority and Valtera were applied on May 22nd, and applications prior to bud of Viper ADV were completed on June 11th. Both trials were desiccated on August 24th, 2020 with 1.09L/ac of Diquat 240. Alsike clover was harvested on September 10th and Red clover was harvested on September 23rd. All plot were harvested using a plot combine, and 6 full crop rows were collected.

Data collection for both trials consisted of crop tolerance, weed control, flowering notes, seed yield, % germination and thousand seed weights. Crop tolerance ratings were completed 7-14 days and 28-35 days after Valtera and Authority herbicide applications. A rating of 0-100% was used, where 100% indicated complete crop tolerance. Weed ratings were also completed using a 0-100% scale, where 100% equated to complete weed control. Weed species present were also noted. Weed control ratings were to be completed at the same time as crop tolerance ratings. Notes of flowering were made to determine any flowering differences due to treatment applications. Seed yield was determined by cleaning and weighing every harvested plot sample and converting into kg/ha and lbs/ac equivalents, while correcting to 10% seed moisture. Lastly, quality analysis consisted of % germination and thousand seed weights, where a subsample was sent for every treatment to a CFIA accredited lab for analysis. Statistical analysis for all data collection was completed using randomized complete block in Statistix 10.

Results

Environmental Conditions:

Average growing season temperature was comparable to the long-term average, although total precipitation was 42.5mm less than the long-term average (Table 2). May and June were 0.6°C and 1.6°C cooler than the long-term average whereas July and August were 1.3°C and 0.8°C warmer. The slightly cooler temperatures in May and June coincided with similar to wet conditions, particularly in June where precipitation was much greater than the long-term average. Reduced precipitation in both August and September, and above average temperatures in August, allowed for early to normal crop maturity, dry down, and harvesting conditions with minimal delays.

Table 2: Mean temperatures and precipitation collect from the Environment Canada Weather Station at Melfort SK., from May to September 2020.

	May	June	July	August	September	Average/Total
	--- Mean Temperature (°C) ---					
2020	10.1	14.3	18.8	17.6	10.8	14.3
Long-Term ^x	10.7	15.9	17.5	16.8	10.8	14.3
	--- Total Precipitation (mm) ---					
2020	26.7	103.7	52.4	18.5	21.2	222.5
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

Crop Tolerance:

Crop Tolerance ratings were completed on June 2nd and June 23rd. Both red and alsike clover demonstrated significantly reduced crop tolerance at 7-14 days after Valtera and Authority applications (Table 3). Regardless of product, both crops experienced reduced tolerance at the 2X rate as compared to the 1X rate. When comparing herbicide products, in red clover crop tolerance was comparable for both products regardless of rate, however alsike clover demonstrated reduced tolerance to Valtera as compared to Authority. Although initial reduced tolerance was observed, when crop tolerance was rated again at 28-35 days after Valtera and Authority application, both crops had recovered and had no visual indications of reduced tolerance.

Table 3. Statistical analyses and treatment means for crop tolerance and weed control in Tolerance of Established Red and Alsike Clover to Valtera and Authority in Melfort, SK 2020.

	Red Clover				Alsike Clover			
	Crop Tolerance ^{y,z}		Weed Control ^{y,z}		Crop Tolerance ^{y,z}		Weed Control ^{y,z}	
	7-14 DAA	28-35 DAA	7-14 DAA	28-35 DAA	7-14 DAA	28-35 DAA	7-14 DAA	28-35 DAA
p-value	<0.0001***	NS	NS	NS	<0.0001***	NS	0.5656	0.0551
Grand Mean	93.1	100.0	100.0	100.0	93.6	100.0	92.3	93.8
CV	2.42	--	--	--	1.61	--	3.32	4.39
Authority 1X	92.5b	100.0	100.0	100.0	95.0b	100.0	93.8a	91.3bc
Authority 2X	87.5c	100.0	100.0	100.0	88.8d	100.0	91.3a	90.0c
Valtera 1X	93.8b	100.0	100.0	100.0	91.3c	100.0	93.8a	91.3bc
Valtera 2X	87.5c	100.0	100.0	100.0	85.0e	100.0	90.0a	91.3bc
Authority +Viper	92.5b	100.0	100.0	100.0	95.0b	100.0	91.3a	96.3ab
Valtera+Viper	91.3b	100.0	100.0	100.0	93.8b	100.0	92.5a	98.8a
Viper ADV	100.0a	100.0	100.0	100.0	100.0a	100.0	92.5a	95.0abc
Control	100.0a	100.0	100.0	100.0	100.0a	100.0	93.8a	96.3ab

^{y***}highly significant at p<0.05

^zLetters signify treatments that are significantly different at p<0.05

Weed Efficacy:

Weed efficacy was noted for both red and alsike clover at the same time as crop tolerance ratings on June 2nd and June 23rd. Weed control differences were very minimal for alsike clover and were not observed in the red clover at 7-14 days after application. The only weeds noted in the alsike clover at the first rating was dandelion. At 28-35 days after application the only weed present in the red clover area was sweet clover, however it was very sparse throughout the trial area. As sweet clover would not be controlled by any herbicides used in this trial all treatments were rated as 100% weed control. Differences in weed efficacy in the alsike clover at the 28-35 day post application date were greater, however there was no statistical significance. Most treatments were comparable to the control, therefore weed control differences provided very little insight into treatment differences. Due to only dandelion being noted at Authority and Valtera application it is likely that any weeds present at the second rating were those that emerged after the herbicide applications. This is likely why weed control had slightly reduced values for single applications of Valtera and Authority at 28-35 days after application as compared to treatments with Viper applied. Weeds of prevalence in the alsike clover were dandelion, volunteer wheat, sweet clover, white cockle and narrow leaved hawk's beard.

Flowering:

Alsike clover was noted as beginning of flowering on June 23rd, and was determined to be in full flower by July 1st. All treatments were evaluated at this time and no treatment differences in flowering were noted. Red clover went into flower much later than alsike clover and was beginning to flower on July 14th. All treatments were evaluated and no treatment differences were noted.

Seed Yield:

Seed yields were not statistically significant between treatments for both alsike and red clover (Table 4). For both crops all treatment applications of Authority and Valtera reduced average yields as compared to the control. Authority + Viper in alsike clover was the only application of either product that demonstrated a yield increase to the control, however this may have been due to a sampling error. When comparing products and rates both crops demonstrated an average yield increase when increasing to the 2X rate for Authority as compared to the 1X rate. For Valtera, alsike clover demonstrated a much greater yield loss at the 2X rate as compared to 1X, however red clover demonstrated comparable yields at both rates. This suggests that red clover may have been more tolerant to an increased rate of Valtera. The only treatment that increased average yields in both crops as compared to the control was the single application of Viper ADV. Overall, the average reductions in yield for Valtera and Authority applications are likely due to the initial reductions in visual tolerance following application.

Table 4. Statistical analyses and treatment means for seed yields in Tolerance of Established Red and Alsike clover to Authority and Valtera in Melfort, SK 2020.

	Alsike Clover Yields²		Red Clover Yields²	
	Kg/ha	lbs/ac	Kg/ha	lbs/ac
p-value	0.913	0.913	0.9238	0.9238
Grand Mean	756.9	674.7	892.7	795.8
CV	19.55	19.55	12.28	12.28
Authority 1X	719.4a	641.3a	882.7a	786.8a
Authority 2X	756.5a	674.3a	913.3a	814.1a
Valtera 1X	762.2a	679.4a	860.9a	767.4a
Valtera 2X	669.6a	596.8a	859.1a	765.8a
Authority +Viper	802.6a	715.4a	879.8a	784.2a
Valtera + Viper	758.2a	675.9a	872.6a	777.8a
Viper ADV	801.2a	714.2a	945.3a	842.6a
Untreated Check	785.7a	700.4a	928.1a	827.3a

²Letters signify treatments that are significantly different at $p < 0.05$

Germination & TSW:

Thousand seed weights (TSW) and % germination were only evaluated as a composite sample for every treatment, therefore statistical analysis was not completed. Overall, % germination was above 90% for all treatments indicating that herbicide applications had minimal effects to germination of the harvested seed. Thousand seed weights were also very comparable and fell within a very narrow range for each crop, with red clover having a 1.54g-1.66g TSW and alsike clover having a 0.74g-0.78g TSW. Overall, Valtera and Authority applications had minimal effects to both red clover and alsike clover seed quality.

Table 5. Treatment means for thousand seed weights (TSW) and % germination in Tolerance of Established Red and Alsike clover to Authority and Valtera in Melfort, SK 2020.

	Red Clover		Alsike Clover	
	Germination	TSW	Germination	TSW
Authority 1X	98	1.60	97	0.78
Authority 2X	95	1.60	98	0.76
Valtera 1X	94	1.60	93	0.76
Valtera 2X	97	1.66	96	0.78
Authority +Viper	92	1.54	96	0.74
Valtera + Viper	96	1.64	95	0.74
Viper ADV	94	1.58	95	0.74
Untreated Check	97	1.60	97	0.74

Conclusions: Established red and alsike clover were quite tolerant to in-crop applications of Valtera and Authority. Although, initial reduced tolerance was observed, visual tolerance issues appeared to resolve within a month after application. Weed control between the treatments was also minimal as red clover was able to outcompete most weeds and alsike clover had minimal weed pressure even in the untreated control. Seed yields were not statistically different, however average yields were reduced for both crops

when Valtera and Authority were applied. The 2X rate only resulted in an average yield decline as compared to the 1X rate for Valtera in alsike clover. This may indicate that alsike clover was less tolerant to increased rates of Valtera as compared to red clover. TSW's and % germination were very comparable for all treatments in both crops demonstrating that Valtera and Authority applications had minimal effects to seed quality. Overall, aside from initial reduced visual tolerance, Authority and Valtera had no significant effects on final seed yields and demonstrated minimal effects to seed quality, indicating that both products may be viable in-crop herbicides for established red and alsike clover grown for seed; however, repeating this trial for more years of data collection would be beneficial to ensure that the average yield losses observed in this site-year are not a result of initial reduced tolerance.