Tolerance of Established Alsike Clover Seed Crops to Viper and Solo

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Caution: *The following treatments are not registered for use and the researchers involved do not recommend their use. Use of these products is entirely at the risk of the producer or company involved.*

INTRODUCTION

Alsike clover is commonly grown for seed throughout the Peace River region of Alberta and BC. The majority of clover seed produced in the region is exported to the U.S. or Europe. Each state in the U.S. has different seed quality standards. Therefore, producing high quality seed with minimal weed seeds and high germination will ensure the seed is marketable to all areas. Weed seeds such as cleavers, volunteer canola, stinkweed, lamb's-quarters, American dragonhead, Canada thistle, white cockle and night-flowering catchfly and other clover species, such as sweet clover, reduce the quality of alsike clover seed.

Figure 1. Alsike clover seed field.

There are no herbicides registered for weed control in established alsike clover seed crops (Table 1). Previous trials have been conducted in the Peace River Region to evaluate what herbicides have potential for use on established alsike clover. Herbicides were tested at the 1x and 2x registered rates used in annual crop production. A summary of the seed yields from these trials is shown in Table 2.

Table 1. Registered and potential herbicides for use on established alsike clover seed crops.		
Weeds	Registered herbicides	Potential herbicides*
Broadleaf	Basagran Forte	Pursuit Ultra, Odyssey
Grassy	Assure II	Select

* Potential herbicides are those that have been tested and show promise but are not registered. These are not recommended.

Table 2. Summary of alsike clover seed yields as a percent of check following the application of broadleaved herbicides in the spring-Peace Region Trials, 2000-2006.

Treatment	Falher 2000	Guy 2000	Guy 2001	Guy 2002	Rycroft 2004	Falher 2005	Falher 2006	Average of Sites
Basagran 1x*	104		95	97	84	80	95	93(6**)
Basagran 2x*					89	102	109	100(3)
MCPA amine 1x	83		96	127	70	66		88(5)
MCPA amine 2x					52	34		43(2)
Odyssey 1x	76		78	101	87	88	101	89(6)
Odyssey 2x					73	80	121	91(3)
Pursuit Ultra 1x	105	103	88	101	95	93	121	101(7)
Pursuit Ultra 2x					98	97	102	99(3)
CHECK (kg/ha)	**591**	**469**	**398**	**344**	**458**	**327**	**426**	**100(8)**

*Basagran Forte used at Rycroft 2004, Falher 2005 and Falher 2006.
**is number of sites tested.

The application of Basagran or Basagran Forte to established alsike clover at both the 1x and 2x recommended rates used in cereal crops did not significantly reduce seed yields at any of the six test locations. Basagran Forte appears to be quite safe on established alsike clover as it did not cause any delays in flowering or stunting of the crop although it may cause some initial leaf burn in some years. The application of MCPA amine to established alsike clover caused severe visual damage and reduced seed yields. Pursuit Ultra caused slight stunting and delays in flowering but the damage was not noticeable 30 to 40 days following application. Pursuit Ultra at 1x recommended rate for use in field peas reduced seed yields in one of the six trials.

The application of Odyssey at both rates caused severe visual damage and stunting to alsike clover in most years. Odyssey 1x recommended rate on field peas significantly reduced seed yield at two of the seven test sites, while Odyssey 2x recommended rate reduced seed yield at one of the three test sites. The damage from the application of The effects of Odyssey on established alsike clover is variable from year to year and has caused more visual damage, delays in flowering and reductions in seed yield as compared to Basagran Forte or Pursuit Ultra.

Solo and Viper were recently registered for use on field peas. Solo controls a number of annual grassy weeds including volunteer cereals and wildoats. Solo also controls a number of broadleaved weeds including canola (with the exception of Clearfield canola), cow cockle, lamb's-quarters, shepherd's-purse and stinkweed. It also suppresses cleavers, kochia and wildbuckwheat. Viper controls similar weeds to Solo with the addition that it will control Clearfield canola. Studies were initiated in 2009 to evaluate tolerance of established alsike clover to Solo and Viper.

METHODS

Four trials were conducted over a three year period beginning in 2009. Three sites were located in the Peace River Region of Alberta and one site at the Scott research farm in Saskatchewan (Table 3). The trials conducted in the Peace Region were established on uniform and weed free fields of red clover that had been established with spring wheat the previous year. The trial conducted at Scott research farm was established on a uniform and weed free stand of red clover that had been seeded the previous year on summer fallow.

The experimental design for each study was a randomized complete block design with four replicates. Plot size for the Peace River Region sites was 2 m x 20 m while plot size for the Scott site was 2 x 5m. Herbicides were applied with a small plot sprayer using 100 l/ha water.

Herbicides evaluated in the study were Odyssey+Merge (imazamox+ imazethapyr) applied at one rate, Solo+Merge (imazamox) applied at two rates and Viper (imazamox+bentazon+28-0-0) at two rates (Table 4). The 1x and 2x rates are the recommended and two times recommended rates registered on field peas.

Visual ratings on percent injury were conducted throughout the summer (Table 5). Alsike clover plots were direct combined with a Wintersteiger Expert plot combine following a Reglone® application. Seed samples were cleaned. Germination on the seed was conducted on some of the treatments. Data was analyzed using Duncan's New MRT.

Table 3. Locations, herbicide application and harvest information for herbicide tolerance trials on established red clover seed crops.

Location	Spray Date	Crop Height (cm)	Harvest Area (m2)	Harvest Date
Falher, AB 2009	06-10-09	20	30.0	09-24-10
Eagelsham, AB 2010	06-08-10	25	30.0	09-24-10
Eaglesham , AB 2011	05-29-11	15	30.0	10-26-11
Scott, Sask. 2011	05-22-11	15	7.6	09-09-11

Table 4. Herbicide treatments applied in the trials to established alsike clover for seed production (2009 and 2010).

Treatment	Active Ingredient	Conc./ Form.	A.I. Rate kg A/ha	Product Rate g or mL/acre
Odyssey+Merge 1x	imazamox+ imazethapyr+ Merge	35 WG 35 WG	0.0147 0.0147 0.5% v/v	17g 0.5% v/v
Solo+Merge 1x	imazamox+ Merge	70 DG	0.020 0.5%	11.7 0.5%
Solo+Merge 2x	imazamox+ Merge	70 DG	0.040 0.5%	23.4 0.5%
Viper+28-0-0 1x	imazamox+ bentazon+	70 DG 480 EC	0.020 0.429	11.7 360

	28-0-0		2% v/v	2% v/v
Viper+28-0-0 2x	imazamox+ bentazon+ 28-0-0	70 DG 480 EC	0.040 0.858 2% v/v	23.4 720 2% v/v

Table 5. Description of visual crop tolerance ratings (0-100%).	
Tolerance Rating	Description
0-9%	Very little injury.
10-20%	Slight discoloration and/or stunting, flowering slightly delayed.
21-30%	Significant stunting, crop twisting and delayed flowering – considered unacceptable.
>30%	Severe
20% or less is considered acceptable injury.	

RESULTS

At the Falher-2010 site there was some slight stunting and delays in flowering to established alsike clover shortly after the application of Solo at both rates (Table 6). The alsike clover did recover from the injury prior to harvest. There were no differences in seed yield and seed germination among the treatments.

Table 6. Tolerance of established alsike clover to herbicides, Falher 2009- visual injury, seed yields and germination.

Treatment	**Visual Ratings % Injury**			**Yield kg ha^{-1}**	**Germ. %**
	13 DAT	49 DAT	105 DAT		
Odyssey+Merge 1x	1	0	0	280	95
Solo 1x+Merge 1x	8	0	0	268	96
Solo 2x+Merge 2x	18	4	0	272	96
Viper+28-0-0 1 x	0	0	0	253	95
Viper+28-0-0 2x	1	4	0	248	97
Check	**0**	**3**	**0**	**250**	**94**
CV%				6.1	2.4
LSD.05				NSD	NSD

Both Odyssey and Solo caused significant visual injury to established alsike clover at the Eaglesham site in 2010 (Table 7). Both herbicides caused severe stunting and delayed flowering of alsike clover. Viper at both the 1x and 2x recommended rates caused very little visual injury or delays in flowering to the alsike clover. The application of Odyssey 1x and Solo at both rates significantly reduced alsike clover seed yields as compared to the check. Viper applied at both rates did not reduce alsike clover seed yields. None of the treatments reduced seed germination.

Figure 2. The effect of Solo 1x (left side of stake) vs Viper 1x (right side of stake) on established alsike clover, Eaglesham 2010.

Table 7. Tolerance of established alsike clover to herbicides, Eaglesham 2010- visual injury, seed yields and germination.

Treatment	Visual Ratings % Injury					Yield kg ha^{-1}	Germ. %
	6 DAT	20 DAT	37 DAT	66 DAT	150 DAT		
Odyssey+Merge 1x	26	23	16	15	0	611 bc	99.0
Solo 1x+Merge 1x	30	25	24	23	0	587 c	98.3
Solo 2x+Merge 2x	35	39	35	29	0	511 d	
Viper+28-0-0 1 x	8	4	5	1	0	663 a	98.3
Viper+28-0-0 2x	14	11	9	3	0	645 ab	
Check	**0**	**0**	**0**	**0**	**0**	**685 a**	**98.3**
CV%						5.1	1.1
LSD.05 (P=.05)*						47	NSD

* Means followed by the same letter do not differ significantly (P=.05, Duncan's New MRT).

The application of Odyssey 1x and Solo 1x to alsike clover caused stunting and chlorosis (Table 8). These treatments also caused some of alsike clover leaves to turn redish in color. The application of Solo 2x resulted in similar damage but was more severe than the damage from Odyssey 1x and Solo 1x. Viper at both rates caused very little damage to established alsike clover with the exception of some leaf burn. The alsike clover did recover from the damage prior to harvest. The application of Odyssey to established alsike clover significantly reduced seed yields. None of the other treatments had any affects on alsike clover seed yields. Viper 2x significantly reduced alsike clover seed germination.

Table 8. Tolerance of established alsike clover to herbicides, Eaglesham 2011-visual injury, seed yields and germination.						
Treatment	**Visual Ratings % Injury**				**Yield kg ha^{-1}**	**Germ. %**
	9 DAT	16 DAT	30 DAT	108 DAT		
Odyssey+Merge 1x	10	19	10	0	559 b	92 a
Solo 1x+Merge 1x	10	21	8	0	575 ab	97 a
Solo 2x+Merge 2x	15	34	25	0	584 ab	
Viper+28-0-0 1 x	4	6	1	0	573 ab	95 a
Viper+28-0-0 2x	5	6	3	0	583 ab	85 b
Check	**0**	**0**	**0**	**0**	**636 a**	**95 a**
CV%					6.4	3.5
LSD.05					56	4.9

* Means followed by the same letter do not differ significantly (P=.05, Duncan's New MRT).

Solo 2x rate caused severe visual damage in the form of clorosis and stunting to established alsike clover at the Scott 2011 site (Table 9). This treatment also caused delays in flowering. Odyssey also caused some slight clorosis and stunting 9 DAT. The application of Viper also caused some initial chlorosis, stunting and slight leaf burn to established alsike clover. Despite some visual injury to alsike clover the crop did recover from the damage prior to harvest. None of the treatments reduced alsike clover seed yields.

Table 9. Tolerance of established alsike clover to herbicides, Scott Sask. 2011-visual injury and seed yields.					
Treatment	**Visual Ratings % Injury**				**Yield kg ha^{-1}**
	9 DAT	30 DAT	49 DAT	65 DAT	
Odyssey+Merge 1x	9	1	2	0	336
Solo 1x+Merge 1x	12	4	1	0	363
Solo 2x+Merge 2x	23	11	11	4	340
Viper+28-0-0 1 x	5	0	0	0	349
Viper+28-0-0 2x	8	1	0	0	316
Check	**0**	**0**	**0**	**0**	**354**
CV%					14.5
LSD.05					NSD

SUMMARY

The application of Odyssey and Solo to established alsike clover caused severe visual damage and delayed flowering of alsike clover although in all cases the clover did recover prior to harvest. Odyssey reduced alsike clover seed yields at two of the four sites it was tested. Solo reduced seed yields at one of the four sites. The application of Viper at both 1x and 2x rates applied to established alsike clover caused very little visual damage, delays in flowering or reduction in seed yield. Established alsike clover has shown good tolerance to the application of Viper in the four trials conducted to date. A minor-use registration for the application of Viper to established alsike clover grown for seed should be submitted.

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