The Seed Head
Fact sheet # 10

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A three year study of growth regulator (trinexapac-ethyl) use on red clover seed crops in the Peace River region

Effects of trinexapac-ethyl on red clover seed crop, Beaverlodge, 2013

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Introduction

In the past few decades there has been an increased interest in plant growth regulators (PGRs) and their use on grass and legume seed crops. Studies on red clover have shown that the PGR trinexapac-ethyl (TE) can have a significant impact on plant height reduction, lodging, increased flower production, and therefore an increase in seed yield (up to a 34% increase in yield found in various trials done in Oregon and in Norway). In general TE has been found to be most effective when applied at early stem elongation[1] or as a split application between growth stages (GS) 32 and 50[2]. Single late stage applications (at GS 50-51) have been less effective or have exhibited a greater negative effect on seed weights[3]. Studies have shown that seed weights tend to decrease with TE use, though inflorescence counts tend to increase which is thought to be one of the contributing factors to the greater seed yields noted in many studies[4].

Trials were conducted in 2013, 2014 and 2015 in partnership with the Smoky Applied Research and Demonstration Association (SARDA) and Agriculture and Agri-Food Canada to explore the impacts of TE use on first year red clover seed fields. TE is currently registered in Canada as Parlay™ for use on turf-type perennial ryegrass only. Studies such as this may contribute to its registration for other grass and legume seed crops.

Methods

Small plot randomized replicated trials (2m x 40 m and 4 reps) were set up in each field. Each trial consisted of six treatments (measured in kg ai ha^{-1} TE):

1) 0.140 stem elongation
2) 0.280 stem elongation
3) 0.420 stem elongation
4) 0.210 stem elongation + 0.210 bud
5) 0.280 bud
6) Check

Treatments were applied with a handheld small plot sprayer. Water volume was 100L/ha. Application dates/stages and harvest information are shown in Table 1. Trials were dessicated with Reglone prior to harvest and straight combined. Area harvested was $64m^2$. Data collected included plant heights, flower counts, seed yields, germination and 1000 seed kwts. Growing season precipitation information was sourced from local weather stations and is shown in Table 2.

Table 1. Applications dates and stages for trinexapac-ethyl on red clover seed crop

Site and Year	1st Application Date/Stage	2nd Application Date/Stage	Harvest Date
Beaverlodge 2013	June 17th/stem elongation	June 28th/bud	October 27th
Girouxville 2013	June 7th/stem elongation	June 24th/early flower	October 31st
Girouxville 2014	June 11th/stem elongation	July 1st/bud	August 22nd
Girouxville 2015	June 15th/stem elongation	July 29th/bud	September 29th

1 Anderson et al 2015a and 2015b, Chastain et al 2014; 2 Anderson et al 2012; 3 Chastain et al 2013 and 2014; 4 Anderson et al 2015a, 2015b and 2012 (Full references for these documents at end of Seed Head fact sheet)

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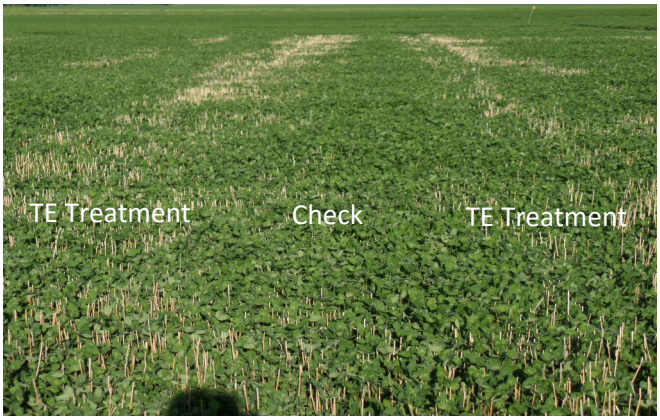
Table 2. Growing season precipitation for red clover trial (inches)

	Beaverlodge 2013		Girouxville 2013		Girouxville 2014		Girouxville 2015	
	2013	LTA*	2013	LTA	2014	LTA	2015	LTA
May	1.6	1.6	1.0	1.7	0.3	1.7	0.6	1.7
June	3.5	2.5	4.1	3.0	1.4	3.0	1.0	3.0
July	3.0	2.8	2.3	2.7	0.9	2.7	1.2	2.7
August	3.7	2.3	2.3	1.9	0.2	1.9	2.2	1.9
Total	11.8	9.2	9.7	9.3	2.8	9.3	5.0	9.3
**Long Term Average*								

Results & Discussion

Trials in all three years showed a reduction in plant height in every treatment (Tables 3-5). A decrease in lodging was noted in the year with above average precipitation. There appeared to be a visual increase in flowers, particularly in 2013 which was the wetter year. There was a slight trend for increase in flower counts in 2013. Similar studies carried out in other regions (e.g. Oregon) have often seen significant increases in inflorescence counts with TE use. Seed yields for red clover increased in all years but 2014 which was particularly dry (Table 6). A decrease in yield was seen under stress (dry) conditions in 2014. Optimum treatment rate for increased seed yield varied with location and year.



Effects of trinexapac-ethyl on red clover seed crop, Girouxville, 2014

Table 3. Effect of trinexapac-ethyl on red clover seed crop - 2013

	Girouxille				Beaverlodge	
Treatment (kg ai/ha)	**Plant Ht (cm)**	**Flowers (#/0.25m$^{2)}$**	**Seed Yield (kg/ha)**	**Germ (%)**	**Plant Height (cm)**	**Seed Yield (kg/ha)**
0.140 Stem Elongation	67.8 a	274	493	97	78.2 b	192
0.280 Stem Elongation	59.8 bc	238	499	99	81 b	167
0.420 Stem Elongation	61.3 bc	278	474	98	76.7 b	209
0.210 Stem Elonga-tion+0.210 Bud	58.5 c	274	466	99		
0.280 Bud	65.0 ab	212	475	97	87.0 a	177
Check	68.5 a	232	417	98	87.7 a	151
CV%	4.6	20.8	11.2	1.9	2.9	16.5
LSD (p=0.05)	4.4	NSD	NSD	NSD	4.5	NSD

CV - coefficient of variance; LSD - least significant difference; NSD - not significantly different
a, b, c - results followed by the same letter do not significantly differ (p=0.05, Student-Newman-Keuls)

Table 4. Effect of trinexapac-ethyl on red clover seed crop - Girouxville 2014

Treatment (kg ai/ha)	Plant Height (cm)	Flowers (#/0.25m$^{2)}$	Seed Yield (kg/ha)*	Germination (%)	1000 kwt (g)
0.140 Stem Elongation	39.4 b	107	53 a	97.1	1.391 ab
0.280 Stem Elongation	32.7 c	114	37 ab	96.5	1.345 b
0.420 Stem Elongation	31.7 c	96	34 b	98.1	1.294 c
0.210 Stem Elongation+0.210 Bud	34.5 c	103	34 b	98.7	1.242 c
0.280 Bud	42.5 ab	100	42 ab	97.6	1.281 c
Check	43.8 a	100	53 a	96.6	1.435 a
CV%	5.6	9.2	18.9	1.9	2.48
LSD (p=0.05)	3.1	NSD	12	NSD	0.051

** Combine setting incorrect, trial yield data lower than actual yield*
CV - coefficient of variance; LSD - least significant difference; NSD - not significantly different
a, b, c - results followed by the same letter do not significantly differ (p=0.05, Student-Newman-Keuls)

Results & Discussion (cont'd)

In all years treatment applied at early stem elongation, as opposed to a split or late (bud) treatment only, appeared to have the greatest effect on increasing seed yield, though the optimum TE application rate varied. In 2013 and 2015 lower plant heights correlated with higher seed yields, though in the drier year of 2014 this was not the case.

In general, plant heights in 2014 were lower than in other years, likely due to the poorer seasonal (dry) growing conditions. Seed germination was not affected by the application of TE while 1000 seed weights were lower following the application of TE. It is recommended that an additional trial take place for red clover in 2016.

Table 5. Effect of trinexapac-ethyl on red clover seed crop - Girouxville 2015

Treatment (kg ai/ha)	Plant Height (cm)	Flowers (#/0.25m$^{2)}$	Seed Yield (kg/ha)	Germination (%)	1000 kwt (g)
0.140 Stem Elongation	54.3	124	295	97.5	1.501 a
0.280 Stem Elongation	54.5	132	297	96.5	1.444 ab
0.420 Stem Elongation	50.2	152	311	94.8	1.449 ab
0.210 Stem Elongation+0.210 Bud	50.4	159	287	98.0	1.398 bc
0.280 Bud	50.6	159	294	99.0	1.356 c
Check	58.5	158	286	98.3	1.509 a
CV%	9.0	21.5	4.8	2.1	2.8
LSD (p=0.05)	NSD	NSD	NSD	NSD	0.06

CV - coefficient of variance; LSD - least significant difference; NSD - not significantly different
a, b, c - results followed by the same letter do not significantly differ (p=0.05, Student-Newman-Keuls)

Table 6. Effects of growth regulator on red clover seed yields, percent of check

Treatment (kg ai/ha)	Beaverlodge 2013	Girouxville 2013	Girouxville 2014	Girouxville 2015
0.140 Stem Elongation	+27	+18	0	+3
0.280 Stem Elongation	+10	+19	-31	+4
0.420 Stem Elongation	+38	+13	-36	+8
0.210 Stem Elongation+0.210 Bud		+12	-36	0
0.280 Bud	+17	+14	-21	+3

Summary

- Plant height reduction in every treatment in every year.
- Trend for increased flower counts in wet year for TE applied at stem elongation.
- Seed weight significantly lower as a result of TE application.
- No effects on seed germination.
- Decreased lodging in wet year.
- Trends for seed yield increase in 2013 and 2015, more pronounced increase in 2013 (wetter year).
- Significant decrease in seed yield in dry (stressed) conditions of 2014.
- Additional trial for red clover planned for 2016.

Red clover field with hives

References (A full list of resources will be available on the PRFSA website)

1) Anderson NP, Chastain TG, Garbacik CJ. 2015a. Irrigation and trinexapac-ethyl effects on seed yield in first- and second-year red clover stands. In Anderson N, Hulting A, Walenta D, Flowers M, Sullivan C, editors. 2014 Seed Production Research Report. Oregon State University: Ext/CrS 151.
2) Anderson NP, Chastain TG, Garbacik CJ, Silberstein TB. 2012. Effect of foliar applications of trinexapac-ethyl plant growth regulator on red clover seed crops. In Young III WC, editor. 2011 Seed Production Research Report. Oregon State University: Ext/CrS 136.
3) Anderson NP, Monks DP, Chastain TG, Rolston MP, Garbacik CJ, Chun-hui Ma, Bell CW. 2015b. Trinexapac-ethyl effects on red clover seed crops in diverse production environments. Agron. J. 107:951-956.
4) Chastain TG, Anderson NP, Garbacik CJ. 2013. Irrigation and PGR effects on red clover seed production. In Hulting A, Anderson N, Walenta D, Flowers M, editors. 2012 Seed Production Research Report. Oregon State University: Ext/CrS 143.
5) Chastain TG, Anderson NP, Garbacik CJ, Angsumalee D, Elias SG. 2014. Irrigation and trinexapac-ethyl effects on seed yield in a second-year red clover stand. In Anderson N, Hulting A, Walenta D, Flowers M, editors. 2013 Seed Production Research Report. Oregon State University: Ext/CrS 150.

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