Effect of trinexapac-ethyl plant growth regulator on red clover seed crops in western Oregon

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Introduction

The use of foliar applied plant growth regulators (PGRs) has become commonplace in cool-season grass crops grown for seed in Oregon and other parts of the world in the last decade. This practice has been adopted due to well documented seed yield increases and reduction in lodging (Chastain et al., 2003). Excessive growth of red clover interferes with maximum seed production and harvest. Lodging can also result in increased problems from disease and can reduce the number of inflorescences (heads) available for pollination. Stem elongation and flowering of red clover are long-day responses mediated by the plant hormone gibberellic acid (Lunnan, 1989). Trinexapac-ethyl (TE), commercially known as Palisade or Moddus, is a plant growth regulator that inhibits gibberellic acid biosynthesis which has resulted in a positive effect in controlling plant height and improving yield in grass and other seed crops.

A study conducted in Norway reported a 21% seed yield increase in red clover crops when TE was applied at stem elongation (Øverland and Aamlid, 2007). In 2004, Moddus was registered for use on red clover seed crops in Norway.

Methods

Large scale on-farm trials were conducted on 8 commercial red clover fields from 2010-2012. Plots were arranged in randomized complete blocks with three replications. Each plot was 6 m or 7.6 m wide by 91.4 m long. Five rate and timing combinations were used to determine the effect of TE. Treatments consisted of 240 g ai ha^{-1} TE (Stem E 240) and 480 g ai ha^{-1} TE (Stem E 480) applied at stem elongation (BBCH scale 32), TE applied at bud emergence stage (BBCH scale 50) at 240 g ai ha^{-1} (Bud E 240), 240 g ai ha^{-1} TE applied at both timings (Split 480), and an untreated control. In all years, seed yield and weight were measured, while head and floret counts, and canopy height measurements were made in 2011 and 2012.

Figure 1. Marked areas show increased seed head density following TE applications.

Results

TE increased seed yields by 15 to 34% compared to the control in 2010 (data not shown), 5 to 13% in 2011 (Table 1) and 7 to 12% in 2012 (Table 2). In all three years, a 480 g ai ha^{-1} TE applied at stem elongation or a split application of 240 g ai ha^{-1} TE applied at both morphological timings were among the best treatments for increasing seed yield. Seed weight was inversely related to seed yield; treatments producing the highest seed yield had the lowest seed weight. Heads m^{-2} were increased by all TE treatments (Fig. 1). Florets $head^{-1}$ were not influenced by TE except 480 g ai ha^{-1} TE applied at stem elongation in 2011. In 2011, the 480 g ai ha^{-1} TE applied at stem elongation reduced canopy height, and that tendency was evident in other treatments. In 2012, all TE treatments reduced canopy height.

Table 1. Effect of TE timing and application rates on red clover clean seed yield and yield components in 2011.

TE timing and rate	Clean seed yield	Seed weight	Heads	Florets	Canopy height
g ai ha^{-1}	kg ha^{-1}	mg	no. m^2	no. $head^{-1}$	cm
Untreated control	1110 a†	1.88 c	969 a	122 b	54.0 b
Stem E 240	1186 b	1.85 bc	1227 b	124 b	51.2 ab
Stem E 480	1210 bc	1.81 ab	1432 b	132 a	48.1 a
Bud E 240	1160 ab	1.82 ab	1227 b	122 b	49.3 ab
Split 480	1251 c	1.79 a	1302 b	125 b	48.5 ab

† Means followed by the same letter are not different.
$P \leq 0.05$.

Table 2. Effect of TE timing and application rates on red clover clean seed yield and yield components in 2012.

TE timing and rate	Clean seed yield	Seed weight	Heads	Florets	Canopy height
g ai ha^{-1}	kg ha^{-1}	mg	no. m^2	no. $head^{-1}$	cm
Untreated control	864 a†	1.70 c	425 c	116 ab	73.9 c
Stem E 240	923 ab	1.68 bc	632 a	128 c	64.9 b
Stem E 480	977 b	1.65 ab	596 ab	123 bc	59.1 a
Bud E 240	921ab	1.64 ab	481 bc	112 a	66.4 b
Split 480	948 b	1.61 a	636 a	120 abc	59.3 a

† Means followed by the same letter are not different.
$P \leq 0.05$.

Conclusion

In all years of this study, red clover grown for seed was responsive to TE applications. Our results suggest that the cause of seed yield increase was increased production of seed heads and reduction in canopy height. Field observations indicate that in addition to increasing seed yield, TE treatments also promoted earlier maturation of the crop, allowing for a more timely harvest. Additionally, TE treatments shortened plant height resulting in less need for straw residue management.

References

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