Effect of Plant Growth Regulator and Irrigation on Physiological and Harvest Maturity in Relation to Seed Quality of Red Clover

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Introduction

Red clover (*Trifolium pratense* L.) is widely grown as a legume seed crop in western Oregon. An earlier study revealed that seed yield was affected by irrigation and by a plant growth regulator, trinexapac-ethyl (TE) (Anderson *et al*., 2012). However, the effect of these factors on physiological maturity (PM), harvest maturity (HM), and seed quality has not been reported. The PM is reached when seeds possess maximum dry weight and HM is attained when seeds reach optimum moisture content for mechanical harvest. The objective of this study was to determine the effect of irrigation and TE (Palisade EC®) on PM and HM as well as viability and vigor at different stages of seed maturity. The information generated from the study is useful for maximizing yield and quality of red clover seed crops.

Methods

Red clover seeds (uncertified common variety) were planted at Hyslop Crop Science Research Farm, Corvallis, Oregon in 2011. Plots were arranged in randomized complete block design with TE treatments as split plots on irrigated and non-irrigated main-plots with four replications. Five TE rates were sprayed at stem elongation (BBCH 32) or bud formation (BBCH 50) growth stages (Fig. 1).

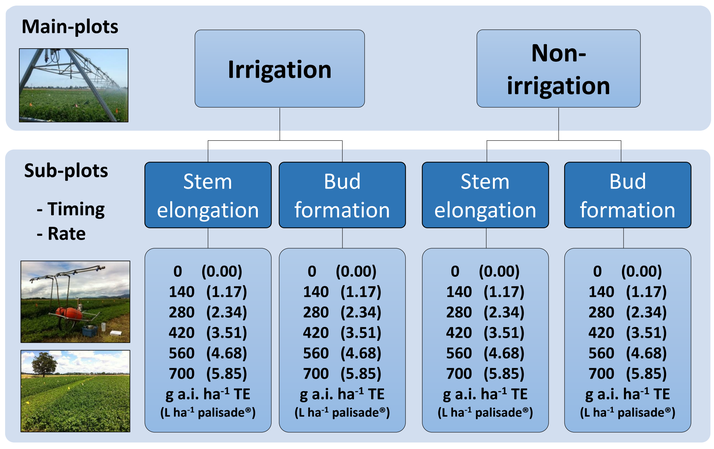

Figure 1. Rates and timing (stage) of application of TE for irrigated and non-irrigated treatments of red clover.

Seeds were sampled twice each week after anthesis until harvest. Physiological and phenological indicators of seed maturity were collected to determine PM and HM (Elias and Copeland, 2001). Standard germination test, tetrazolium (TZ) test, and cold test were conducted to evaluate seed viability and vigor at weekly intervals after anthesis. Data were collected two years, 2012 and 2013.

Results

Effects of TE and irrigation on PM and HM

The two-year study period indicated that neither rate nor timing of TE application had any significant effect on PM and HM compared to the untreated control. The irrigation resulted in a four-day delay in PM and HM compared to the non-irrigated treatment. Seed dry weight did not change significantly from PM to HM. Seed moisture content at PM ranged from 340 to 540 g kg^{-1}, and was approximately 100 g kg^{-1} at HM (Fig. 2).

The PM and HM of the second-year stand, 2013, were approximately one week earlier than the PM and HM of the first-year stand, 2012. The earlier PM and HM in the second year may be because the temperature during seed development in 2013 was higher than those in 2012 (data not shown).

Visual indicators of PM and HM

Red clover from all treatments reached PM when the inflorescences contained light brown petals with pale green sepals. Seeds ranged from pale green to pale yellow.

At HM, inflorescences contained dark brown petals and sepals and seeds were yellow or different shades of yellow-purple. Seeds were hard and easy to separate from the inflorescences at HM (Fig. 3).

Effects of TE and Irrigation on Seed Quality

The TE application at stem elongation increased seed yield in 2013, but not in 2012. Irrigation treatment increased seed yield in 2012 and 2013 (data not shown). Seed quality at HM in both years was not significantly different among TE and irrigation treatments. The viability as measured by TZ and germination tests ranged from 93 to 100% and vigor by the cold test ranged from 92 to 96%. At PM, seed viability ranged between 62 and 91%, and seed vigor ranged between 7 and 28%. Thus, maximum seed viability and vigor were reached at HM (Fig. 4).

Conclusions

- Neither rate nor timing of TE application had significantly effect on PM or HM of red clover compared to control.
- Irrigation treatment delayed PM and HM by four days.
- Seed quality, viability and vigor, reached maximum levels at HM and was not significantly different among TE and irrigation treatments.

References

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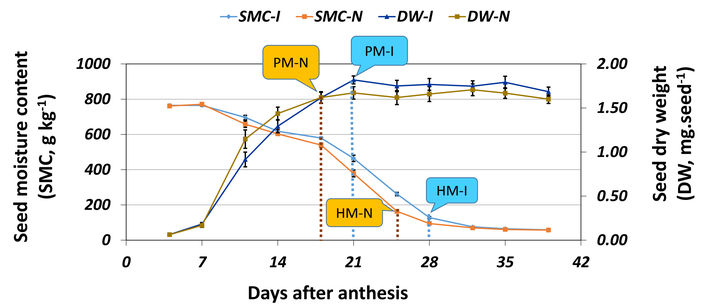

Figure 2. Physiological (PM) and harvest maturity (HM) resulted from irrigated (I) and non-irrigated (N) treatments in 2013. If error bars regions do not overlap, treatments are significantly different.

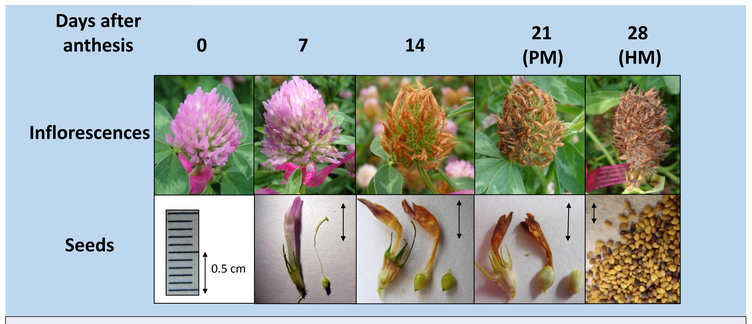

Figure 3. Visual indicators of PM and HM for inflorescences and seeds.

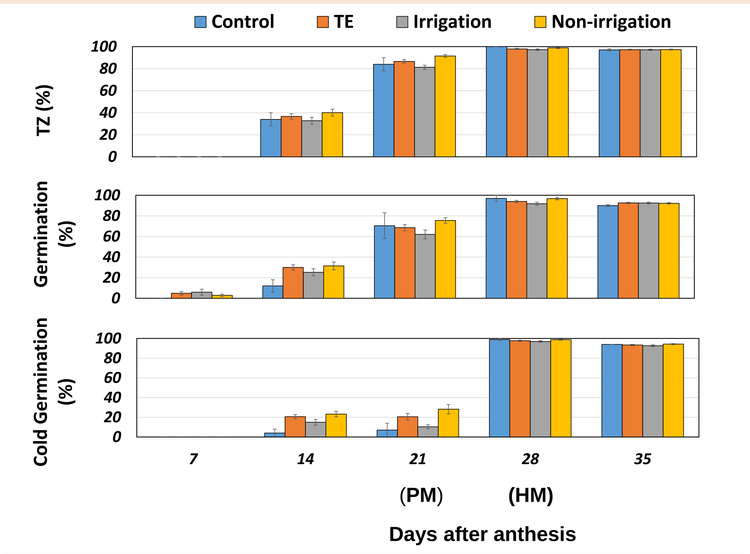

Figure 4. Tetrazolium test (TZ), standard germination test, and cold test in 2013.
TE = average over rates and times of TE applications.
Irrigation = average over irrigated treatments.
Non-irrigation =average over non-irrigated treatments.
If error bars regions do not overlap, treatments are significantly different.

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