PLANT GROWTH REGULATOR AND IRRIGATION EFFECTS ON WHITE CLOVER SEED CROPS

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Introduction

Forage legume seed crops, including white clover grown for seed, are a vital part of seed production enterprises and valuable rotation crops for grass seed crops grown in Oregon. While white clover seed crop acreage has increased dramatically over the past decade in Oregon, seed yields harvested by growers have shown smaller increases over that period, compared to red clover and crimson clover seed crops. Recent work has demonstrated that trinexapac-ethyl (Palisade EC) plant growth regulator (PGR) is a key tool for increasing seed yield in red clover (Anderson et al., 2015; Øverland and Aamlid, 2007). This 2-year study was undertaken to determine whether trinexapac-ethyl and paclobutrazol (Bonzi) PGRs can also be utilized to further improve seed yield in white clover.

Seed yield in white clover seems to be related to the number of inflorescences (heads) per unit area. Inflorescences arise in the leaf axils of stolons (horizontal above-ground stems). To maximize the production of inflorescences, the stolons need unshaded space in which to grow. Moreover, the indeterminate habit of white clover means that there is a broad period of flowering with no definitive peak, so the timing of management practices to enhance seed yield is more difficult than in other vertically elongated clover species.

The most widely tested PGR in white clover seed production has been paclobutrazol. Previous results with paclobutrazol have been variable. When paclobutrazol is effective, however, seed yield increases have been encouraging. More recently, trinexapac-ethyl has received some attention in white clover seed crops in New Zealand, but most reports indicate that seed yield responses have not been as beneficial as in red clover (Chakwizira et al., 2011). No information is available on the responses of white clover seed crops to paclobutrazol or trinexapac-ethyl PGRs under Oregon conditions.

Irrigation research has shown mixed effects on seed yield in white clover, and therefore irrigation is not widely practiced in the Willamette Valley. However, growers have expressed interest in seeing more research data on the effects of irrigation in white clover seed production. Oliva et al. (1994) suggested that irrigation could increase white clover seed yield in western Oregon, but there is a need to control the excessive development of stolons in response to irrigation. One aim of this study was to determine whether PGRs could be used as a tool to manipulate the development of stolons in irrigated stands by reducing the internode length, thus providing a better environment for flowering and improved seed yield.

Materials and Methods

Field plots were established with ladino (VNS) white clover at OSU's Hyslop Farm in the fall of 2014 and followed for two seed harvests (2015 and 2016). The experimental design for the trials was a randomized complete block with a split-plot arrangement of treatments and four replications. Main plots were irrigation treatments, and subplots were PGR products and rates. The PGR subplots were randomly allocated within irrigation main plots.

Irrigation main plots included:

- No irrigation
- Irrigation (4 inches)

PGR subplots included the following products and rates in 2015 and 2016:

2015

- Palisade EC (4.3 pt/acre)
- Palisade EC (5.7 pt/acre)
- Bonzi (0.89 lb ai/acre)

2016

- Palisade EC (2.15 pt/acre)
- Palisade EC (4.3 pt/acre)
- Bonzi (0.89 lb ai/acre)

Plot size was 11 feet x 50 feet. One strategically timed application of irrigation was carried out on irrigated white clover treatments during early flowering. Above-ground biomass was taken from plots near crop maturity, and total above-ground biomass was determined. Inflorescence number was ascertained near peak flowering.

Seed was harvested with a small-plot swather and combine, and seed yield was determined on the cleaned seed. Seed weight was determined by counting two 1,000-seed samples with an electronic seed counter and weighing these samples on a laboratory balance. Harvest index, the ratio of seed yield to above-ground biomass, was also measured.

Results and Discussion

Irrigation had no effect on seed yield, but increased seed weight in both years (Tables 1 and 2). In the first-year stand (2015), application of Palisade EC decreased seed yield and seed weight (Table 1). The high rates of Palisade EC seemed to have phytotoxic effects on the foliage. Palisade EC rates were reduced in the second year, and there was no effect on seed yield, although seed weights still decreased compared to the control (Table 3). Cleanout was not affected by irrigation or PGRs in either year.

Aside from seed weight, irrigation had no effect on any of the seed yield components measured in either year (Tables 3 and 4). In the first-year stand (2015), neither PGR affected dry weight or number of inflorescences (Table 3). However, Palisade EC increased florets per inflorescence. Bonzi had no effect. Irrigation had no effect on harvest index, while PGRs had mixed effects. In the second-year stand (2016), Bonzi had no effect

Table 1. Seed yield, percent cleanout, and 1,000-seed weight measurements following PGR applications applied at stem elongation in irrigated and nonirrigated environments, 2015.[1]

	Yield	Cleanout	Seed weight
	(lb/a)	(%)	(mg seed^{-1})
Irrigation			
Irrigated	487	9.8	0.57 b
Nonirrigated	494	10.4	0.54 a
Treatment			
Control	557 b	10.8	0.59 c
Palisade EC 4.3 pt/a	424 a	10.6	0.51 b
Palisade EC 5.7 pt/a	400 a	11.1	0.50 a
Bonzi 0.89 lb ai/a	560 b	8.7	0.59 c

[1]Means followed by the same letter are not different at LSD (*P* = 0.05).

Table 2. Seed yield, percent cleanout, and 1,000-seed weight measurements following PGR applications applied at stem elongation in irrigated and nonirrigated environments, 2016.[1]

	Yield	Cleanout	Seed weight
	(lb/a)	(%)	(mg seed^{-1})
Irrigation			
Irrigated	481	8.0	0.59 b
Nonirrigated	458	6.2	0.57 a
Treatment			
Control	494	7.2	0.60 c
Palisade EC 2.15 pt/a	474	7.4	0.57 b
Palisade EC 4.3 pt/a	443	7.2	0.54 a
Bonzi 0.89 lb ai/a	449	6.4	0.60 c

[1]Means followed by the same letter are not different at LSD (*P* = 0.05)

Table 3. Seed yield component measurements following PGR applications applied at stem elongation in irrigated and nonirrigated environments, 2015.

	Dry weight	Inflorescences	Florets[1]	Harvest index[1]
	(g/m^{-2})	(number/m^{-2})	(number/inflorescence)	(%)
Irrigation				
Irrigated	748.3	636.7	85	7.5
Nonirrigated	651.6	607.7	85	8.8
Treatment				
Control	760.2	605.3	80 a	8.6 bc
Palisade EC 4.3 pt/a	666.9	616.0	92 b	7.4 ab
Palisade EC 5.7 pt/a	694.7	632.8	89 b	6.6 a
Bonzi 0.89 lb ai/a	694.2	623.4	82 a	9.5 c

[1]Means followed by the same letter are not different at LSD (*P* = 0.05)

Table 4. Seed yield component measurements following PGR applications applied at stem elongation in irrigated and nonirrigated environments, 2016.

	Dry weight	Inflorescences[1]	Florets	Harvest index[1]
	(g/m^{-2})	($number/m^{-2}$)	(number/inflorescence)	(%)
Irrigation				
Irrigated	783.1	741	74	7.1
Nonirrigated	672.8	742	77	8.7
Treatment				
Control	747.0	699 ab	75	8.6 b
Palisade EC 2.15 pt/a	771.5	845 c	75	6.6 a
Palisade EC 4.30 pt/a	723.5	800 bc	80	6.3 a
Bonzi 0.89 lb ai/a	717.4	689 ab	75	9.1 b

[1]Means followed by the same letter are not different at LSD (*P* = 0.05)

on any yield components, but TE increased numbers of inflorescences/m^2 (Table 4). Unfortunately, this increase did not influence seed yield. PGRs had no effect on floret number in the second-year stand.

Results from this 2-year trial indicate that irrigation and PGRs do not influence seed yield of white clover crops grown in western Oregon. Therefore, we do not recommend either practice on commercial fields at this time.

References

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