# Optimizing the Use of Plant Growth Regulators in Grass and Clover Seed Crops

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Trinexapac-ethyl (Palisade)



Prohexadione-calcium (Apogee)



- Plant growth regulator (PGR) work began in the 1980's with paclobutrazol and uniconazole to control lodging.
- Ttrinexapac-ethyl (TE) and prohexadione calcium (PC) currently registered on grass seed crops in Oregon.
- TE and PC PGRs inhibit the 3-β hydroxylation of GA<sub>20</sub> to GA<sub>1</sub>. GA<sub>1</sub> promotes stem elongation, GA<sub>5</sub> promotes flowering, GA<sub>29</sub> is inactive.
- Chlormequat chloride (CCC) coming to the grass seed market in North America. CCC works much earlier in the GA biosynthesis pathway.

#### Chlormequat Chloride (Manipulator)



- Stem elongation is promoted by the hormone GA<sub>1</sub>.
- When elongating stems cannot support the weight of inflorescences, tillers lodge or fall to the ground.
- Lodging restricts pollination and reduces fertilization, and in turn reduces seed yield.
- Seed number is reduced by lodging.



#### PGR plant effects

#### Palisade and Apogee PGR Effects Increased floret number

Increased noret number Increased seed set Increased seed number Increased seed yield Increased harvest index Mixed effects on seed weight Decreased stem length Decreased lodging  The biggest increases in seed number can be obtained through PGRs and Nitrogen.



Effect of Palisade (TE) PGR rate on seed number in tall fescue and perennial ryegrass (Chastain et al, 2014).

## PGRs in Grass Seed Crops Trinexapac-ethyl treated

- Spike Length = 7.4 inches
- Spikelets/Spike = 22.3
- Seeds/Spike = 48.3



Untreated

- Spike Length = 8.5 inches
- Spikelets/Spike = 23.0
- Seeds/Spike = 40.8

Effect of trinexapac-ethyl (TE) on perennial ryegrass spike morphology (TG Chastain photo)

TE rate effects on perennial ryegrass seed production in 9 years of trials (Chastain et al., 2014).

TE rate	Seed yield	Yield increase
g ai ha <sup>-1</sup>	lbs/acre	%
0	1305 a	0
200	1635 b	25.3
400	1868 c	43.1
600	2056 c	57.6



Perennial ryegrass seed (USDA photo)





#### **Plant Growth Regulator Mixtures**

Plant growth regulator (PGR) effects on seed yield of four turf-type tall fescue seed crops from 2015 – 2017 (Anderson et al., 2018).

PGR treatment	PGR Timing	Seed Yield 2016	Seed Yield 2017	2 Year Avg. Yield Change
		lb a <sup>-1</sup>	·	%
Untreated Control		2,033 a	2,276 a	0
210 g ai ha <sup>-1</sup> TE	GS 32	2,511 b	2,748 b	22.0
1.3 lbs/a CCC	GS 32	2,137 a	2,235 a	1.4
210 g ai ha-1 + 0.7 lbs/a CCC	GS 32	2,609 b	2,805 b	25.6
210 g ai ha <sup>-1</sup> + 1.3 lbs/a CCC	GS 32	2,590 b	2,854 b	26.3
210 g ai ha <sup>-1</sup> TE + 0.7 lbs/a CCC	GS 32	2,457 b	2,732 b	20.4

LSD = 0.05



TE rate effects on creeping red fescue seed production in 3 years of trials (Silberstein et al., 2002).

TE rate	Year 1	Year 2	Year 3	Mean
g ai ha⁻¹		Lbs	acre	
0	1295	1151	896	1114 a
200	1504	1680	1477	1554 b
400	1771	1938	1707	1805 c
600	1796	1961	1645	1801 c





TE rate effects on chewings fescue seed production in 3 years of trials (Silberstein et al., 2002).

TE rate	Year 1	Year 2	Year 3	Mean
g ai ha <sup>-1</sup>		Lbs	acre	
0	1467	1190	1368	1342 a
200	1757	1732	1956	1815 b
400	1672	1812	2173	1886 b
600	1881	1688	2033	1867 b







PC effects on creeping red fescue and chewings fescue seed production in 3 years of trials (Silberstein et al., 2002).

Species	PC rate	Year 1	Year 2	Year 3	Mean
	lbs/acre		lbs	s a <sup>-1</sup>	
Creeping	0	1295	1151	896	1114 a
Red Fescue	0.25	1538	1527	1601	1555 b
Chewings	0	1555	1190	1387	1377 a
Fescue	0.25	1933	1698	1902	1844 b

 0.25 lb ai/acre rate of PC produced results similar to the 200 g ai/ha rate for TE.



#### **Plant Growth Regulator Mixtures**

Plant growth regulator (PGR) effects on seed yield of 'Wendy Jean' creeping red fescue seed crops (Anderson et al., unpublished).

PGR treatment	PGR Timing	Seed Yield 2019	Yield Change
		Ib a <sup>-1</sup>	%
Untreated Control		1,187 a	0
210 g ai ha <sup>-1</sup> TE	GS 32	1,416 c	19.3
400 g ai ha <sup>-1</sup> CCC	GS 32	1,297 b	9.3
210 g ai TE + 200 g ai ha <sup>-1</sup> CCC	GS 32	1,370 bc	15.4

LSD = 0.05



#### **Plant Growth Regulator Mixtures**

Plant growth regulator (PGR) effects on seed yield of 'Survivor' Chewings fescue seed crops (Anderson et al., unpublished).

PGR treatment	PGR Timing	Seed Yield 2019	Yield Change
		lb a <sup>-1</sup>	%
Untreated Control		786 a	0
210 g ai ha <sup>-1</sup> TE	GS 32	865 a	10.1
400 g ai ha <sup>-1</sup> CCC	GS 32	907 a	15.5
210 g ai TE + 200 g ai ha <sup>-1</sup> CCC	GS 32	1,115 b	41.9

LSD = 0.05



#### **PGRs in Red Clover Seed Crops**

TE rate and stand age effects on red clover seed yield with TE was applied at BBCH 32 (stem elongation).

	Stai	nd 1	Star	Stand 2		ncrease
TE rate	1 <sup>st</sup> Year	2 <sup>nd</sup> Year	1 <sup>st</sup> Year	2 <sup>nd</sup> Year	1 <sup>st</sup> Year	2 <sup>nd</sup> Year
g ai ha <sup>-1</sup>	lbs/acre			9	%	
0	818	698	621	639	0	0
140	860	818	618	717	2.7	14.8
280	852	826	630	741	3.0	17.2
420	844	833	614	754	-1.4	18.7

Consistent seed yield increases were observed in 2<sup>nd</sup> year stands, but not in 1<sup>st</sup> year stands. Applications at bud elongation (BBCH 50) did not increase yield.



#### Seed Weight and Seed Number





#### **PGRs in Red Clover Seed Crops**

PGR rate and timing effects on red clover seed yield. TE was applied at BBCH 32 (stem elongation) and BBCH 50 (bud emergence).



### **PGRs in Grass and Clover Seed Crops**

- Registered PGRs still provide significant seed yield increases in grass seed crops.
- Optimum PGR rates vary by species must be tested.
- Best seed yields are attained by PGR applications between early stem elongation (GS 32) and early head emergence (GS 51).
  Varies by species.
- Product choice. TE vs. PC vs. CCC?
- Visual effects vs. seed yield?
- TE is now registered on clover seed crops in Oregon. Significant seed yield increases in red and crimson.



Species	TE rate	PGR timing
	(g ai ha <sup>-1</sup> )	
Perennial ryegrass	420	BBCH 32
Tall fescue	210	BBCH 32-51
Annual ryegrass	210-420	BBCH 32
Chewings fescue	420	BBCH 32
Creeping red fescue	210	BBCH 32
Orchardgrass	210	BBCH 32-51
Red Clover	280-420	BBCH 32
Crimson Clover	140	BBCH 32
White Clover	N/A	N/A

# **Questions?**



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