RESPONSE OF COOL SEASON GRASSES TO FOLIAR APPLICATIONS OF APOGEE® (PROHEXADIONE-CALCIUM) PLANT GROWTH REGULATOR, 2000

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Introduction

Perennial grasses grown for seed are prone to lodging at the high fertility rates used to maximize seed production. Lodging of the crop can result in increased problems from disease and can reduce the efficacy of pollination. Use of manufactured plant growth regulators (PGRs) to control stem elongation and optimize seed production in cool season grasses had some success in the mid 1980s. Research developed during this period was based on the use of a residual, soil applied PGR in the triazole family (paclobutrazol) that gave reliable control of lodging and was able to improve seed yields. However, due to the longevity of this chemical in the soil, and difficulties in funding registration of chemicals for use on minor crops, use of this family of chemicals is not allowed.

Recent development of foliar applied PGR type chemicals that readily breakdown in the environment and are effective at controlling rapid stem elongation are being studied to assess their potential for use in grass seed production systems. Initial trials using Apogee (prohexadione-calcium), a foliar applied PGR manufactured by BASF Corporation, on perennial ryegrass grown for seed production were conducted on an older perennial ryegrass stand in 1998. The trial resulted in substantial yield improvement (see 1998 Seed Production Research report). How well this compound works on new stands of perennial ryegrass as well as other cool season grasses (primarily tall fescue and fine fescue) grown for seed in the Willamette Valley is not known. The trials summarized in this report are for the second crop year in perennial ryegrass, creeping red fescue, and chewings fescue. The first crop year results were reported last year (see 1999 Seed Production Research report). Also, trials were conducted in 2000 on a first crop year field of tall fescue.

Procedure

Established stands of Cutter perennial ryegrass (Hyslop Research Farm), Brittany Chewings fescue (Joe Schumacher farm) and Silverlawn creeping red fescue (Ioka Farms) entering the second seed crop year were used for this experiment. In addition, a spring 1999 stand of Velocity tall fescue (Hyslop Research Farm) in the first year of seed production was included. A factorial design with rate and date as main factors was used as the main experimental design. PGR treatments were applied at walking speed using a bicycle-type 10-foot wide boom sprayer with nozzles at 18 inch spacing. The sprayer operated at 20 psi with XR TEEJET 8003VS nozzles (approx. 30 gal/a water). Treatments at all sites were applied as single or split treatments at several rates of prohexadione-calcium (3/16, 1/4, 3/8 lb a.i./a). Treatment dates were selected to coincide with defined plant growth stages. Application dates generally coincided with rapid node expansion with some flag leaves emerging (1st date) and early heading (2nd date). Plot size ranged from 10 ft x 30 ft to 10 ft x 50 ft depending on location. Stem elongation and nodal development was assessed using a weighted average of tiller size and internode expansion from random plant samples to determine treatment dates.

Plots were sampled at early bloom for fertile tiller counts, length measurements, and above ground biomass dry weights. Inflorescences were also randomly sampled for yield component analysis and spike or panicle length measurements. Harvesting was done using a 6 ft wide swather for windrowing and a Hege 180 small plot combine for harvest (see Table 1 for harvest dates). Combined harvested seed samples were cleaned using an M2-B clipper cleaner for final cleanout; sub samples of clean seed were taken for 1000 seed weights.

Table 1. Calendar dates for PGR application, swathing, and combining, 2000.

Crop species	Flag leaf emergence	Early heading	Swath	Combine
Perennial ryegrass	4/24	5/5	7/5	7/21
Tall fescue	4/24	5/5	6/30	7/18
Creeping red fescue	5/1	5/12	7/17	7/25
Chewings fescue	5/1	5/12	7/3	7/13

Results

Perennial Ryegrass

Apogee applications to perennial ryegrass increased seed yield over the untreated check by an average 400 lb/a (32%) as shown in Table 2. Generally, yield was increased as application rate was increased. Splitting the application was not effective in increasing seed yield as it was last year (1999). Above ground biomass, fertile tiller density, and 1000 seed weight were not affected by PGR applications. The two timings used is this trial gave similar responses. Plant height was reduced an average of 14% and lodging was controlled more by the later than the earlier application. Improved seed yield without increased biomass resulted in an increase in the harvest index, a good measure of increased plant efficiency.

Tall fescue

Tall fescue was more responsive to applications of Apogee in 2000 than in 1999. The seed yield increase averaged almost 700 lb/a with the application of Apogee (Table 3) compared to the untreated check. There was no significant treatment effect from different rates or dates. There was a slight general increase (not significant) when using a split application. Fertile tiller density was not affected by the PGR applications, nor were above ground biomass and seed size (1000 seed weight). Harvest index increased by 6%, and plant height was reduced an average of 18% (with the greatest reduction from a split application). Lodging was effectively managed at all rates and dates. Very little lodging occurred in any of the treatments except the untreated check. The best lodging control was achieved at the higher application rates, the 1st date, and from the split application.

Creeping red fescue

The Silverlawn creeping red fescue site was similar in seed yield response to the tall fescue previously discussed. Treatment with Apogee increased yields an average of 455 lb/a (39%) over the untreated check (Table 4). In addition, there was significant response to a split application over a single application at the same rate with an increase of 230 lb/a (19%). Above ground biomass, fertile tiller density and 1000 seed weight were not affected by PGR treatments. Harvest index was increased 3%. Lodging was reduced more by the split application treatment than the single application, but both were effective at reducing the amount and severity of lodging. Later application at full heading (Table 5, May 22) was not as effective and yielded less than earlier applied treatments at lower rates (see Table 4).

Table 5. Response of seed yield to different application dates of foliar applied Apogee (1/4 lb a.i./a) in Silverlawn creeping red fescue, 2000.

Treatment	Seed yield (lb/a)
Check	1151
Date of application	
May 1 (single)	1417
May 12 (single)	1612
May 22 (single)	1392
May 1, May 12 (split)	1637
	(NS)

*Means in columns followed by the same letter are not significantly different by Fisher's protected LSD values at P=0.05.

Chewings fescue

Seed yield in Brittany Chewings fescue was greatly improved by the applications of Apogee PGR. The seed yield increase averaged 492 lb/a (41%) as seen in the check vs treated data in Table 6. This crop was also responsive to a split application treatment of Apogee (Table 6). Above ground biomass and 1000 seed weight were not affected by the PGR applications, thus the increase in seed yield subsequently increased harvest index. Fertile tiller density remained constant. Crop lodging was decreased most by the higher rates and the single application.

Summary

All four species treated this year were responsive to Apogee applications. The creeping red, Chewings fescue, and tall fescue species were the most responsive in seed yield. Perennial ryegrass was little less responsive. This compound was effective at controlling lodging and increasing yield. The cause of the yield increase has not been fully accounted for, but from other data collected this season (not presented here), improved seed set, reduced lodging and improvements in yield components are all adding to the increased yield. With all fescue crops the split application generally gave higher yields. This compound appears to work best as a split application, but the single applications also gave good yield responses. It should be noted also that no treatment by the PGR was less than the untreated check. The overall cause of the yield increase appears to be from several factors: less lodging, better seed set, and improved canopy architecture. With more research the best treatment timing and rates will be established to improve the potential and actual yields in these crops. This product is not yet registered for use on these crops.

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Table 2. Main factor effects of foliar applied Apogee (prohexadione-calcium) on seed yield, harvest components, and tiller length in Cutter perennial ryegrass, 2000.

Main factor treatments	Seed yield		Above ground biomass	Fertile tillers	1000 seed weight	Harvest index	Culm reduction	Lodging score
	(lb/a)	(% of check)	(ton/a)	(no./sq. ft.)	(g)	--------(%)	--------	(1-5)[1]
Check vs Treated								
Check	1259[2]	100	6.9	254	1.93	9	0 b	5.0 b
Treated (all)	1661	132	6.9	217	1.92	12	14 a	4.0 a
Rate of application (lb a.i./a)								
3/16	1523	121	6.8	207	1.94	11	11	4.1
1/4	1675	133	6.8	203	1.91	13	13	4.1
3/8	1819	145	7.2	233	1.92	13	19	3.9
Date of application								
April 24 (single)	1659	132	6.4	198	1.94	13	12	4.2 b
May 5(single)	1693	135	7.2	227	1.90	12	14	3.9 a
April 24, May 5 (split)	1665	132	7.0	219	1.93	13	17	3.9 a

*Within each main factor, means in columns followed by the same letter are not significantly different by Fisher's protected LSD values at P=0.05, No letters = no significant differences

[1] Lodging score at harvest 1-5: 1 = vertical; 5 = horizontal

[2] P-value between 0.05 and 0.10

Table 3. Main factor effects of foliar applied Apogee (prohexadione-calcium) on seed yield, harvest components, and tiller length in Velocity tall fescue, 2000.

Main factor treatments	Seed yield		Above ground biomass	Fertile tillers	1000 seed weight	Harvest index	Culm reduction	Lodging score
	(lb/a)	(% of check)	(ton/a)	(no./sq. ft.)	(g)	--------(%)	--------	(1-5)[1]
Check vs Treated								
Check	1072 b	100	6.9	70	2.37	8 b	0	4.0 b
Treated (all)	1750 a	163	6.4	59	2.44	14 a	18	1.6 a
Rate of application (lb a.i./a)								
3/16	1717	160	6.9	63	2.42	13 b	14	1.6
1/4	1830	171	5.7	55	2.52	17 a	18	1.7
3/8	1726	161	6.8	64	2.37	13 b	21	1.6
Date of application								
April 24 (single)	1677	156	6.3	58	2.49	14 b	18	1.5
May 5(single)	1775	166	7.1	63	2.43	13 b	14	1.9
April 24, May 5 (split)	1821	170	6.1	61	2.39	16 a	21	1.6

*Within each main factor, means in columns followed by the same letter are not significantly different by Fisher's protected LSD values at P=0.05. No letters = no significant differences

[1] Lodging score at harvest 1-5: 1 = vertical; 5 = horizontal

Table 4. Main factor effects of foliar applied Apogee (prohexadione-calcium) on seed yield, harvest components, and tiller length in Silverlawn creeping red fescue, 2000.

Main factor treatments	Seed yield		Above ground biomass	Fertile tillers	1000 seed weight	Harvest index	Culm reduction	Lodging score
	(lb/a)	(% of check)	(ton/a)	(no./sq. ft.)	(g)	--------(%)--------		(1-5)[1]
Check vs Treated								
Check	1151 b	100	4.8	309	1.06	13[2]	0 b	4.7 b
Treated (all)	1606 a	139	5.0	297	1.03	16	12 a	4.0 a
Rate of application (lb a.i./a)								
3/16	1568	136	5.0	290	1.00	16	12	3.9
1/4	1527	133	5.0	293	1.06	16	11	4.2
3/8	1723	150	5.1	308	1.03	17	13	3.8
Date of application								
May 1 (single)	1491 b	130	4.9	303	1.03	15	9[2]	4.2 b
May 12 (split)	1721 a	149	5.1	290	1.02	17	14	3.7 a

*Within each main factor, means in columns followed by the same letter are not significantly different by Fisher's protected LSD values at P=0.05. No letters = no significant differences

[1] Lodging score at harvest 1-5: 1 = vertical; 5 = horizontal

[2] P-value between 0.05 and 0.10

Table 6. Main factor effects of foliar applied Apogee (prohexadione-calcium) on seed yield, harvest components, and tiller length in Brittany Chewings fescue, 2000.

Main factor treatments	Seed yield		Above ground biomass	Fertile tillers	1000 seed weight	Harvest index	Culm reduction	Lodging score
	(lb/a)	(% of check)	(ton/a)	(no./sq. ft.)	(g)	--------(%)--------		(1-5)[1]
Check vs Treated								
Check	1190 b	100	4.8	311	0.98	11[2]	0	3.5
Treated (all)	1682 a	141	4.7	317	0.97	16	14	3.5
Rate of application (lb a.i./a)								
3/16	1602	135	4.3	285	0.98	16	13	3.9
1/4	1698	143	4.9	330	0.97	16	10	3.5
1/2	1746	147	4.9	338	0.96	16	18	3.2
Date of application								
May 1 (single)	1592 b	134	4.7	315	0.97	16	10[2]	3.5
May 12 (split)	1772 a	149	4.6	320	0.97	17	17	3.5

*Within each main factor, means in columns followed by the same letter are not significantly different by Fisher's protected LSD values at P=0.05. No letters = no significant differences

[1] Lodging score at harvest 1-5: 1 = vertical; 5 = horizontal

[2] P-value between 0.05 and 0.10