

Efficacy of experimental plant growth regulator on biomass growth reduction and crop tolerance in creeping bentgrass fairway type turf.

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The objective of this research project is:

1. to evaluate experimental PGR for reduction grass biomass reduction and compare with an industry standard PGR in golf course turf (creeping bentgrass/*Poa annua* mixture at 9 mm fairway mowing height)
2. to determine appropriate rate for experimental PGR competitive to the industry standard rate and evaluate crop safety on turf

Data collected included measurements of phytotoxicity 7 and 21 DAT, regular canopy reflectance data (NDVI and R/NIR indices) shoot dry matter accumulation to estimate grass biomass reduction (at mowing), turf quality, uniformity, and density, and resistance of the turf to disease and other stresses.

MATERIALS/METHODS

The trial involved established creeping bentgrass/annual bluegrass fairway type turf on sandy loam soil. Treatments consisted of the sponsor's product at several rates (Table 1) applied monthly beginning June 8, 2009. An untreated check as well as an industry standard treatment was also included. Treatments were applied to 1 x 2 m plots of turf maintained as appropriate on the sandy loam soil research ranges at the Guelph Turfgrass Institute (Figure 1). Management included twice weekly mowing at 9 mm, regular

fertility, and irrigation to prevent stress. Treatments were replicated four times in a randomized complete block design. Treatments were applied in 5 applications (monthly June 8 – September 25). Treatments were applied with a compressed air sprayer (20 psi; 50 ml m⁻² spray volume; TeeJet 8001VS flat fan nozzles). Plots were mowed as close as possible in time prior to application, but not closer than 1 hour before application. Regular mowing frequencies between applications were roughly twice weekly.

Color response and general vigor of the turf was assessed, both visually and using canopy reflectance (chlorophyll meter, Greenseeker NDVI and R/NIR), daily for the first week after application and then weekly for 3 weeks until next application date or the end of the trial (Nov. 1). Uniformity of the color response was assessed visually. Plots were rated for turf quality, density and uniformity. Clippings were collected from a fixed area (0.8 m²) of each plot from regular mowings to determine shoot growth rates. Clippings were collected on every mowing date, for a total of 27 collections. An anecdotal photographic record of the experiment was kept.

All measurements were analyzed by appropriate statistical analyses (general linear models).

Table 1. Treatments

Treatment	Product	Product rate (mL 100 m ⁻²)	Application volume
1	Untreated	—	—
2	LI6279	3.85	500 L ha ⁻¹
3	LI6279	7.7	500 L ha ⁻¹
4	LI6279	11.5	500 L ha ⁻¹
5	LI6279	15.4	500 L ha ⁻¹
6	LI6314	7.7	500 L ha ⁻¹

All products applied monthly: June 8, July 6, August 4, September 1, and September 25, 2009.





Figure 1. Plot area in creeping bentgrass fairway turf on soil range, August 18, 2009.

RESULTS

Canopy reflectance and turf performance.

There significant differences among treatments in canopy reflectance on all but one measurement date (Table 2). The absolute values of the NDVI differences, whether positive or negative, were too small to be significant to management (there were no differences in turf color or quality visible to a trained visual rater).

Growth rate. Shoot growth as estimated by measurements of shoot dry matter accumulation showed a slight reduction in growth in the plots treated with the standard (LI6314), particularly late in the season after the last application (Table 3.) On many dates there were no significant differences in growth rate among any of the treatments, and on most dates when there was a significant difference, all of the LI6279 treatments were not different from the untreated control. The exception was June 29, 21 days after the first application, when the highest rate of LI6279 had significantly less growth than the control. In September, after the last application, the two highest rates of LI6279 were not significantly different from the standard, but they were also

not significantly different from the control. The maximum growth reduction among the LI6279 treatments was on June 29, when the 15.4 ml 100 m⁻² rate had a 37% reduction in growth compared to the control. In comparison, the maximum growth rate reduction of the standard LI6314, on September 17, was a 63% reduction.

DISCUSSION AND CONCLUSIONS

All growth regulator treatments produced some reduction in shoot tissue growth relative to the untreated check, but the growth rate reductions were modest, and in general not statistically significant, in part because of the background variation growth rate and small sample size. There was a rate effect among the LI6279 treated plots, with the higher rates tending to reduce growth rates more. This can be seen in the seasonal mean growth rates, but again the differences among the rates were not statistically significant on most dates. None of the treatments had a negative effect on turf color or quality (assessed by canopy reflectance and visually).

Sponsor: United Agri Products Canada Inc.

Table 2. Canopy reflectance of treated plots.

Treatment	May-20	May-29	Jun-08	Jun-09	Jun-11	Jun-12	Jun-15	Jun-16	Jun-18	Jun-22	Jun-25	Jul-02	Jul-08
				1 DAT	3	4	7	8	10	14	17	24	2 DAT
LI6279-12	0.581 ¹	0.567	0.607	0.605	0.628	0.654	0.656	0.669	0.653	0.673	0.665	0.717	0.662
LI6279-8	0.590	0.547	0.591	0.585	0.611	0.635	0.645	0.656	0.649	0.651	0.666	0.718	0.665
Untreated	0.584	0.569	0.592	0.596	0.621	0.630	0.651	0.658	0.647	0.656	0.667	0.714	0.659
LI6279-4	0.590	0.577	0.591	0.590	0.618	0.628	0.644	0.654	0.640	0.657	0.664	0.717	0.656
LI6314	0.587	0.557	0.593	0.584	0.612	0.625	0.637	0.650	0.642	0.659	0.671	0.718	0.659
LI6279-15	0.582	0.571	0.576	0.573	0.594	0.613	0.630	0.640	0.631	0.640	0.660	0.711	0.654
LI6279-12	-0.003 ²	-0.002	0.016	0.009	0.007	0.023	0.005	0.011	0.006	0.017	-0.002	0.003	0.004
LI6279-8	0.006	-0.021	-0.001	-0.011	-0.010	0.005	-0.007	-0.002	0.002	-0.004	-0.001	0.004	0.006
Untreated	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LI6279-4	0.006	0.009	0.000	-0.006	-0.003	-0.002	-0.007	-0.004	-0.007	0.001	-0.003	0.002	-0.003
LI6314	0.003	-0.012	0.002	-0.012	-0.009	-0.006	-0.014	-0.008	-0.005	0.004	0.004	0.004	0.000
LI6279-15	-0.002	0.002	-0.015	-0.024	-0.027	-0.017	-0.021	-0.018	-0.016	-0.016	-0.007	-0.003	-0.005
lsd p=0.05	NS	0.015	0.010	0.009	0.010	0.010	0.011	0.007	0.007	0.008	0.006	0.004	0.008
Treatment	Jul-14	Jul-15	Jul-17	Jul-22	Jul-27	Jul-30	Aug-04	Aug-11	Aug-14	Aug-17	Aug-20	Jul-14	Aug-24
	8	9	11	16	21	24	29	7 DAT	10	13	16	8	20
LI6279-12	0.651	0.635	0.636	0.625	0.652	0.650	0.663	0.649	0.595	0.661	0.714	0.651	0.700
LI6279-8	0.649	0.629	0.650	0.616	0.649	0.646	0.662	0.648	0.596	0.662	0.717	0.649	0.699
Untreated	0.646	0.629	0.648	0.621	0.646	0.652	0.659	0.643	0.587	0.658	0.715	0.646	0.701
LI6279-4	0.651	0.636	0.638	0.634	0.662	0.656	0.665	0.642	0.586	0.665	0.718	0.651	0.699
LI6314	0.640	0.620	0.636	0.622	0.662	0.657	0.679	0.643	0.573	0.658	0.717	0.640	0.702
LI6279-15	0.642	0.627	0.639	0.619	0.653	0.637	0.653	0.627	0.586	0.653	0.705	0.642	0.697
LI6279-12	0.005	0.006	-0.012	0.004	0.006	-0.002	0.004	0.006	0.008	0.002	-0.001	0.005	-0.001
LI6279-8	0.003	0.000	0.002	-0.004	0.003	-0.007	0.003	0.004	0.009	0.004	0.003	0.003	-0.002
Untreated	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LI6279-4	0.005	0.007	-0.010	0.013	0.016	0.003	0.006	-0.002	0.000	0.007	0.003	0.005	-0.002
LI6314	-0.006	-0.009	-0.012	0.001	0.016	0.005	0.020	-0.001	-0.014	-0.001	0.002	-0.006	0.001
LI6279-15	-0.004	-0.002	-0.009	-0.002	0.007	-0.015	-0.006	-0.017	-0.001	-0.006	-0.010	-0.004	-0.004
lsd p=0.05	0.007	0.006	0.009	0.009	0.009	0.009	0.006	0.010	0.013	0.005	0.006	0.007	0.004
Treatment	Aug-28	Aug-31	Sep-02	Sep-08	Sep-10	Sep-11	Sep-14	Sep-17	Sep-22	Oct-06	Oct-14	Oct-21	
	24	27	1 DAT	7	9	10	13	16	21	11 DAT	19	26	
LI6279-12	0.684	0.686	0.664	0.706	0.703	0.687	0.705	0.720	0.699	0.667	0.670	0.652	
LI6279-8	0.682	0.684	0.660	0.709	0.706	0.696	0.715	0.726	0.705	0.675	0.681	0.656	
Untreated	0.683	0.683	0.656	0.710	0.710	0.698	0.712	0.723	0.697	0.668	0.677	0.656	
LI6279-4	0.682	0.681	0.655	0.707	0.703	0.687	0.706	0.717	0.697	0.676	0.678	0.654	
LI6314	0.691	0.692	0.664	0.706	0.699	0.680	0.698	0.715	0.701	0.669	0.674	0.651	
LI6279-15	0.674	0.682	0.660	0.705	0.703	0.686	0.699	0.715	0.695	0.672	0.668	0.651	
LI6279-12	0.001	0.003	0.007	-0.004	-0.007	-0.011	-0.006	-0.003	0.002	0.001	-0.007	-0.004	
LI6279-8	-0.001	0.001	0.004	-0.001	-0.004	-0.002	0.003	0.003	0.008	0.009	0.004	0.000	
Untreated	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
LI6279-4	-0.001	-0.002	-0.001	-0.003	-0.007	-0.011	-0.006	-0.006	0.000	0.008	0.001	-0.002	
LI6314	0.008	0.009	0.008	-0.004	-0.011	-0.018	-0.013	-0.008	0.004	0.005	-0.003	-0.006	
LI6279-15	-0.009	-0.001	0.004	-0.005	-0.006	-0.012	-0.013	-0.008	-0.001	0.002	-0.009	-0.005	
lsd p=0.05	0.005	0.004	0.003	0.004	0.004	0.005	0.005	0.004	0.004	0.004	0.005	0.005	

¹ Normalized-difference vegetation index; means of 40-50 readings x 4 replicates.

² Normalized-difference vegetation index relative to untreated control (=0); means of 40-50 readings x 4 replicates.

Table 3. Shoot growth rate; dry mass of clippings collected from bentgrass turf mowed at 4 mm every 3-5 days.

Treatment	Jun-15 7 DAT	Jun-19 11	Jun-23 15	Jun-26 18	Jun-29 21	Jul-03 25	Jul-06 28	
Untreated	0.75 ¹	3.36	4.37	3.65	3.74 a	3.20	2.92	
LI6279-4	0.67	2.99	3.92	3.31	3.85 a	3.24	3.17	
LI6279-8	0.69	2.75	3.67	2.91	3.27 ab	3.06	2.68	
LI6279-12	0.60	2.61	3.59	2.73	2.61 ab	3.05	2.97	
LI6279-15	0.43	2.08	2.83	2.34	2.36 b	2.87	2.60	
LI6314	0.45	2.01	3.33	3.09	3.34 ab	3.00	3.07	
Untreated	0.00	0.00	0.00	0.00	0.00 a	0.00	0.00	
LI6279-4	-0.08 ²	-0.37	-0.46	-0.33	0.11 a	0.04	0.25	
LI6279-8	-0.07	-0.61	-0.70	-0.74	-0.48 ab	-0.14	-0.24	
LI6279-12	-0.15	-0.75	-0.79	-0.92	-1.14 ab	-0.15	0.05	
LI6279-15	-0.32	-1.28	-1.54	-1.31	-1.38 b	-0.34	-0.32	
LI6314	-0.30	-1.36	-1.05	-0.56	-0.41 ab	-0.20	0.15	
lsd p=0.05	NS	NS	NS	NS	1.35	NS	NS	
Treatment	Jul-10 4 DAT	Jul-13 7	Jul-17 11	Jul-20 14	Jul-24 18	Jul-27 21	Jul-31 25	Aug-04 29
Untreated	1.69	2.57 a	3.98	2.21	2.65	1.03	1.96	0.82
LI6279-4	1.56	2.99 a	3.97	2.03	2.77	1.10	2.32	0.94
LI6279-8	1.58	2.94 a	4.20	1.86	2.81	0.97	1.94	0.66
LI6279-12	1.55	2.44 a	3.85	2.46	2.63	1.16	1.85	0.64
LI6279-15	1.68	3.05 a	3.94	2.61	2.70	1.18	1.98	0.86
LI6314	0.97	1.14 b	2.10	1.09	1.77	1.08	2.30	0.98
Untreated	0.00	0.00 a	0.00	0.00	0.00	0.00	0.00	0.00
LI6279-4	-0.13	0.42 a	-0.01	-0.19	0.13	0.07	0.36	0.11
LI6279-8	-0.11	0.37 a	0.21	-0.35	0.16	-0.06	-0.02	-0.16
LI6279-12	-0.14	-0.13 a	-0.13	0.25	-0.02	0.13	-0.10	-0.18
LI6279-15	-0.01	0.48 a	-0.04	0.40	0.05	0.15	0.03	0.04
LI6314	-0.72	-1.44 b	-1.89	-1.13	-0.88	0.04	0.34	0.16
lsd p=0.05	NS	1.24	NS	NS	NS	NS	NS	NS
Treatment	Aug-07 3 DAT	Aug-10 6	Aug-14 10	Aug-17 13	Aug-22 18	Aug-27 23	Aug-31 27	
Untreated	1.30	0.98	3.29 a	3.18	1.87	5.67	3.86	
LI6279-4	1.36	1.33	3.53 a	3.00	1.78	5.46	3.75	
LI6279-8	1.14	0.91	3.02 a	2.69	1.67	5.41	3.21	
LI6279-12	1.21	0.84	3.15 a	2.60	1.53	3.20	3.30	
LI6279-15	1.37	1.10	3.22 a	2.62	1.30	3.15	3.12	
LI6314	1.27	1.62	1.63 b	2.09	1.72	5.49	3.87	
Untreated	0.00	0.00	0.00 a	0.00	0.00	0.00	0.00	
LI6279-4	0.06	0.17	0.24 a	-0.19	-0.09	-0.22	-0.11	
LI6279-8	-0.17	-0.03	-0.27 a	-0.50	-0.20	-0.27	-0.65	
LI6279-12	-0.09	-0.07	-0.14 a	-0.59	-0.34	-2.48	-0.56	
LI6279-15	0.07	0.06	-0.07 a	-0.56	-0.57	-2.53	-0.74	
LI6314	-0.04	0.32	-1.66 b	-1.10	-0.15	-0.19	0.01	
lsd p=0.05	NS	NS	1.30	NS	NS	NS	NS	
Treatment	Sep-05 4 DAT	Sep-10 9	Sep-17 16	Sep-22 21	Sep-30 5	Season mean		
Untreated	1.00	1.59 a	2.28 a	3.44	1.67 a	2.56 a		
LI6279-4	0.87	1.35 a	1.85 a	3.12	1.67 a	2.51 a		
LI6279-8	0.91	1.31 a	1.95 a	3.56	1.69 a	2.35 ab		
LI6279-12	0.83	1.18 a	1.55 ab	3.13	1.61 ab	2.18 ab		
LI6279-15	0.78	1.24 a	1.43 ab	2.94	1.49 ab	2.12 ab		
LI6314	0.64	0.68 b	0.85 b	2.76	1.10 b	1.98 b		
Untreated	0.00	0.00 a	0.00 a	0.00	0.00 a	0.00 a		
LI6279-4	-0.13	-0.24 a	-0.42 a	-0.32	0.00 a	-0.04 a		
LI6279-8	-0.09	-0.28 a	-0.33 a	0.11	0.03 a	-0.21 ab		
LI6279-12	-0.16	-0.41 a	-0.73 ab	-0.31	-0.06 ab	-0.38 ab		
LI6279-15	-0.22	-0.35 a	-0.84 ab	-0.50	-0.18 ab	-0.44 ab		
LI6314	-0.35	-0.91 b	-1.43 b	-0.68	-0.57 b	-0.58 b		
lsd p=0.05	NS	0.44	0.95	NS	0.52	0.49		

¹ Shoot growth rate (g m⁻² day⁻¹) from tissue collected; means of 4 replicates.

² Shoot growth rate (g m⁻² day⁻¹) relative to untreated control (=0); means of 4 replicates. Means within columns followed by the same letter are not significantly different (Fisher's protected lsd, p=0.05)

