MANAGEMENT REQUIREMENTS FOR DRYLAND CREEPING BENTGRASS SEED PRODUCTION

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ABSTRACT

An extensive research project was initiated in 1992 to develop a dryland seed production system for creeping bentgrass (*Agrostis stolonifera* L.) in western Canada. Two objectives involved determining the appropriate renovation method and spring nitrogen timing and rate to maximize seed yield. Renovation experiments included scalping, mowing, aeration, tillage, burning and chemical and mechanical gapping and spring N fertilization experiments included at 0, 50, 100, and 150 kg N ha^{-1} at two dates. Scalping (removal of stubble and growth to 1.25 cm) showed the greatest potential to maintain seed yields. Timing of renovation was also important with early (after harvest) treatments superior as they allowed an adequate regrowth period prior to winter. Spring nitrogen applications of greater than 50 kg ha^{-1} did not show increased seed yields. Dryland seed production is possible in the higher rainfall areas of western Canada with yields ranging from 50 to 500 kg ha^{-1}, but attention to recommended management practices is essential given the short growing season.

INTRODUCTION

Creeping bentgrass (*Agrostis stolonifera* L.) is the most widely planted cool season grass for golf putting greens in North America. Its aggressive growth and decumbent habit make it an ideal species for the close mowing and wear experienced on a putting green. At present, 95% of creeping bentgrass seed is produced in Oregon, but there is potential for dryland production of this high value crop (retail \$14-20 kg^{-1} U.S.) in western Canada. An extensive research project was initiated at the University of Manitoba in 1992 to develop a dryland seed production system for creeping bentgrass (Smith and Cattani, 1993). Management practices that have been investigated include seeding rate, row spacing, seeding date, herbicide tolerance, fertility timing and rate, and post-harvest renovation method. Two of the specific objectives of this research were to determine the appropriate renovation method and the timing and rate of spring nitrogen fertility to maximize seed yields.

METHODS AND MATERIALS

Spring Nitrogen Fertility. Nitrogen fertilizer was applied to '18th Green' creeping bentgrass seed production fields in late April (at spring regrowth) and in early June (heading) in Oakville and Morweena, MB in 1994, and at Rosenort and Arborg, MB in 1995 (2 yr old fields). All fields had been fertilized the previous fall with 50 kg ha^{-1} each of N, P_2O_5, and K_2O. Treatments were arranged in a RCBD design with 4 replications and 2m x 6m plots. They involved the application of 0, 50, 100 and 150 kg N ha^{-1} in all possible combinations, with total nitrogen applications not exceeding 150 kg N ha^{-1}. The source of nitrogen was ammonium nitrate with a 34-0-0 analysis. Biomass, seedhead number and seed yield measurements were taken 3 weeks after the cessation of flowering from one 0.25 m^2 sample area within each plot.

Renovation Methods. Stand renovation experiments were conducted on creeping bentgrass seed production fields in Morweena and Arborg, MB in 1992 and at Oakville and Broad Valley, MB in 1993 (immediately after the first production harvest). Treatments were arranged in a RCBD with 4 replications and 2m x 6m plots. All treatments were applied immediately after harvest (August 3 - 8), with a late renovation experiment (September 1) also conducted at Broad Valley in 1993. In 1992, renovation methods included scalping (cut at 1.25 cm), scalping and power raking (45 cm Ryans Verticutter, Ryan's Equipment Co., St. Paul, Minn), mowing (cut at 5.0 cm), mowing and power raking, power raking, light tillage (Mainline rototiller with half of the tines removed), heavy tillage (Mainline tiller with all tines intact), gapping (Ryan Jr. 30 cm sod cutter, Ryan's Equipment Co., St. Paul, Minn) with 30 cm between gaps and a check treatment with no renovation, but with trash removal. Residue was removed from the treatments involving scalping and mowing, all other plots were left with residue at swathing height. Seedheads were harvested 3 weeks after the cessation of flowering in 1993 on a plot sample area of 0.25 m^2. Seedhead counts, biomass and seed yield were measured.

In 1994, treatments were slightly modified and included scalping, mowing, with and without aeration, using a 1.8 m wide AerWay aerifier (Holland Hitch of Texas Inc., Wylie, TX), aeration alone, light tillage, two chemical gapping treatments using glyphosate (2.47 l a.i. ha^{-1}) and burning (using a propane torch), and an untreated check with only stubble removal. All plots received 50 kg ha^{-1} each of N, P_2O_5 and K_2O immediately after renovation, and 50 kg ha^{-1} N in the spring at green up. Harvest was similar to 1993, except seedheads were not counted. Harvested seedheads were threshed with an alternating speed belt type thresher and the seed was cleaned with a Clipper brand seed cleaner. Analysis of variance was conducted using SAS (SAS, 1988).

RESULTS AND DISCUSSION

Spring Nitrogen Fertility. Spring nitrogen applications produced significant seed yield differences in 1994 (Table 1). The A50J0 treatment (50 kg N ha^{-1} April, 0 kg N ha^{-1} June) consistently produced high seed yields and the addition greater than 50 kg ha^{-1} in late April provided no additional benefit in seed yield. Higher amounts of spring nitrogen (>50 kg ha^{-1}) resulted in increased biomass production (data no shown) at all sites with the exception of Beausejour in 1995. The addition of increased amounts of spring nitrogen did result in a taller stand which may allow for the cutting of a greater percentage of seedheads during swathing or may promote lodging.

Renovation Method. Creeping bentgrass requires a vernalization period for the conversion of vegetative to reproductive primordia. Most vernalization occurs in the late fall, early spring in western Canada. Effective renovation is essential to allow regrowth for vernalization and seedhead production. The scalping renovation method, with or without aeration, was consistently the best method over all experiments. Although the late renovation experiment showed no significant differences, the scalping method produced the highest relative seed yield. Scalping also produced the highest seedhead density (Table 2). There was a high correlation coefficient ($r = 0.968$) between seedhead density and seed yield for scalping, mowing and no renovation treatments (data from 4 renovation experiments, 2 not shown).

The use of the Aerway aerifier increased seed yields in 1994 and should be further investigated (Table 2). This machine opens slits into the soil with limited surface disturbance, possibly increasing fertilizer and water infiltration. Renovation methods that involve the disruption of the sod, by tillage or mechanical gapping, created a more difficult swathing operation due to a lack of surface smoothness. The ability of the producer to obtain the lowest cutting height possible at swathing may be a major factor in obtaining an economic yield especially with low plant heights during moisture deficits.

Previous experiments (Smith and Cattani, 1993) on seeding rate, seeding date and row spacing showed that the methods that allow for a rapid cover of the soil surface produced the highest seed yields. The scalping renovation method increases the potential for continued seed yields. The use of spring nitrogen fertility is recommended, with 50 kg ha^{-1} N in the early spring adequate for the plants requirements under dryland conditions.

REFERENCES

SAS institute, Inc. 1988. SAS users' guide: Statistics. SAS Institute Inc., Cary, NC.

Smith, S.R., Jr. and Cattani, D.J., 1993. Creeping bentgrass seed production in western Canada. Proc. of the XVII International Grassland Congress: 1651-1653.

Table 1
Seed yield (kg ha^{-1}) and rankings for spring nitrogen fertility treatments at Oakville and Morweena, MB in 1994 and Beausejour and Rosenort, MB in 1995.

	1994				1995			
	Oakville		Morweena		Beausejour		Rosenort	
Treatment								
A50J50[z]	103.5 a[y]	(1)	98.2 a	(6)	295	(7)	126.5	(3)
A50J0	97.8 ab	(2)	115.3 a	(1)	385	(1)	104.2	(6)
A100J50	78.7 abc	(3)	111.9 a	(2)	282	(9)	101.0	(7)
A50J100	71.6 bc	(4)	91.5 ab	(8)	353	(2)	100.9	(8)
A150J0	69.5 bc	(5)	88.8 ab	(9)	350	(3)	116.0	(4)
A100J0	69.1 bc	(6)	108.8 a	(3)	328	(4)	138.2	(2)
A0J100	66.6 c	(7)	105.2 a	(5)	229	(10)	182.2	(1)
A0J150	64.4 c	(8)	95.8 ab	(7)	321	(6)	111.7	(5)
A0J50	56.4 c	(9)	107.3 a	(4)	322	(5)	92.2	(10)
A0J0	49.3 c	(10)	59.4 b	(10)	287	(8)	100.4	(9)

[z] A50, April applied nitrogen at 50 kg N ha^{-1}; J50 June applied nitrogen at 50 kg N ha^{-1}.
[y] Means followed by the same letter are not significantly different using Fishers protected least significant difference (P=.05).

Table 2
Seed yield and seedheads m^{-2} from post-harvest renovation experiments at Morweena and Arborg, MB in 1993 and Oakville and Broad Valley, MB in 1994.

	1993 Harvest				1994 Harvest		
	Morweena		Arborg		Oakville and Broad Valley[y]	Broad Valley[x] Early	Broad Valley[x] Late
	Seed Yield	Seedheads	Seed Yield	Seedheads	Seed Yield	Seed Yield	Seed Yield
Treatment	—(kg/ha)—	—(#/m^{-2})—	—(kg/ha)—	—(#/m^{-2})—	(kg/ha)	(kg/ha)	(kg/ha)
Scalp	175	4257 a[z]	265 a	7362 a	417b	398 a	119
Power Rake and Scalp	79	1662 cd	251 a	9107 a	-	-	-
Aerway and Scalp	-	-	-	-	512a	488 a	60
Mow	174	3367 ab	25 b	1498 b	217d	135 cd	31
Power Rake and Mow	111	2142 bc	39 b	1985 b	-	-	-
Aerway and Mow	-	-	-	-	267cd	209 bc	27
Check	88	1325 cd	51 b	1928 b	121ef	18 e	14
Power Rake	88	2060 bcd	46 b	2108 b	-	-	-
Aerway	-	-	-	-	182 de	47 de	12
Light Till (Till)	67	1060 cd	19 b	1222 b	210 de	118 cd	1
Till and Roll	-	-	-	-	210 de	140 c	4
Heavy till	44	495 d	6 b	400 b	-	-	-
Gap (Mechanical)	55	995 cd	25 b	867 b	-	-	-
Gap (Roundup)	-	-	-	-	82 f	19 e	1
Gap (Ignite)	-	-	-	-	70 f	7 e	1

[z] Means followed by the same letter are not significantly different using Fishers protected least significant difference (P=.05).
[y] Oakville and Broad Valley, 1994 seed yield data was combined, since no cultivar x location interaction.
[x] Early and late renovation experiment at Broad Valley in 1994 used early August as the early treatment and early September as the late treatment.