

EXECUTIVE SUMMARY
END OF YEAR REPORT (Nov 1, 2000)
GROW-IN AND CULTURAL IMPACTS ON USGA PUTTING GREENS AND THEIR
MICROBIAL COMMUNITIES

Dr. R.E. Gaussoin, Principal Investigator

Cooperators: R. Drijber, W. Powers, M. Aslan, J. Schimelfenig, C.K. Meyer, and L.A. Wit

The overall goal of this project is to develop a better understanding of the impact of grow-in procedures on putting green establishment and performance. Impacts on the physical, chemical, and microbiological factors associated with the USGA root zones and rhizosphere are emphasized in the project.

The five year project is composed of three phases, One: Construction and Grow-in, Two: Microbial Community Assessments, and Three: Grow-in Procedure Impacts on the Long-term Performance of the Putting Green. Phases One and Two span three year periods, while Phase Three will involve experiments repeated over the five years of the project.

Two separate USGA-specification root zone mixtures - one composed of sand and peat (80/20 ratio) and one a combination of sand, peat, and soil (80/15/5 ratio) - were developed in 1996. Materials used for construction complied with USGA Greens recommendations for physical characteristics and organic matter content. First year greens (1997 Greens) were constructed in late summer of 1996, allowed to settle over the winter, and were seeded with Providence creeping bentgrass (1.5 lbs/1000 ft²) in the spring (May 30) of 1997. Second year greens (1998 Greens) were constructed in the summer of 1997, allowed to settle over the winter, and were seeded with Providence creeping bentgrass (1.5 lbs/1000 ft²) in the spring (May 27) of

1998. Third year greens (1999 Greens) were constructed in the fall of 1998 and allowed to settle over the winter. They were seeded with Providence creeping bentgrass (1.5 lbs/1000 ft²) in spring (May 26) of 1999. The fourth year greens have been constructed and will be allowed to settle over the winter. They will be seeded with Providence creeping bentgrass in the spring of 2000.

Establishment results were similar in greens established in 1997, 1998 1999 or 2000. For four consecutive years it was found that higher inputs will initially increase cover during grow-in. This increase may not translate to earlier opening for play if environmental stress conditions occur that result in damage to lush, immature turf.

Data collected and analyzed in 2000 follows. Comprehensive multi-year analysis of establishment and agronomic data as well as soil chemical, physical and microbial is pending. Anticipated date of completion of these data is July 2001.

Grow-in and Cultural Impacts on USGA Putting Greens and their Microbial Communities

R.E. Gaussoin, R. Drijber, W. Powers, M. Aslan, J. Schimelfenig, C.K. Meyer, and L.A. Wit

The overall goal of this project is to develop a better understanding of the impact of grow-in procedures on putting green establishment and performance. Impacts on the physical, chemical, and microbiological factors associated with the USGA root zones and rhizosphere are emphasized in the project.

The project is being conducted at the University of Nebraska's John Seaton Anderson Turfgrass Research Facility located near Mead, NE. The five year project is composed of three phases, One: Construction and Grow-in, Two: Microbial Community Assessments, and Three: Grow-in Procedure Impacts on the Long-term performance of the Putting Green. Phases One and Two span three year periods, while Phase Three will involve experiments repeated over the five years of the project.

Two separate USGA-specification root zone mixtures - one composed of sand and peat (80/20 ratio) and one a combination of sand, peat, and soil (80/15/5 ratio) - were developed in 1996. Materials used for construction complied with USGA Greens recommendations for physical characteristics and organic matter content. First year greens were constructed in late summer of 1996, allowed to settle over the winter, and were seeded with Providence creeping bentgrass (1.5 lbs/1000ft²) in the spring (May 30) of 1997. Year two greens were constructed in 1997. They were allowed to settle over the winter and were seeded in the spring (May 27) of 1998. Year three greens were constructed in 1998, allowed to settle over the winter and seeded in May 1999. Year four greens were constructed in 1999 and were allowed to settle over the winter and were seeded in the spring (May) of 2000. Accelerated and Controlled grow-in treatments were applied prior to and after seeding of the four greens according to the treatment schedule outlined in Table 1.

Data collected on year one through year four greens were: (1) color, (2) quality, (3) ball roll distance (Stimpmeter), and (4) surface hardness (Clegg). Additional data taken includes (5) vegetative cover (Year four green only) and (6) fairy ring density (years one, two, and three greens only). A treatment related incidence of fairy ring was noted in early May for greens

constructed in 1997 and 1998. Data was collected for number of fairy rings per plot on 5 May, 2000.

Soil physical properties were examined annually, in October. Infiltration rates were measured in the field using a 6" single-ring infiltrometer. Soil cores were sampled and analyzed for water retention and total porosity using pressure plate techniques. Soil chemical properties were analyzed annually, in the spring, prior to treatment, and in the fall. Samples for microbial characterization were also collected in the spring and fall.

1997 Greens

- (1) Quality and color of the turfgrass were unaffected by differences in the root zone mix or grow-in treatments (Tables 2 and 3).
- (2) Neither the root zone mix nor grow-in had any effect on ball roll distance (Table 4) .
- (3) The soil-containing root zone mixture had higher surface hardness than the soil-less mix on all observation taken in April, May, July and September 2000 on the 1997 greens (Table 5). Surface hardness was not affected by grow-in treatment.
- (4) Soil infiltration rates in 1997, 1998 and 1999 greens were not significantly different between root zone mixes (Table 6).
- (5) Fairy ring infestation was suppressed by the root zone containing soil. (Table 7).

1998 Greens

- (1) No quality or color differences were observed among treatments in 1998 greens (Tables 2 and 3).
- (2) Ball roll distance in the controlled grow-in was greater where soil was absent from the mix than when soil was present, in July for 1998 greens (Table 4).
- (3) Surface hardness was greater in the root mix containing soil than in the soil-less mix in June and September on the 1998 greens (Table 5). Grow-in treatments did not have any effect on surface hardness.

(4) Soil infiltration rates were not significantly different between root zone mixes or grow-in treatments in 1998 or 1999 greens (Table 6).

5) Fairy ring infestation was suppressed by the root zone containing soil. (Table 7).

1999 Greens

(1) No quality or color differences were observed among treatments in 1999 greens (Tables 2 and 3).

(2) Root zone mix and grow-in had no effect on ball roll in 1999 greens (Table 4).

(3) Surface hardness was greater in the root mix containing soil than in the soil-less mix in April, May and June on 1999 greens (Table 5). Grow-in treatments did not have any effect on surface hardness.

(4) Infiltration was not affected by grow-in or root zone treatments (Table 6).

2000 Greens

(1) No significant differences in mean vegetative cover were observed for the 2000 greens (Table 2). Quality of the controlled grow-in was significantly lower than that of the accelerated grow-in in August of 2000. Quality was lower for the root mix containing soil than that in which soil was absent in October of 2000 (Table 2). No color differences were observed among treatments in 2000 (Tables 3).

(2) Ball roll for the accelerated grow-in and the root zone mix lacking soil was higher than either the accelerated grow-in with a soil mix or a controlled grow-in without soil, in August of 2000 (Table 4).

(3) Surface hardness was unaffected by root mix or grow-in treatment in 2000 (Table 5).

(4) Infiltration was not affected by grow-in or root zone treatments (Table 6).

Water infiltration measurements from treatments established in 1997, 1998 or 1999 did not differ in establishment or subsequent years.

Results for soil physical characteristics (bulk density, porosity) and microbial data not shown are pending.

Table 2. Cover and Quality Means for USGA/GCSAA Greens Construction Project. J. S. Anderson Turfgrass and Ornamental Research Facility, Mead, Neb.

	% Cover†			Quality‡											
Root Zone Mix	1997	1998	2000	1997	1998 Results				1999 Results				2000 Results		
1997 Greens	7/3	6/15		8/1	7/14	9/1	9/15						8/20	9/21	10/26
sand/peat	68.3	66.7*		5.2	5.8	6.5	6.8						8.0	7.3	8.2
sand/peat/soil	78.3	70.8		6.2	6.0	6.5	6.3						8.0	7.2	7.8
1998 Greens								5/27							
sand/peat								6.0					6.8	5.5	6.5
sand/peat/soil								6.0					6.3	5.3	6.3
1999 Greens									7/27	8/26	9/22	10/26			
sand/peat									4.5	6.7	5.8	5.8	7.7	6.2	6.7
sand/peat/soil									4.5	7.3	6.3	6.7	7.0	6.5	6.5
2000 Greens			8/20												
sand/peat			57.0										8.2	4.5	6.5
sand/peat/soil			53.0										8.0	11.3	6.2

† Turfgrass cover evaluated on a 0 to 100% scale.

‡ Turfgrass quality evaluated on a 1 to 9 scale, with 1= poorest and 9= highest quality turf.

* Denotes significant ($p \leq 0.05$) differences between treatment means within years.

Grow-In Treatment														
1997 Greens	7/3	6/15		8/1	7/14	9/1	9/15							
Accelerated	84.2*	69.2		3.0*	5.7	6.2	6.3					8.0	7.2	7.8
Controlled	62.5	68.3		8.3	6.2	6.8	6.8					8.0	7.3	8.2
1998 Greens								5/27						
Accelerated								6.0				6.3	5.3	6.5
Controlled								6.0				6.8	5.5	6.3
1999 Greens								7/27	8/26	9/22	10/26			
Accelerated								3.0*	7.2	5.0*	5.2*	7.5	6.3	6.5
Controlled								6.0	6.8	7.2	7.2	7.2	6.3	6.7
2000 Greens			8/20											
Accelerated			50.0									9.0	4.0	5.7
Controlled			60.0									7.2	11.8	7.0

**Table 3. Color Means for USGA/GCSAA Greens Construction Project. J. S. Anderson
Turfgrass and Ornamental Research Facility, Mead, Neb.**

	Color†								
<i>Root Zone Mix</i>	1997	1998	1999 Results				2000 Results		
1997 Greens	8/15	9/1					8/20	9/21	10/26
sand/peat	7.2	7.2					8.2	8.0	8.0
sand/peat/soil	7.2	7.7					8.2	8.0	7.7
1998 Greens			5/27						
sand/peat			6.8				7.7	7.8	8.3
sand/peat/soil			7.0				7.7	7.8	7.8
1999 Greens				7/27	8/26	10/26			
sand/peat				6.5	5.0	7.3	7.7	8.0	7.8
sand/peat/soil				6.3	5.0	7.7	7.8	8.0	7.7
2000 Greens									
sand/peat							6.7	7.3	7.7
sand/peat/soil							6.8	7.5	7.5

† Turfgrass color evaluated on a scale of 1 to 9, with 9= darkest color.

* Denotes significant ($p \leq 0.05$) differences between treatment means within years

<i>Grow-In Treatment</i>									
1997 Greens	8/15	9/1							
Accelerated	7.2	8.7*					8.3	8.0	7.8
Controlled	7.2	6.2					8.0	8.0	7.8
1998 Greens			5/27						
Accelerated			7.2				7.7	7.8	8.2
Controlled			6.7				7.7	7.8	8.0
1999 Greens				7/27	8/26	10/26			
Accelerated				6.2	3.7*	7.3	7.7	8.0	7.7
Controlled				6.7	6.3	7.7	7.8	8.0	7.8
2000 Greens									
Accelerated							7.3	7.2	7.7
Controlled							6.2	7.7	7.5

† Turfgrass color evaluated on a scale of 1 to 9, with 9= darkest color.

* Denotes significant ($p \leq 0.05$) differences between treatment means within years.

Table 4. Ball Roll Distance in feet (Stimpmeter) for USGA/GCSAA Greens Construction Project. J. S. Anderson Turfgrass and Ornamental Research Facility, Mead, Neb.

Root Zone Mix	1997			1998					1999 Results				2000 Results							
1997 Greens	7/3	9/16	10/22	5/21	7/14	8/14	9/24	10/14	5/27	6/22	7/27	8/26	4/27	5/23	6/22	7/25	8/20	9/21	10/26	
sand/peat	2.6	2.1	2.4*	66.7*	8.1	8.7	6.9	6.1	6.9	7.1	8.5	7.5	7.7	8.3	11.2	10.4	8.8	7.1	6.2	
sand/peat/soil	2.6	2.1	2.6	70.8	8.3	8.7	6.7	6.4	6.9	7.1	8.8	7.6	7.2	8.1	11.2	10.4	8.7	7.1	6.2	
1998 Greens																				
sand/peat							6.3	5.6	7.7	6.5	8.5	7.6	7.6	7.7	10.8	11.1	8.9	7.0	6.5	
sand/peat/soil							6.2	5.7	7.6	6.5	8.5	7.6	7.8	8.1	11.0	10.8	8.7	7.0	6.2	
1999 Greens																				
sand/peat													8.0	8.3	10.6	10.6	8.5	6.8	6.3	
sand/peat/soil													7.5	8.3	10.8	10.5	8.4	7.0	6.2	
2000 Greens																				
sand/peat																	6.9	6.7	5.8	
sand/peat/soil																	7.2	6.5	6.2	

Grow-In Treatment	1997			1998					1999 Results				2000 Results								
1997 Greens	7/3	9/16	10/22	5/21	7/14	8/14	9/24	10/14	5/27	6/22	7/27	8/26	4/27	5/23	6/22	7/25	8/20	9/21	10/26		
Accelerated	2.5	2.1	2.3*	6.1	8.2	8.7	7	6.1	6.9	7.0	8.5	7.5	7.4	8.2	11.1	10.3	8.6	7.0	6.1		
Controlled	2.6	2.2	2.7	6.4	8.2	8.7	6.5	6.4	7.0	7.2	8.8	7.6	7.5	8.2	11.3	10.4	8.9	7.2	6.3		
1998 Greens																					
Accelerated									6.0	5.0*	7.8	6.7	8.4	7.4	8.1	7.9	10.9	10.9	8.8	7.2	6.5
Controlled									6.5	6.3	7.6	6.4	8.6	7.8	7.3	7.9	11.0	11.0	8.8	6.8	6.2
1999 Greens																					
Accelerated													7.9	8.6	10.8	10.7	8.4	6.8	6.3		
Controlled													7.7	8.0	10.6	10.4	8.5	7.0	6.1		
2000 Greens																					
Accelerated																		6.8	6.7	5.9	
Controlled																		7.3	6.5	6.2	

† Denotes significant ($p \leq 0.05$) differences between treatment means within years.

Table 5. Surface Hardness (Clegg, gravities (G)) for USGA/GCSAA Greens Construction Project. J. S. Anderson Turfgrass and Ornamental Research Facility, Mead, Neb.

Root Zone Mix	1997 Results			1998 Results						1999 Results						2000 Results								
1997 Greens	8/4	9/16	10/22	5/21	6/15	7/14	8/14	9/24	10/14	5/27	6/22	7/27	8/26	9/22	10/18	4/27	5/23	6/22	7/25	8/20	9/21	10/26		
sand/peat	47.9*	56.4*	56.1*	53.0*	54.8*	57.8*	60.8*	57.4	64.2*	52.3*	57.8	58.2*	58.4*	56.4*	61.9*	53.7*	54.5*	44.7	44.6*	72.0	49.9*	52.2		
sand/peat/soil	60.3	68.3	68.1	60.8	64.0	70.2	71.1	65.2	75.1	57.9	58.2	65.6	64.5	60.8	67.6	56.7	61.4	47.5	50.3	71.0	52.8	55.2		
1998 Greens																								
sand/peat										67.1	78.9*	60.4	64.0*	66.9*	65.8*	64.9	69.9*	57.8	60.9	46.5	51.4	72.5	54.1*	58.5
sand/peat/soil										74.3	91.3	62.8	68.8	74.0	72.4	69.7	76.9	58.9	65.6	51.4	51.9	71.5	56.8	62.1
1999 Greens																								
sand/peat																								
sand/peat/soil																56.6*	61.7*	45.3*	52.2	69.8	57.8	59.0		
2000 Greens																								
sand/peat																								
sand/peat/soil																								

Grow-In Treatment																						
1997 Greens	8/4	9/16	10/22	5/21	6/15	7/14	8/14	9/24	10/14	5/27	6/22	7/27	8/26	9/22	10/18	4/27	5/23	6/22	7/25	8/20	9/21	10/26
Accelerated	53.0	61.2	61.7	56.8	59.2	64.9	63.3	61.9	70.3	54.9	57.0	62.4	58.2	56.2	65.5	54.3	57.4	44.7	47.4	70.2	50.5	53.6
Controlled	55.2	63.5	62.4	57.0	59.6	63.2	68.8	60.7	68.9	55.2	59.0	61.3	59.0	59.0	64.0	56.1	58.6	44.6	47.8	72.9	52.2	53.7
1998 Greens																						
Accelerated								70.3	85.9	61.7	65.3	70.3	68.6	68.6	73.3	58.7	63.2	48.7	50.7	71.8	55.6	60.2
Controlled								71.1	84.3	61.4	67.6	70.6	66.1	66.1	73.2	58.0	63.3	49.2	52.7	72.2	55.3	60.4
1999 Greens																						
Accelerated													69.6	68.6	71.1	58.1	66.1	48.9	56.6	69.1	59.3	63.7
Controlled													68.9	67.8	71.1	58.5	64.4	49.1	52.6	69.3	57.3	59.9
2000 Greens																						
Accelerated																				56.0	52.2	58.9
Controlled																				59.7	49.8	57.7

† Denotes significant ($p \leq 0.05$) differences between treatment means within years.

Table 6. Infiltration at 2 inch soil depth (inch/hour) for USGA/GCSAA Greens Construction Project. J. S. Anderson Turfgrass and Ornamental Research Facility, Mead, Neb.

<i>Root Zone Mix</i>	<i>1997 Results</i>	<i>1998 Results</i>	<i>1999 Results</i>	<i>2000 Results</i>
1997 Greens	10/20	10/17	10/18	10/3
sand/peat	21.6	23.8	24.9	21.7
sand/peat/soil	20.3	19.8	22.9	19.3
1998 Greens				
sand/peat		20.9	19.9	19.0
sand/peat/soil		19.2	20.5	16.4
1999 Greens				
sand/peat			20.1	19.3
sand/peat/soil			18.4	15.3
2000 Greens				
sand/peat				32.6
sand/peat/soil				27.9

<i>Grow-In Treatment</i>	<i>1997 Results</i>	<i>1998 Results</i>	<i>1999 Results</i>	<i>2000 Results</i>
1997 Greens				
Accelerated	20.4	21.9	26.1*	19.1
Controlled	21.4	22.8	22.0	21.9
1998 Greens				
Accelerated		22.7	20.0	19.0
Controlled		17.9	20.3	16.4
1999 Greens				
Accelerated			21.2	17.7
Controlled			17.5	16.9
2000 Greens				
Accelerated				30.8
Controlled				29.7

† Denotes significant ($p \leq 0.05$) differences between treatment means within years.

Table 7. Fairyring fungal infection (# of rings on 5 May 2000)
Of the USGA/GCSAA Greens Construction Project. J.S.
Anderson Turfgrass and Ornamental Research Facility, Mead, NE.

Root Zone Mix	2000 Results
----------------------	---------------------

1997 Greens

sand/peat	18.3*
sand/peat/soil	6.3

1998 Greens

sand/peat	3.7*
sand/peat/soil	0.2

(*Denotes significant ($p \leq 0.05$) differences between treatment means within years)