TURFGRASS RESEARCH FOR HIGH TRAFFICKED AREAS

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1997 was another busy year for turfgrass research for high trafficked areas. This year we concentrated our research in three major areas:

1) DEVELOPMENT OF ESTABLISHMENT TECHNIQUES FOR SOD PRODUCTION UTILIZING A REFINED WOOD FIBER MAT (ECOMAT™) AS THE GROWTH MEDIA OVER AN IMPERMEABLE PLASTIC BARRIER
2) DETERMINGING THE PERFORMANCE OF POA SUPINA GROWN IN VARYING MEDIA FOR ATHLETIC FIELD CONDITIONS UNDER REDUCED LIGHT CONDITIONS
3) COMPARING KENTUCKY BLUEGRASS (*Poa pratensis* L.) VERSUS SUPINA BLUEGRASS (*Poa supina* SCHRAD.) AND CRUMB RUBBER WITHIN SPORTGRASS® FOR INDOOR STADIA

Each of these areas of these areas will be reviewed in some detail in this paper and/or in subsequent papers within these proceedings.

DEVELOPMENT OF ESTABLISHMENT TECHNIQUES FOR SOD PRODUCTION UTILIZING A REFINED WOOD FIBER MAT (ECOMAT™) AS THE GROWTH MEDIA OVER AN IMPERMEABLE PLASTIC BARRIER

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Introduction:

Manufactured in New Westiminster, British Columbia, by Canadian Forest Products Ltd., Ecomat™ is used extensively as an erosion control mat along roadsides. Ecomat™ is a recycled wood fiber mat and can be used as the growth medium on plastic sheeting for turfgrass establishment. Sod production on plastic is a unique practice and demonstrates many advantages versus traditional sod production. Root shearing during sod harvesting is eliminated when grown on plastic which allows the sod to establish faster than conventional sod. The sod is light-weight due to the absence of soil, potentially allowing for cheaper shipping costs and larger sod pieces. The sod pieces are held together by the binding of the roots, thus enabling the production of turfgrasses with bunch type growth habits. Since, the Ecomat™ is a soil less growing media, the recommended seeding rates, and fertility rates and type will differ from conventional turfgrass establishment in soil growth media. Currently, sod production on plastic utilizes wood chips, compost, and sand as the growth media for turfgrass establishment. Although sod production on soil less growing media has been practiced for a number of years, little published research exists to recommend specific establishment practices. In 1997, two separate experiments were conducted to satisfy the following objectives: 1) Determine the optimum seeding rate for turfgrass establishment on a soil less media (Ecomat™) over plastic, and 2) Determine the optimum fertilizer type (organic vs. mineral) and application rate for turfgrass establishment on a soil less media (Ecomat™) over plastic.

Materials and Methods:

Experiment 1: Seeding rate

Four cool season turfgrasses were established from seed on Ecomat™(1 cm thick) over an impermeable plastic barrier (6 mil thickness) at the Hancock Turfgrass Research Center, Michigan State University, during summer 1997. The experiment was a 2 factor randomized complete block design (RCBD) with 3 replications.

Factor one was the four turf species which included: *Poa pratensis* L (Kentucky bluegrass (KBG)), *P. supina* Schrad. (supina bluegrass (SBG)), *Lolium perenne* L. (perennial ryegrass (PR)), and *Festuca arundinacea* L. (tall fescue (TF)). Factor two was the three seeding rates for each turf species (Table 1). The initial seeding rate was the typical recommended seeding rate for conventional turfgrass establishment on soil. There were a total of 36- 4' by 6' plots which were seeded on 7 June 1997. Seed was applied using a hand shaker, and each plot was individually seeded. Straw was put over the seeded plots as a mulch. Prior to seeding all plots were fertilized with 2 lbs P/1000 ft^2 using Lebanon Country Club (13-25-12) Starter Fertilizer. Every two weeks an additional 1 lb P/1000 ft^2 was applied using the 13-25-12 fertilizer for a total of 7 fertilizer applications. Water was applied as needed using an automatic irrigation system. Mowing began 4 weeks after seeding, and was done twice per week using a reel mower at a 1.25" mowing height. Turf density was evaluated to determine turfgrass cover for establishment.

Table 1. Seeding rates (lbs/1000 ft^2) for turfgrass establishment on four turf species, East Lansing, MI. 1997.

	turfgrass species			
	KBG	SBG	PR	TF
Seeding rate:				
1x	1.5	1.5	8.0	8.0
2x	3.0	3.0	16.0	16.0
3x	6.0	6.0	32.0	32.0

<u>Experiment 2:</u> Fertility type and rates

On 10 June 1997, 45 3' by 4' Ecomat™ plots were laid on plastic, with 18" sod strips between each plot to act as a buffer. The study consists on 6 main treatments consisting of two fertilizer types (different forms of nitrogen (N)), and three fertility rates. The two types of fertilizers used were a organic fertilizer (Milorganite™ 6-2-0), and a mineral fertilizer (ammonium nitrate 34-0-0). The three fertility rates compared were 0.25, 0.5, and 1.0 lbs N/1000 ft^2. An additional three treatments were included as orthogonal contrasts with the 0.5 lb ammonium nitrate treatment. The additional treatments included: high potassium, high phosphorous, and urea. Phosphorous (0-46-0), and potassium (0-0-50) were both applied at 0.25 lbs/1000 ft^2 each time the treatments were applied. High nitrogen and phosphorous treatments were applied prior to seeding as a bed source of nutrient. Four post fertilizer treatment applications were made every two weeks after seeding. Table 2 shows the arrangement of the fertilizer treatments. on 11 June 1997 all plots were seeded with Kentucky bluegrass Var. 'Touchdown' at 1.5 lbs/1000 ft^2, and then straw was placed over top as a mulch. Water was applied as needed using an automatic irrigation system. Mowing began 4 weeks after seeding, and was done twice per week using a reel mower at a 1.25" mowing height. Turf density was evaluated to determine turfgrass cover for establishment.

Table 2. Fertilizer treatment types and rates for turfgrass establishment utilizing Ecomat™ on plastic East Lansing, MI. 1997.

Treatment†:	Bed N	Post N	Bed P	Post P	Bed K	Post K
1	2 .0 (O)	0.25	2.0	0.25	0	0.25
2	2.0 (O)	0.5	2.0	0.25	0	0.25
3	2.0 (O)	1.0	2.0	0.25	0	0.25
4	2.0 (M)	0.25	2.0	0.25	0	0.25
5	2.0 (M)	0.5	2.0	0.25	0	0.25
6	2.0 (M)	1.0	2.0	0.25	0	0.25
7	2.0 (M)	0.5	2.0	0.5	0	0.25
8	2.0 (M)	0.5	2.0	0.25	0	0.5
9	2.0 (U)	0.5	2.0	0.25	0	0.25

† Treatment rates are all in lbs/1000 ft^2.
O=organic form of nitrogen (Milorganite™), M=mineral form of nitrogen (ammonium nitrate), and U=mineral form of nitrogen (urea).

Results and Discussion:

Experiment one: Seeding rate

Table 3 shows that there is a significant difference between the four turf species studied. Perennial ryegrass has a much greater density than any of the other turf species studied with tall fescue following second, and Kentucky bluegrass and supina bluegrass are similar, and have significantly less cover than the tall fescue. The greater densities of the perennial ryegrass and tall fescue were expected on the early data collection dates because, of their superior germination rate than the two bluegrass species. However, even after two months, the two bluegrass species had significantly less cover than the perennial ryegrass, as did the tall fescue. With the exception of the 8 September rating, tall fescue had significantly greater turfgrass density than the two bluegrass species. This may be a result of the tall fescue having a much faster germination rate than the two bluegrass species. Only the Perennial ryegrass had high turf density after two months.

Significant differences between the three seeding rates occurred on rating dates except the 2 July rating date (Table 3). The significant difference is occurring between the 1x rate and the 4x rate. When seeding at the 1x rate (recommended seeding rate) turfgrass density is relatively poor even after two months.

Table 3. Turf density (% cover) on 4 species and 3 seeding rates utilizing Ecomat™ on plastic, East Lansing, MI. 1997

	Date				
	2 July	18 July	30 July	8 Aug.	8 Sept.
			density†		
Turf Species (TS):					
Kentucky bluegrass (KBG)	0.2	13.7	15.1	16.7	19.2
Supina bluegrass (SBG)	1.3	12.0	17.7	19.6	23.0
Perennial ryegrass (PR)	29.7	74.1	71.9	73.0	76.3
Tall fescue (TF)	12.9	40.0	37.6	37.0	41.1
$LSD_{(0.05)}$	10.7	19.0	18.1	17.6	18.9
Seeding Rate (SR):					
1 times (1X)	5.4	23.0	23.6	24.6	27.3
2 times (2X)	12.8	37.3	36.2	36.8	41.3
4 times (4X)	14.9	44.6	46.9	48.3	51.3
$LSD_{(0.05)}$	ns	16.5	15.7	15.2	16.4

ns Indicates no significance at the $p = 0.05$ probability level.

† Density is a percent turf cover where, 0 = no turf cover, and 100 = complete turf cover.

Experiment two: Fertility type and rates

Table 4 shows that significant differences occurred within each factor on all dates where ratings were collected. There is also an interaction between the two factors (nitrogen fertilizer type and rate). Results indicate that the use of an organic fertilizer greatly increases turfgrass density during establishment compared to the mineral form of nitrogen. In turn, increasing the rate of fertility also significantly increases turfgrass density. Results show that at least 0.5 lbs/1000 ft^2 organic fertilizer are required to increase turfgrass density. It is likely that the organic nitrogen form did significantly better than the mineral nitrogen form as a result of the test site being poorly drained; which lead to the occurrence of standing water to often accumulate as a result of a heavy rain or too much irrigation. On many occasions the research plots were submerged under water for long periods of time, resulting in denitrification to occur with the mineral nitrogen form (ammonium nitrate); therefore, reducing greatly the amount of available nitrogen for the germinating plants to uptake. Table 5 shows that no significant differences occurred when the post phosphorous application rates were doubled. Also, no important significant differences occurred when the post potassium application rates were doubled. Finally, when comparing two types of mineral nitrogen sources (ammonium nitrate and urea), no significant differences occurred.

Table 4. Effect of fertilizer type and rate on turf establishment (% cover) utilizing Ecomat™ on plastic, East Lansing, MI. 1997.

	Date			
	10 July	30 July	8 Aug.	8 Sept.
	density†			
Fertilizer Type lbs/1000 ft^2 (FT):				
organic (O)	11.4	29.0	31.5	35.5
mineral (M)	3.9	14.3	12.7	14.9
LSD	*	*	*	*
Fertilizer Rate (FR):				
0.25 lbs (A)	3.5	15.8	13.9	16.6
0.5 lbs (B)	9.1	21.6	23.6	26.2
1.0 lbs (C)	10.5	27.5	28.8	32.8
$LSD_{(0.05)}$	3.2	7.0	8.2	9.6
FT x FR				
O x A	2.6	14.8	13.6	15.6
O x B	15.2	33.0	38.0	42.0
O x C	16.6	39.2	43.0	49.0
M x A	4.4	16.8	14.2	17.6
M x B	3.0	10.2	9.2	10.4
M x C	4.4	15.8	14.6	16.6
$LSD_{(0.05)}$	4.2	9.0	10.6	12.3

* Indicates significance at the 0.01 probability level.
† Density ratings are on a percent turf cover 0 = no turf (bare) and 100 = complete cover.

Table 5. Effect of increasing post phosphorous and potassium rates, or using urea nitrogen on turf density (% cover) utilizing Ecomat™ on plastic, East Lansing, MI. 1997.

	Date			
	10 July	30 July	8 Aug.	8 Sept.
	density†			
Phosphorous Rate:				
0.25	2.0	10.2	9.8	11.8
0.5	7.2	16.2	17.2	20.2
LSD	ns	ns	ns	ns
Potassium Rate:				
0.25	1.8	10.2	9.8	10.8
0.5	3.6	18.6	13.8	15.6
LSD	ns	*	ns	ns
Nitrogen Form:				
ammonium nitrate	2.4	10.2	9.8	14.2
urea	4.6	17.8	18.8	24.6
LSD	ns	ns	ns	ns

* Indicates significance at the 0.01 probability level, ns = no significance at p = 0.05 level.
† Density is a percent turf cover where 0 = no turf cover, and 100 = complete turf cover.

Conclusions:

Experiment one: Seeding rate

Based on the results from experiment one, perennial ryegrass was the superior turfgrass because of its fast establishment rate, and the ineffective watering regimes. The 4x seeding rate significantly increased turfgrass density compared to the recommended rate for conventional seeding on soil. The two bluegrass species and the tall fescue, two months after seeding, had very poor turf cover at all seeding rates. The poorly drained research plot, and the fact that the fertility applied was a mineral fertilizer, may have resulted in nitrogen being unavailable as a result of denitrification.

Experiment two: Fertility type and rate

Clearly, the organic fertilizer showed significantly greater turf density than the mineral fertilizer. The 0.5 and 1.0 lb fertility rates showed little difference, but were superior to the 0.25 lb rate. Results determined that the organic fertilizer at the 0.5 lb N rate is sufficient enough to establish turfgrass within Ecomat™ on plastic.

Turfgrass establishment on plastic utilizing Ecomat™ requires specific turfgrass management practices. Knowledge gained from experiment one and two can be compared and specific management practices can be implemented to obtain a high quality turf stand. For instance, the use of organic fertilizer at 2 times the recommended seeding rate, on a well drained surface, with an effective mulch would enable one to establish sod using Ecomat™.

DETERMINGING THE PERFORMANCE OF POA SUPINA GROWN IN VARYING MEDIA FOR ATHLETIC FIELD CONDITIONS UNDER REDUCED LIGHT CONDITIONS

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Introduction:

Poa supina has a demonstrated ability to perform well under reduced light conditions when exposed to athletic field conditions (Stier et, al. 1996). However, optimum management practices have not been determined for maintaining the highest quality of turf possible. Currently, optimum fertility levels and applications of plant growth regulators (PGRs) have been determined for the management of *Poa supina* under reduced light conditions (Stier, 1997). The use of varying growth media for sod establishment, as well as, the use of crumb rubber (shredded car tires) are some management techniques that have the potential to maintain high quality turf under reduced light and trafficked conditions.

Sod establishment on plastic is a method of turf establishment that posses many benefits. One of the greatest benefits of sod on plastic is the ability to select the desired growth media. For this experiment, the use of four different growth media were used in addition to washed sod (no media) for comparison. The four growth media selected for this study are: pine mulch, fine grade compost, refined wood fiber mat, and SportGrass™ back filled with sand. The pine mulch consists of shredded wood pieces that have a relatively low water holding capacity. Wood mulch is a growth media currently used for sod production on plastic. The second media is fine grade compost, and is very unstable on the plastic when there is no established turfgrass for support. The compost also has the potential to compete with the nitrogen fertilizer. The refined wood fiber mat (Ecomat™) provides a light weight and stable surface for turfgrass establishment. Finally, SportGrass™ is a woven polyethylene mat with synthetic strands intended to provide additional support for the turfgrass. The four different media were selected because of the current and potential use for athletic fields. The use of crumb rubber as a topdressing material has proven to be an effective amendment for reducing surface compaction and turfgrass wear. The objective of this study was to compare the four growth media with crumb rubber opdressing, under athletic field conditions in reduced light situations (covered stadia).

Materials and Methods:

Supina bluegrass (*Poa supina* Schrad. var. 'Supranova') sod was grown on four varying growth media (wood mulch, sand, refined wood fiber mat (Ecomat™), and SportGrass™) during the summer of 1996 at the Hancock Turfgrass Research Center on the campus of Michigan State University. On 11 November 1996 15 4' by 4' boxes were sodded inside the indoor turfgrass research facility on the campus of Michigan State University. Sod grown in each of the four growth media, and washed sod from Manderley Sod in Nepean, Ontario were each sodded on three separate boxes. On 27 December, each box was split and crumb rubber was topdressed at a 0.75" depth. The experiment was setup as a randomized complete block design (RCBD) for factor A, with factor B a split plot on A. Factor A consisted of the four different media and the washed sod. Factor B was the crumb rubber topdressing applied to one half of the Factor A plots. Fertility was applied twice per month at 0.5 lbs N/1000^2 using Lebanon Country Club 18-3-18 fertilizer until the end of April 1997. Traffic applications were applied two times a week using studded soccer cleats, and began 10 January 1997 through 11 April 1997. A total of 50 jogging passes were applied during each traffic application. 0.4 oz/1000 ft^2 of PGR (Primo®) was applied on 8 December 1997, and on 7 January 1997, 26 February 1997, and 28 March 1997 0.2 oz/1000 ft^2 of PGR was applied. The appearance of PGR toxicity accounts for the lag between the 7 January and 26 February PGR applications. Chipco® was applied periodically (4 times) when pink snow mold became visible. Mowing was done every Monday, Wednesday, and Friday at 1.25" using a reel mower. Watering was done on an as needed basis, and fans were setup to provide air movement across the turf. Color, density, and quality ratings were visually taken every two weeks. Color and quality ratings were based on a 1-9 scale with 1 being the lowest, 9 being the highest, and 6 being acceptable. Density ratings were based on a percentage of turf cover (0-100%). Clippings were collected and weighed weekly. Clegg and Shear Vane data were also collected to measure turfgrass surface characteristics.

Results and Discussion:

No important significant differences occurred among either factor (growth media and crumb rubber level) for color ratings (table 1). Table 2. significant differences in plots with crumb rubber versus plots without crumb rubber. During the final three rating periods, the plots with crumb rubber had greater turfgrass density, which was anticipated. The increased turf density on the crumb rubber plots resulted in significantly higher quality turf stands (Table 3). Turf density and quality did not differ significantly between the 5 different growth media. Clipping yields did not show any significant differences among treatments.

Table5 Surface hardness characteristics (Clegg) differed significantly among the two treatments tested. SportGrass™ plots had significantly harder surface characteristic than any other growth media. The compost and wood mulch had the lowest surface hardness while, the Ecomat™ and washed sod were in the middle. Plots treated with crumb rubber exhibited significantly lower surface hardness characteristics; which, was anticipated. SportGrass™ plots consistently showed the highest shear strength readings. The Ecomat™ and washed sod plots were a close second; while, the compost and wood mulch were the weakest. It can be expected that the SportGrass™ and Ecomat™ plots would have the highest shear strength because of the very nature of the composition of both growth media being very strong. Interactions show that growth media without crumb rubber have a significantly greater shear strength than the media with crumb rubber. However, the washed sod and wood mulch, with crumb rubber, had greater shear strength than the plot without the rubber. Comparing the two dates that Shear Vane was collected, the 29 March date consistently had increased shear strength ratings even after traffic had been applied. The 3 January was collected prior to traffic applications.

Table 1. Effect of traffic on turf color of supina bluegrass grown on varying growth media (GM) with crumb rubber (CR) topdressing as a split, East Lansing, MI. 1996-97.

	Dates							
	8Dec.	27 Dec.	17 Jan.	4 Feb.	17 Feb.	13 Mar.	21 Mar.	28 Mar.
					color†			
Growth Media (GM)								
Ecomat (EM)	7.5	7.3	6.0	5.1	5.0	6.3	6.7	6.5
SportGrass (SG)	8.0	7.7	6.6	6.3	5.6	5.4	6.3	6.4
Compost (CP)	5.8	7.0	7.0	7.7	6.8	6.5	7.0	7.0
Wood Mulch (WM)	6.5	7.7	7.0	7.8	6.7	6.6	7.0	6.8
Washed Sod (WS)	7.0	7.5	6.6	5.6	5.5	6.9	7.0	6.3
LSD	1.4	ns	0.7	0.7	ns	0.8	ns	ns
Crumb Rubber (CR)								
No	7.0	7.4	6.5	6.4	5.9	6.2	6.8	6.6
Yes	7.0	7.4	6.8	6.6	5.9	6.5	6.8	6.6
LSD	ns	ns	**	ns	*	*	ns	ns

*,** Significant at the 0.05 and 0.01 probability levels, respectively; ns = not significant at $p = 0.05$.
† Color was rated visually on a 1-9 scale: 1=100% brown, 9=dark green.

Table 2. Effect of traffic on turf density of supina bluegrass grown on varying growth media (GM) with crumb rubber (CR) topdressing as a split, East Lansing, MI. 1996-97.

	Dates							
	8Dec.	27 Dec.	17 Jan.	4 Feb.	17 Feb.	13 Mar.	21 Mar.	28 Mar.
				density†				
Growth Media (GM)								
Ecomat (EM)	97.7	98.7	98.3	98.7	96.0	93.2	90.5	90.8
SportGrass (SG)	100.0	100.0	98.7	97.3	94.8	87.5	75.0	74.2
Compost (CP)	98.7	99.0	98.2	98.3	99.0	89.7	88.8	88.3
Wood Mulch (WM)	97.7	99.7	98.5	98.5	99.0	89.7	85.0	82.2
Washed Sod (WS)	99.3	100.0	98.8	98.7	99.0	92.7	86.3	86.0
LSD	ns	ns	ns	ns	ns	ns	ns	ns
Crumb Rubber (CR)								
No	98.7	99.5	98.2	97.9	97.0	88.7	82.1	80.5
Yes	98.7	99.5	99.0	98.7	98.1	92.4	88.2	88.1
LSD	ns	ns	*	ns	ns	**	*	**

*,** Significant at the 0.05 and 0.01 probability levels, respectively; ns = not significant at $p = 0.05$.
† Density of turf was estimated on a percentage (0 = no turf cover and 100 = total turf cover).

Table 3. Effect of traffic on turf quality of supina bluegrass grown on varying growth media (GM) with crumb rubber (CR) topdressing as a split, East Lansing, MI. 1996-97.

	Dates							
	8Dec.	27 Dec.	17 Jan.	4 Feb.	17 Feb.	13 Mar.	21 Mar.	28 Mar.
				quality†				
Growth Media (GM)								
Ecomat (EM)	7.7	7.5	6.9	5.3	4.5	6.6	6.8	6.6
SportGrass (SG)	8.2	7.7	7.3	6.8	5.1	5.3	5.5	5.8
Compost (CP)	6.5	6.8	7.4	7.8	6.8	6.2	7.4	6.5
Wood Mulch (WM)	7.5	7.8	7.6	7.9	6.8	6.4	6.8	6.3
Washed Sod (WS)	7.5	7.7	7.0	6.3	4.9	6.4	6.6	6.3
LSD	ns	ns	ns	0.9	1.6	ns	ns	ns
Crumb Rubber (CR)								
No	7.5	7.5	7.2	6.7	5.6	6.0	6.4	6.1
Yes	7.5	7.5	7.3	6.9	5.6	6.4	6.8	6.5
LSD	ns	ns	ns	ns	ns	**	**	*

*,** Significant at the 0.05 and 0.01 probability levels, respectively; ns = not significant at p = 0.05.
† Quality was rated visually on a 1-9 scale: 1=100% necrotic turf/bare soil, 9=dense, uniform turf with acceptable color
(color ³ 5).

Table 4. Effect of traffic on clipping yields of supina bluegrass grown on varying growth media (GM) with crumb rubber (CR) topdressing as a split, East Lansing, MI. 1997.

	Dates								
	17 Jan	24 Jan	31 Jan	7 Feb	28 Feb	7 Mar	14 Mar	21 Mar	28 Mar
				clipping yields†					
Growth Media (GM)									
Ecomat (EM)	0.3	0.4	0.5	0.4	3.2	3.2	1.3	1.9	1.7
SportGrass (SG)	0.5	0.7	0.5	0.6	3.6	2.9	1.1	1.6	1.7
Compost (CP)	0.7	0.9	0.6	1.0	3.8	4.2	1.0	1.6	1.2
Wood Mulch (WM)	0.4	0.8	0.7	1.0	3.3	3.7	1.0	1.3	1.8
Washed Sod (WS)	0.5	0.6	0.5	0.5	3.7	4.3	1.6	2.2	1.9
LSD	ns	ns	ns	0.4	ns	ns	ns	ns	ns
Crumb Rubber (CR)									
No	0.5	0.6	0.5	0.7	3.4	3.4	1.3	1.7	1.6
Yes	0.5	0.7	0.6	0.7	3.7	3.9	1.0	1.8	1.8
LSD	ns	ns	ns	ns	*	ns	ns	ns	ns

*,** Significant at the 0.05 and 0.01 probability levels, respectively; ns = not significant at p = 0.05.
† Clippings were collected using a reel mower set at 1.25", and weights were measured in grams (g).

Table 5. Effect of surface hardness (Clegg) and Shear Vane on supina bluegrass grown on varying growth media (GM) with crumb rubber (CR) topdressing as a split, East Lansing, MI. 1997.

	Dates		
	3 Jan. Clegg (G_{max})	3 Jan. Shear Vane (nm)	29 March Shear Vane (nm)
Growth Media (GM)			
Ecomat (EM)	51.8	14.6	22.8
SportGrass (SG)	64.0	17.1	24.2
Compost (CP)	40.1	15.1	16.6
Wood Mulch (WM)	41.3	13.5	13.1
Washed Sod (WS)	51.8	21.1	20.4
LSD	4.2	2.9	4.1
Crumb Rubber (CR)			
No	51.7	20.1	21.9
Yes	48.1	12.4	16.9
LSD	**	**	**
GMxCR			
EM-CR	54.7	17.7	27.5
EM+CR	49.0	11.5	18.0
SG-CR	67.7	23.5	31.7
SG+CR	60.3	10.7	16.7
CP-CR	40.8	18.2	18.2
CP+CR	40.3	12.0	15.0
WM-CR	43.0	16.0	12.7
WM+CR	39.7	11.0	13.5
WS-CR	52.3	25.2	19.3
WS+CR	51.3	17.0	21.5
$\text{LSD}^{\ddagger}_{(0.05)}$	ns	3.3	3.2
$\text{LSD}^{\S}_{(0.05)}$	ns	4.3	4.6

*,** Significant at the 0.05 and 0.01 probability levels, respectively; ns = not significant at $p = 0.05$.

† Between crumb rubber levels with same growth media.

‡ Between growth media with same or different crumb rubber levels.

Conclusions:

Up until the conclusion of the experiment, turfgrass performance characteristics (color, density, quality, and clipping yields) were above an acceptable level for athletic field conditions under reduced light conditions. Unfortunately, it appears that traffic applications were not intense enough to show important significant differences between the growth media and crumb rubber treatments for color, density, quality, and clipping yield data collection.