Chapter 2

THE EFFECT OF DIFFERENT GROWTH MEDIA FOR TURFGRASS ESTABLISHMENT AND PERFORMANCE

ABSTRACT

Experiment one: Turfgrass establishment

The germination and establishment of *Poa pratensis* and *Poa supina* in four different growth media (sand, pine wood mulch, Ecomat®, and SportGrass™) placed over plastic sheeting was investigated. Percent turfgrass cover (0-100%) as a measure of germination density was evaluated 1, 2, 5, and 10 weeks after seeding. The study began 10 June 1996 and was restarted on 12 August 1996. Results determined that SportGrass™ was the most successful growing medium for turfgrass establishment. The Ecomat® did not have as high turfgrass cover as the SportGrass™, because the watering requirements for the Ecomat® was much greater than the SportGrass™. Establishing turf from seed with different growth mediums, of different water holding capacities under one irrigation block results in too much or too little water being applied to each growth medium. There were no significant differences between turfgrass species ten weeks after seeding.

Experiment two: Turfgrass performance

The athletic field performance of *Poa supina* sod grown on four different growth media over plastic were compared. Washed *Poa supina* sod was included as a control. Crumb rubber topdressing was applied as a split treatment on the five sod types. The plots were subjected to simulated athletic field traffic under reduced light conditions.

Results showed the use of crumb rubber contributed to higher turfgrass density. No significant differences in turfgrass density between sod types occurred, because not enough wear was applied to show potential differences.

INTRODUCTION

Maximizing footing and minimizing player injury are two criteria expected from turf fields by athletic field managers. Having a tough, shear resistant turf is one way to augment these criteria. However, turfgrass is living plant material and when exposed to heavy athletic or recreational use, the quality of the turf will deteriorate. To maintain a tough, shear resistant turf, resodding is often implemented. In sod production and in installation, tear-resistant turf that quickly roots is most desirable (Hall, 1993).

Shear strength of sod is the force required to tear or break a piece of cut sod apart (Hall, 1993). In the case of conventional sod, shear strength is dependent upon the remaining root mass after harvesting, rhizomes and/or stolons, soil type, and moisture content (Rogers and Waddington, 1992). Additionally, sod produced over an impervious layer like plastic increases shear strength as a result of the dense and intact root mass provided.

Sod produced on plastic is a method of turfgrass establishment that possesses many benefits. One of the greatest benefits of sod on plastic is the ability to select the desired growth medium. Choosing a particular growth medium can reduce the likelihood of problems commonly associated with conventional sodding practices. For instance, choosing a non-soil-growing medium can eliminate soil layering. In addition, selecting a growth medium that contributes to increasing turf shear strength also has practical applications. However, comparative research between establishing turfgrass on plastic using various growth media, and how they perform under traffic as an established turf is limited, and warrants further investigation.

<u>Part one</u>: Turfgrass establishment

For this study, four different growth media were investigated for turfgrass establishment using two turfgrass species. The four growth media selected for this study were, pine mulch, sand, refined wood fiber mat (Ecomat®) and SportGrass™ topdressed with sand. The pine mulch, sand, and SportGrass™ are three growth media currently in use for sod production over plastic. SportGrass™ is a woven polyethylene mat with synthetic strands intended to provide additional support for the turfgrass. The Ecomat® is a refined wood fiber mat available in large rolls (40 m x 1.5 m), and provides a very light weight and stable surface for turfgrass establishment. The two turfgrass species selected were *Poa supina* var. 'Supranova' and *Poa pratensis* var. 'Touchdown'. Both species are cool season turves used for athletic fields. *P. pratensis* has a rhizomatous growth habit, and *P. supina* has a stoloniferous growth habit.

<u>Part two</u>: Turfgrass performance

Poa supina performs well under reduced light conditions when exposed to (high traffic) athletic field conditions (Stier, 1997). Optimum fertilizer levels and applications of plant growth regulators (PGRs) for the management of *P. supina* under reduced light conditions have been determined (Stier, 1997), but further research is warranted to improve the wear resistance of the turfgrass.

Previous research has shown that compost grown sod over plastic performed as well or better than conventional sod grown commercially (Cisar and Snyder, 1992), and the basis of tear resistance for compost grown and commercially grown sod, were noticeably different. For this experiment, established *Poa supina* sod was investigated for athletic field use in low light conditions. The *P. supina* was established within four different growth media over plastic (pine wood mulch, Ecomat®, SportGrass™, and compost) and a fifth treatment washed *Poa supina* was included. The pine wood mulch, Ecomat® and SportGrass™ sods were selected from the Part one: Turfgrass establishment study. Pacific Sod Company (Camullo, California) grew the compost sod in California (nine months old), and the washed sod was grown in Nepean, Ontario, Canada, by the Manderley Sod Company (18 months old).

Further attempts to reduce wear through the use of crumb rubber as a topdressing material has been proven to be an effective amendment for reducing surface compaction and turfgrass wear (Rogers *et al.*, 1998). Therefore, the inclusion of crumb rubber topdressing as a second treatment to improve the overall performance of the turfgrass under high traffic and low light conditions was investigated. The purpose of this study was to compare the four growth media with crumb rubber topdressing, exposed to extreme conditions including high traffic and reduced light situations.

MATERIALS AND METHODS

Part one: Turfgrass Establishment

The experimental design was a 2 x 4 factorial randomized complete block design with three replications. The 24 plots were 7.3 m x 2.8 m, and randomized over black 6 mil polyethylene sheeting at the Hancock Turfgrass Research Center (HTRC), Michigan State University. The four growth media included sand, pine wood mulch, SportGrass™ (SportGrass™ Ltd., Richmond, Virginia) and Ecomat® (Canadian Forest Products Ltd., New Westminster, British Columbia) Sand and pine mulches were laid over the polyethylene sheeting at a 20-mm depth. The SportGrass™ was rolled out over the polyethylene sheeting back filled with 25-mm of sand, with the individual strands vertically aligned. Each growth media gave the appearance of a shallow seeding bed. *Poa supina* var. 'Supranova' and *P. pratensis* var. 'Touchdown' were seeded on 3 June 1996 at 4.9 g m^{-2}. All plots were then mulched with PennMulch® at 37 kg 100 m^{-2}. Fertilizer was applied on 3 and 10 June 1996 using 12-25-12 Starter Fertilizer at 4.9 g P m^{-2}. On 17 June 1996 73 mm of rain in 90 minutes washed out the entire study. The experiment was restarted on 12 August 1996 following the above protocol. Fertilizer applications were applied at the beginning of each week for the first four weeks using the 13-25-12 Starter Fertilizer at 4.9 g P m^{-2}. Three fertilizer applications were applied every two weeks using 18-3-18 at 2.5 g N m^{-2} beginning 13 September 1996. Irrigation was applied as needed using an automatic irrigation system, and by hand watering. The hand watering was required because the four growth media each had different watering requirements. Percent turfgrass cover was visually measured at two, three, five, and ten weeks after seeding.

Part two: Turfgrass performance

Poa supina var. 'Supranova' sod was grown on four different growth media (pine wood mulch, sand, Ecomat®, and SportGrass™) during the summer of 1996 at the Hancock Turfgrass Research Center (HTRC) on the campus of Michigan State University. On 11 November 1996 fifteen 1.2 m x 1.2 m x 0.15 m depth boxes were sodded over a sand:peat mix (80:20 v/v) inside the indoor turfgrass research facility at the HTRC, Michigan State University. This facility, constructed of sheerfill II fiberglass fabric (Chemical Fabrics Corporation, Buffalo, NY), was an air-supported structure (600 m^2) designed to simulate the conditions inside the Pontiac Siverdome (Stier, 1993). The sheerfill II fiberglass fabric is a white cover that allows neutral density light to pass through (approximately 9 to 13%) *Poa supina* sod grown in the pine wood mulch, Ecomat®, and SportGrass™ growth media, *P. supina* sod grown in compost from the Pacific Sod Company in California, and washed *P. supina* sod from Manderley Sod Company in Nepean, Ontario were sodded on individual boxes. The compost-grown sod (50 mm depth) and washed sod were delivered to the HTRC in spring 1996 and were maintained outside on plastic until they were moved inside on 11 November 1996. On 27 December, each plot was split and crumb rubber was topdressed at a 19-mm depth.

The experiment was setup as a randomized complete block design (RCBD) growth media as a factor, and crumb rubber as a split plot on the first factor. 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. Fertilizer was applied twice per month at 2.5 g N m^{-2} using Lebanon Country Club 18-3-18 fertilizer until the end of April 1997. Traffic applications were applied two times a week using molded soccer cleats (thirteen 14-mm studs per shoe), 10 January 1997 through 11 April 1997. A total of 50 jogging passes were applied during each traffic application to simulate typical athletic field wear. PGR (Trinexapac ethyl) was applied on 8 December 1996 at 0.13 ml m^{-2}, and on 7 January 1997, 26 February 1997, and 28 March 1997. Chlorosis and browning of the leaf tips became apparent after the second PGR application. Therefore, the appearance of PGR toxicity accounts for the rate reduction, and lag between the 7 January and 26 February PGR applications. Iprodione (Chipco®) was applied on 10 December 1996, 29 January 1997, and 8 March 1997, after *Microdochium nivale* (pink snow mold) became visible. The Iprodione was applied at 1.3-ml a.i. m^{-2}. Mowing was done every Monday, Wednesday, and Friday at 32 mm using a reel mower. Watering was done on an as needed basis, and fans were used 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 dead or bare ground, 9 being the ideal turf and 6 being acceptable. Turfgrass cover was visually estimated as a percent cover. Clippings were collected and weighed weekly. Clegg and shear vane data were also collected to measure surface hardness and turf shear strength. The Clegg meter measures surface hardness in gravity deceleration (G_{max}), and shear vane measured lateral turf strength in Newton meters (Nm) (Stier, 1997).

RESULTS

Part one: Turfgrass establishment

Successful turfgrass establishment can be determined after the first 10 weeks of seeding, and differences between the different growth media existed (Table 5). The significance for the two treatment effects for percent turfgrass cover, at two, three, five, and ten weeks after seeding determined the SportGrass™ provided greater turfgrass density than the Ecomat®, pine wood mulch, and sand, respectively (Table 6). *Poa supina* had significantly greater turf cover only at five weeks after seeding (Table 6).

Table 5. Part one: Turfgrass establishment – Significance of treatment effects for turfgrass cover†, East Lansing, MI. 1996.

	Weeks after seeding			
Source	2	3	5	10
Turf species (T)	ns	ns	*	ns
Growth media (G)	*	**	**	**
T x G	ns	ns	ns	ns

*, ** Significant at the 0.05 and 0.01 probability levels, respectively.

ns Not significant at the 0.05 probability level.

† Turfgrass cover was visually estimated on a percent (0-100%) scale.

Table 6. Part one: Turfgrass establishment – Turfgrass cover† (0-100%) for turfgrass species and growth media established as sod on plastic, East Lansing, MI. 1996.

	Weeks after seeding			
Turfgrass sp.	2	3	5	10
Poa pratensis	2.1	5.3	30.6	42.8
Poa supina	2.2	6.9	37.9	51.8
$LSD_{(0.05)}$	ns	ns	*	ns
Growth media				
Pine mulch	1.8	5.0	15.2	35.8
Sand	1.3	2.8	12.0	18.8
Ecomat®	2.0	3.3	19.5	36.7
SportGrass™	3.3	13.2	90.3	97.8
LSD	ns	2.4	7.9	14.4

ns Not significant at the 0.05 probability level.

† Turfgrass cover was visually estimated on a percent (0-100%) scale.

Part two: Turfgrass performance

The fiberglass fabric of the indoor research facility transmitted approximately 11% ± 2% sd sunlight. The temperature inside was normally maintained at 16.8 ± 0.9 °C sd; temperature extremes ranged from 3-23 °C. Relative humidity (RH) averaged 44.8% ± 6.2 sd with a range of 24-70% RH. The fiberglass fabric provided relatively neutral shading. As expected, the high pressure sodium lamps provided a high proportion of their radiation in the yellow to red wavelengths (Stier, 1997).

No important significant differences occurred among either factor (growth media and crumb rubber topdressing) for color ratings (Table 7). Significant differences in turf cover between plots with crumb rubber versus plots without crumb rubber existed (Table 8) during the final three rating periods (13, 31, and 28 March 1997). The plots with crumb rubber had greater turfgrass cover (Table 8). The increased turf cover on the crumb rubber plots resulted in significantly higher quality turf ratings (Table 9). However, turfgrass cover and quality did not differ significantly among the five different growth media. Clipping yields determined no significant differences among treatments (Table 10).

Table 7. Part two: Turfgrass performance – Effect of traffic on turf color† of supina bluegrass grown on different growth media with crumb rubber topdressing as a split, East Lansing, MI. 1996-97.

	Color							
Growth media	8/12	27/12	17/01	4/02	17/02	13/03	21/03	28/03
Ecomat	7.5	7.3	6.0	5.1	5.0	6.3	6.7	6.5
SportGrass	8.0	7.7	6.6	6.3	5.6	5.4	6.3	6.4
Compost	5.8	7.0	7.0	7.7	6.8	6.5	7.0	7.0
Pine mulch	6.5	7.7	7.0	7.8	6.7	6.6	7.0	6.8
Washed sod	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
Topdressing								
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	ns

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

Table 8. Part two: Turfgrass performance – Effect of traffic on turf cover† of supina bluegrass grown on various growth media with crumb rubber topdressing as a split, East Lansing, MI. 1996-97.

	% cover							
Growth media	8/12	27/12	17/01	4/02	17/02	13/03	21/03	28/03
Ecomat	97.7	98.7	98.3	98.7	96.0	93.2	90.5	90.8
SportGrass	100.0	100.0	98.7	97.3	94.8	87.5	75.0	74.2
Compost	98.7	99.0	98.2	98.3	99.0	89.7	88.8	88.3
Pine mulch	97.7	99.7	98.5	98.5	99.0	89.7	85.0	82.2
Washed sod	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
Topdressing								
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 the 0.05 probability level.
† Turf cover was visually estimated on a percent (0-100%) scale.

Table 9. Part two: Turfgrass performance – Effect of traffic on turf quality† of supina bluegrass grown on various growth media with crumb rubber topdressing as a split, East Lansing, MI. 1996-97.

	Quality							
Growth media	8/12	27/12	17/01	4/02	17/02	13/03	21/03	28/03
Ecomat	7.7	7.5	6.9	5.3	4.5	6.6	6.8	6.6
SportGrass	8.2	7.7	7.3	6.8	5.1	5.3	5.5	5.8
Compost	6.5	6.8	7.4	7.8	6.8	6.2	7.4	6.5
Pine mulch	7.5	7.8	7.6	7.9	6.8	6.4	6.8	6.3
Washed sod	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
Topdressing								
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 the 0.05 probability level.
† Quality was rated visually on a 1-9 scale: 1=100% necrotic turf/bare soil, 9=dense, uniform turf with acceptable color (color ≥ 5).

Table 10. Part two: Turfgrass performance – 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.

	Clipping yields (grams)†								
Growth media	17/01	24/01	31/01	7/02	28/02	7/03	14/03	21/03	28/03
Ecomat	0.3	0.4	0.5	0.4	3.2	3.2	1.3	1.9	1.7
SportGrass	0.5	0.7	0.5	0.6	3.6	2.9	1.1	1.6	1.7
Compost	0.7	0.9	0.6	1.0	3.8	4.2	1.0	1.6	1.2
Pine mulch	0.4	0.8	0.7	1.0	3.3	3.7	1.0	1.3	1.8
Washed sod	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
Topdressing									
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 0.05 and 0.01 probability levels, respectively; ns = not significant at p = 0.05.
† Clippings were collected using a reel mower set at 3.2 cm, and weights were measured in grams.

Surface hardness characteristics differed significantly among the two treatments (growth media and crumb rubber topdressing) tested. SportGrass™ plots had a significantly harder surface (64.0 G_{max}) than any other growth media (Table 11). Plots treated with crumb rubber exhibited significantly lower surface hardness characteristics.

The SportGrass™ , Ecomat®, and washed sod had significantly higher shear strength readings than the compost and pine wood mulch (Table 11). Additionally, plots topdressed with crumb rubber had significantly lower shear strength than the plots without crumb rubber (Table 11).

Interactions show that the growth media without crumb rubber topdressing had a significantly greater shear strength than the media with crumb rubber (Table 11) except for the washed sod and pine wood mulch treatments. The rubber likely had not worked into the mat layer during the 3 January rating date (Rogers *et al.*, 1998). Differences in March showed that there were differences with rubber among plots with backings (Ecomat® and SportGrass™).

Table 11. Part two: Turfgrass performance – Effect of surface hardness† and shear strength‡ on *Poa supina* grown on varying growth media with crumb rubber topdressing as a split, East Lansing, MI. 1997.

	Date		
	3 Jan.	3 Jan.	29 March
Growth media (GM)	Clegg (G_{max})	Shear Vane (nm)	Shear Vane (nm)
Ecomat (EM)	51.8	14.6	22.8
SportGrass (SG)	64.0	17.1	24.2
Compost (CP)	40.1	15.1	16.6
Pine mulch (PM)	41.3	13.5	13.1
Washed sod (WS)	51.8	21.1	20.4
$LSD_{(0.05)}$	4.2	2.9	4.1
Crumb rubber (CR)			
No	51.7	20.1	21.9
Yes	48.1	12.4	16.9
LSD	**	**	**
GM x CR			
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
PM – CR	43.0	16.0	12.7
PM + CR	39.7	11.0	13.5
WS – CR	52.3	25.2	19.3
WS + CR	51.3	17.0	21.5
LSD§ $_{(0.05)}$	ns	3.3	3.2
LSD¶ $_{(0.05)}$	ns	4.3	4.6

*,** Significant at the 0.05 and 0.01 probability levels, respectively.

ns Not significant at $p = 0.05$.

† Surface hardness was measured using the Clegg Impact Soil Tester in gravity deceleration (G_{max}).

‡ Shear strength was measured using the Eijelkamp Shear Vane in Newton meters (nm).

§ Between crumb rubber levels with same growth media.

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

DISCUSSION

Part one: Turfgrass establishment

Although significant difference between the four growth media existed, the question of the relative accuracy of these results naturally arises. Because the four growth media differed so much in physical characteristics it was nearly impossible to treat each growth medium with the optimal management practices necessary for turfgrass establishment. The experimental design made the watering requirements necessary for each treatment virtually impossible to provide. Chapter One showed that dense turfgrass could be established on the Ecomat® in only 28 days after seeding when the PennMulch® was used. However, in this experiment the Ecomat® only achieved 37% density ten weeks after seeding (70 days after seeding). This occurred because the Ecomat® did not receive satisfactory moisture during the initial stages of seed germination. The pine wood mulch also had a poor turfgrass density ten weeks after seeding because it too did not receive satisfactory moisture during the initial stages of seed germination. For the sand, repeated shifting and washing of the growth medium during water applications resulted in low turfgrass cover. The SportGrass™ had the greatest turfgrass density because it was the growth medium that received the optimal watering regimes during seed germination. In addition the polyethylene fibers of the SportGrass™ provided ideal stability for the back filled sand.

Part two: Turfgrass performance

Beard (1973) noted that sod possessing a particle size substantially different from the underlying soil had a cleavage plane at the interface. However, Cairol and Chevallier (1981) found that cleavage did not appear when a good incorporation of pine bark into the upper 20 mm of the underlying soil was noticed, and the knitting was very satisfying regardless of the intensive or medium traffic conditions applied. Conversely, the findings in this experiment determined significant differences in cleavage (shear strength) occurred among the different growth media tested for turfgrass density. However, unlike the findings by Cairol and Chevallier, the pine wood mulch and compost had significantly lower shear strength than the SportGrass™, Ecomat®, and washed sod. The lower shear strength for the pine wood mulch may also be attributed to the stress provided by the reduced light levels. Root mass and growth is severely limited when turves are exposed to low light conditions (Stier, 1997). Therefore, rooting in the pine wood mulch was likely limited to the mulch itself and the instability of the wood mulching material lessened the shear strength of the sod. In addition, the blades of the shear vane apparatus on penetrate 2.5 cm into the turf; therefore, the shear strength of the pine wood mulch was only measuring the growth medium and not the sand root zone.

Rogers *et al.*, (1998) determined that topdressing turfgrass with crumb rubber initially lowers turfgrass shear strength, and maintains higher turfgrass density when subjected to heavy traffic. They also found that shear vane numbers increased as the age of the turf increased with topdressing. In this experiment the crumb rubber topdressing had a different particle size than the underlying growth media, and is likely the cause for the lower shear strength as a result of topdressing crumb rubber. This supports the findings by Rogers and Vanini (1998), and Beard (1973). Maintaining higher turfgrass density with crumb rubber topdressing and providing lower surface hardness supports the findings by Rogers and Vanini (1998).