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Effects of Crumb Rubber and Sand Selection on Surface Characteristics of SportGrass™.

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Introduction

SportGrass™ consists of natural grass grown into and in-between fibrulated synthetic strands intended to protect the crown and roots of the turfgrass plant and provide stability. Rice Stadium at the University of Utah was the first field established with this new technology. While this first installation has largely been considered successful, there have been concerns raised by players and other experts regarding the field hardness and traction. The lack of information on the effects of the shallow sand layer on top of the synthetic surface on surface characteristics (impact absorption and traction) warrents investigation. Previous studies with sports turf surface characteristics indicated a relationship between field hardness and injury potential. One solution concerning this problem is the use of crumb rubber from ground up car tires as a topdressing. This is a recently new tool introduced for maintaining turfgrass under trafficked conditions. Crumb rubber is an athletic field amendment, researched at Michigan State University. One objective of this research was to determine the effect of crumb rubber applications above and below the SportGrass™ layer in terms of surface hardness, turfgrass wear, and traction.

Another criteria for the performance of a SportGrass™ field is the selection of the SportGrass™ top layer. A second objective was to evaluate different sands as SportGrass™ top layer for their ability in providing turfgrass growth and performance. A comparison of five different sand types varying in particle size analysis was studied. The five sand types are: sport mix, 2NS, coarse to very coarse sand, TDS 21/50, and a USGA mix. The 2NS sand possesses a wide distribution in particle size analysis. Developed by the Michigan Department of Transportation, 2NS is primarily used for subsurface support on newly paved roads. TDS 21/50 is a dune sand from the Grand Haven area of Michigan, and is commonly used as a topdressing sand on golf course putting greens, and has been used to construct several PAT fields. TDS 21/50 is a uniform sand with round particles, just the opposite of the 2NS sand, making it rather unstable. The coarse to very coarse sand is simply sieved sand, from 2NS, mostly within the 0.5 mm to 2 mm particle size analysis. The USGA mix is a sand that meets specifications suggested by the United States Golf Association, to be used for constructing golf course putting greens. Finally, the sport mix is similar to the USGA sand with a slightly higher soil content (silt and clay) for increased stability. Selecting sand types with differing particle size analysis is important in determining their effects on surface hardness, wear potential, and stability.

Materials and Methods

Experiment 1.

Experiment one was a 2 by 3 factorial randomized complete block design (RCBD) with three replications for a total of eighteen 4 foot by 4 foot wooden boxes. The plots were established in the covered stadia simulator facility at the Hancock Turfgrass Research Turfgrass Center at Michigan State University under light conditions necessary for turfgrass growth and development. Factor one was the base soil mix: 1) 6 inches of sand 2) 5 inches of sand below 1 inch of crumb rubber. The crumb rubber used beneath the SportGrass™ and as a topdressing was 2 - 4 mm in diameter. The base soil was the USGA sand mix described in Experiment 2. It was also used as the top layer. The SportGrass™ fiber was laid on all eighteen boxes and filled with three levels of sand (Factor 2: 1.125, 0.75, and 0.5 inches). The plots were seeded on 23 February 1996 with *Lolium perenne* (perennial ryegrass) at 7 lbs seed/1000 ft^2. Fertility was applied at the beginning of each week for six weeks using a 13-25-12 starter fertilizer at 1 lb. N/1000 ft^2. Beginning on week eight (12 April 1996) the plots were fertilized with 0.5 lbs. N/1000 ft^2 every three weeks, using a 18-3-18 fertilizer. Fertility concluded on 18 October 1996. On 13 May 1996 the established plots were moved outside where, they remained for the remainder of the test. On 15 May 1996 crumb rubber was topdressed into the SportGrass™ at rates of 0, 0.375, and 0.625 inches respectively. Research has shown crumb rubber can inhibit establishment of turfgrass, particularly in the spring when temperatures are rising; thus, it was important to let the turfgrass establish before topdressing. The treatment consisting of base soil with sand only and no crumb rubber topdressing was comparable to the SportGrass™ field in Rice Stadium in terms of construction. Plot evaluations consisted of impact absorption characteristics, turfgrass density, and turfgrass shear strength. Water was applied on a as needed basis. Beginning 1 July 1996 traffic treatments were applied everyday (Monday through Friday) until 2 August 1996. Traffic applications were made by people, wearing 0.75 inch studded cleats, running back and forth over the plots for a total of 50 passes per application. Traffic resumed 26 August 1996 (Monday, Wednesday, and Friday) until 15 November 1996. Final evaluations of surface characteristics were taken upon completion of the last traffic treatment. Data collected from each surface were impact absorption characteristics, density ratings, and shear strength. Impact absorption characteristics were taken measured with the Clegg Impact Soil Tester and the Brüel and Kjaer 2515 Vibration Analyzer measuring G_{max} (gravities). Density ratings were an estimated percent turfgrass cover (0 - 100%). Turfgrass shear strength was measured in Newton meters (Nm) using the Eijkelkamp apparatus (Eijkelkamp, Geisbeek, The Netherlands).

Experiment 2.

Experiment two was a 1 factor randomized complete block design of five top layer sands with three replications for a total of fifteen 4 feet by 4 feet plots of SportGrass™. The plots were established in the covered stadia simulator facility at the Hancock Turfgrass Research Center at Michigan State University under light conditions necessary for turfgrass growth and development. The five sands were: 1) sport mix, 2) 2NS, 3) coarse to very coarse sand, 4) TDS 21/50, and 5) USGA mix (Table 2.0). The base sand used was the USGA mix. *Lolium perenne* (perennial ryegrass) was seeded at 7 lbs seed/1000 ft^2. The SportGrass™ plots were established on plastic with no soil medium below the SportGrass™. During establishment the turfgrass roots bound to the SportGrass™ fabric making it possible to transport the individual plots as pieces of sod. These plots were then transplanted to prepared 4 feet by 4 feet boxes with a 6 inch sand subgrade. Data collected from each surface were impact absorption characteristics, density ratings and Shear Vane. Fertility, irrigation and traffic applications were done in accordance to experiment one.

Data, for both experiments, were analyzed for statistically significant differences between treatments using the MSTAT program.

<u>Results and Discussion</u>

Experiment 1.

Table 1.1 shows the results obtained at the end of the crumb rubber experiment after 36 fall traffic applications, for a total of 3600 passes on each treatment. Statistical analysis shows that there was a significant difference in surface hardness in both factors and their interaction. Density ratings and turfgrass shear resistance showed significant differences when crumb rubber was used as a topdressing material. On 8 November 1996 there was a G_{max} interaction between the crumb rubber topdressing and the layer of crumb rubber beneath the SportGrass™. The application of crumb rubber reduced G_{max} greater in plots where there was no rubber beneath the SportGrass™. This shows that topdressing with 0.375 inches of crumb rubber is all that should be necessary and that the 1 inch layer of crumb rubber beneath the SportGrass™ did not affect surface characteristics. Turfgrass shear resistance showed the same significance as the surface hardness and turfgrass density results when the crumb rubber was used as a topdressing material. However, in contrast, the plots receiving no crumb rubber topdressing had the greatest shear resistance. These results may be somewhat misleading, since the plots with no crumb rubber topdressing had a much lower turfgrass density but, still showed greater shear resistance. This may be a combination of two occurrences. First the worn turfgrass areas on the plots with no crumb rubber topdressing are showing shear resistance as a result of the SportGrass™ adding support. The second factor may be that the crumb rubber used as a topdressing material is preventing the shear resistance apparatus (shear vane) from penetrating into the turfgrass surface fully, thus causing reduced resistance values.

Table 1.2 illustrates the progression of surface hardness characteristics on the crumb rubber study. The first two dates are G_{max} values prior to receiving the crumb rubber topdressing applications. The 21 June 1996 data are G_{max} values prior to traffic applications, and after receiving the crumb rubber topdressing application on 15 May 1996. The final two dates are G_{max} values after traffic applications have been applied. As discussed in the previous paragraph, the interaction on 8 November is what is significant.

Experiment 2.

Table 2.1 shows the results obtained at the end of the sand top layer study. Statistical analysis showed that there are no significant differences between the five sands selected for surface hardness or turfgrass density. However, there is a significant difference in the turfgrass shear resistance for the five sands tested. The only statistical difference in the sand top layer study occurred in the turfgrass shear resistance. Only the coarse to very coarse sand had a significant difference in turfgrass shear resistance versus the other five sand types tested. No other significant differences occurred in surface hardness or turfgrass density.

Table 3.0 shows for both experiments how turfgrass density remained high during traffic applications while the turfgrass was actively growing. However, turfgrass densities began to decline as the turfgrass growth declined. The use of crumb rubber as a topdressing was effective in maintaining turfgrass density. It should be considered with future SportGrass™ applications. The rate of 0.375 inches is appropriate, and the 1 inch of rubber immediately below the SportGrass™ reduced impact, but is probably not necessary.

Table 2.0
Experiment 2 Top Layer Sand

Particle size	Sport mix	2NS	Coarse to v. coarse	TDS 21/50	USGA mix†
> 2 mm	1.1	15.4	0.4	0	0.8
1 - 2 mm	3.3	23.3	41.1	0.1	4.5
0.5 - 1 mm	33.7	31.6	43.0	2.3	30.4
0.5 - 0.25 mm	49.7	23.1	15.2	72.6	38.7
0.25 - 0.1 mm	11.8	5.9	0.2	24.7	24.3
0.1 - 0.05 mm	0.4	0.7	0.1	0.3	1.3

† note the USGA mix is the same sand used as the base sand, and in the top layer for experiment 1.

Table 1.1
Surface Characteristics on SportGrass (SG) Crumb Rubber Study After Final Traffic Treatment

	Turfgrass performance characteristics		
Soil Base (SB) beneath SG (inches)	$G_{max\ (g)}$†	Density‡ $_{(\%)}$	Shear Vane§ $_{(Nm)}$
6 inches of sand	66.6	70.4	14.4
5 inches of sand & 1 inch rubber	58.2	76.9	14.8
significance	**	n/s	n/s
Rubber Depth (RD) in SG (inches)			
0	68.4	57.5	19.5
3.375	62.5	78.7	11.8
3.625	56.3	84.7	12.5
$LSD_{(0.05)}$	4.1	10.0	5.7
SB x RD			
6, 0	75.7	53.3	18.3
5 + 1, 0	61.1	61.7	20.7
6, 0.375	65.2	75.0	12.3