ENHANCING PARTICIPANT SAFETY ON NATURAL TURFGRASS SURFACES PART II*

by

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Injuries on football fields and other sports surfaces can be grouped into different categories as related to the type of athlete movement and to the relative softness of the turf-soil surface. Many impact-type injuries are related to varying degrees of surface hardness, with the safety of the participant increasing inversely with a lessening of surface hardness. There are other surface playability characteristics of concern, such as traction, wear tolerance, divot opening/turf recovery, and smoothness. This paper will address primarily the aspects of hardness of surfaces.

Root Zone Effects

Aside from turfgrass species/cultivar selection and culture, the other primary component that can be modified to decrease the hardness of natural turfgrass surfaces is via selection of the associated turfgrass root zone. Assessments shown in Table 5 indicate an increase in surface hardness occurred with changes in soil texture from high sand to soils having more silt and clay. The range in CIV for the 5 lb (2.25 kg) hammer weight on bare soils was 91 to 132 gravities (g) and for turfed soils 88 to 116 g. There was 3 to 16% less hardness in turfed surfaces versus bare soil. The CIV's for the three soils were within the acceptable range of the two proposed standards. Soils with a high clay content develop, overtime, a serious compaction problem that increases hardness and results in a very unfavorable environment for root growth of turfgrasses.

The ever increasing intensity of traffic on golf greens, sports fields, and horse race tracks during the past three decades necessitated the development and use of high-sand root zones such as the Texas-USGA Method (2), for construction of root zones. This development minimized serious soil compaction problems and provided a higher quality, safer turfed playing surface. However, these root zones were relatively unstable under certain playing conditions.

Table 5. Comparisons of the hardness of four moist nonturfed and Tifway bermudagrass (*Cynodon dactylon* x *C. transvaalensis*) turfed root zones expressed as means of multiple observations over 3 years of the Clegg Impact Value (CIV).

Root Zone Texture	Clegg Impact Value (g)		
	Soil Only	Soil and Turf	% Change
high-sand mix (95% sand, 2% silt, 3% clay)	91	88	-3
sandy loam (86% sand, 6% silt, 8% clay)	102	97	-5
sandy clay loam (65% sand, 12% silt, 23% clay)	120	107	-13
clay loam (47% sand, 24% silt, 29% clay)	132	116	-16

Mesh Inclusion Effects

In 1985, the authors began a series of long-term investigations at Texas A&M University to assess the use of randomly oriented, interlocking mesh elements for stabilization of high-sand root zones, while also enhancing the environment for turfgrass root growth. These investigations were

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subsequently expanded in 1990 to include root zones with sandy clay loam and clay loam soil textures.

The mesh elements, manufactured by Netlon Ltd., consist of discrete 2 by 4 inch (50 x 100 mm) rectangular units that have dimensional stability and flexural stiffness. Each element has open ribs extending from the perimeter and a square aperture between the mesh ribs of 10 by 10 mm. The open ribs facilitate an interlocking structure that provides a unique three-dimensional matrix of a relatively fixed, but microflexible nature. This three-dimensional, interlocking mesh element-root zone is distinctly different from the two-dimensional, noninterlocking fibrillated polypropylene fibers.

The mesh elements were combined with the soils in specific amounts of 4.2, 6.3, and 8.4 lb. per cubic yard (2.5, 3.75, or 5.0 kg/m^3) of soil, with rigorous mixing to ensure a completely random orientation of the mesh element pieces. The mesh-soil mix was then installed to a depth of 6 inches (150 mm) over a 6-inch (150-mm) depth of the same soil without mesh elements that had been placed over a prepared subbase that included a drainage system. Three replicate plots of each mesh density rate and three plots of the same soil without mesh elements were then compared. In most of the studies, a topdressing mix with 1-inch (25 mm) of the same soil without mesh elements was placed over the mesh/soil matrix before planting the turfgrass, while one treatment was not topdressed. This top layer proved to be of significant benefit, especially in the divot size and divot opening turf recovery assessments.

Two traffic stress components were assessed over a four-year period. The turf wear components were characterized by the divot opening length, width, and depth; the rate of turf recovery in the divot openings; and the turf tear. The second traffic stress component, soil compaction, also was assessed via water infiltration rate, percolation rate, and surface hardness. Playing surface characteristics assessed were traction, ball bounce, surface hardness, and compression displacement. Soil moisture retention and turfgrass quality also were determined.

Results of the original field assessments were summarized in an earlier ASTM publication (1). Results of the subsequent field studies conducted at Texas A&M University, which have been conducted for a minimum of three years for each soil texture, are remarkably similar, except for scale. Generally, as the volume of the interlocking mesh elements added to the root zone increased, there was a corresponding enhancement of the root zone/turfgrass complex, regardless of the soil texture, with the 8.4 lb. (5.0-kg) inclusion rate being best. There were relative scale differences between soils of different texture in some of the assessments. However, in all cases, the addition of interlocking mesh elements was beneficial when compared to the same soil without mesh elements.

Surface hardness results shown in Table 6 indicate that, with the 5 lb. (2.25 kg) hammer, the range of CIVs for turfed soils with interlocking mesh elements was 69 to 87 g or 19 to 29% less hard than the same turfed soils without mesh. All of the soils containing interlocking mesh elements were within the acceptable playability range. The mesh imparted a dramatic improvement in relative softness of the surface providing a cushion against potential injuries to sports participants.

Table 6. Effects of interlocking mesh elements on the hardness of four moist Tifway bermudagrass turfed root zones expressed as means of multiple observations over the 3 years of the Clegg Impact Value (CIV).

Root Zone Texture	Clegg Impact Value (g)		
	No Mesh	Mesh	% Change
high sand	88	69	-19
sandy loam	97	76	-19
sandy clay loam	107	84	-23
clay loam	116	87	-29

Summary

These studies indicate that surface hardness can be decreased, with resultant increases in participant safety, through selection of turfgrass species/cultivar, height of cut, nitrogen fertility regime, root zone texture, and use of interlocking mesh element inclusions.

Based on these and other studies by the authors, the benefits that are to be expected from the addition of interlocking mesh elements to a turfed-root zone installation are the following:

- enhanced soil stabilization.
- less surface hardness.
- enhanced participant safety.
- improved load-bearing capacity.
- resistance to surface rutting.
- 24 to 49% reduction in divot size.
- 29 to 41% faster divot opening recovery.
- improved uniformity of ball bounce.
- decreased soil compaction.
- comparable traction.
- internal microflexing for aeration.
- increased water infiltration & percolation.
- improved soil moisture retention.
- improved turfgrass rooting & turf health.

Although these benefits are realized within each soil type and each volume of interlocking mesh inclusion, the best overall root zone in these assessments was the high-sand root zone with a 8.4 lb. per cubic yard (5.0-kg/m^3) volume of interlocking mesh elements and an inclusion depth of 6 inches (150 mm).

Potential uses for this interlocking mesh elements/turfgrass root zone complex are numerous. Major installation types now in existence using the mesh are sports fields, golf course tees and cart paths, turfed horse race tracks, equestrian event arenas and show grounds, turfed roadways and parking lot areas, and other heavy load-bearing areas such as fire truck access lanes around tall buildings.

To achieve this type of multifunctional surface that performs under a range of diverse stresses, it will be somewhat more expensive to install. However, it will function for a longer time and accommodate a much larger number of events, recreational activities, or traffic pressures, which, makes this system far more cost-effective. Additionally, this system may provide the only answer to some unique, severe-stress turfgrass problems that had no solution in the past.

References

(1) Beard, J.B and S.I. Sifers. (1990) Feasibility assessment of randomly oriented interlocking mesh element matrices for turfed root zones. Natural and Artificial Playing Fields: Characteristics and Safety Features. American Society for Testing and Materials, West Conshohocken, PA, ASTM STP 1073, pp. 154-165.

(2) Beard, J. B and S.I. Sifers. (1993) Stabilization and enhancement of sand-modified root zones for high traffic sports turfs with mesh elements. Texas Agricultural Experiment Station, Texas A&M University, B-1710, 40 pp.

(3) Beard, J.B and S.I. Sifers. (1989) A randomly oriented, interlocking mesh element matrices system for sport turf root zone construction. In Proceedings of the International Turfgrass Research Conference. Vol. 6, pp. 253-257.

(4) Sifers, S.I., J. B Beard, and M.H. Hall. (1993) Turf plant responses and soil characterizations in sandy clay loam and clay loam soil augmented by turf in interlocking mesh elements - 1992. Texas Turfgrass Research, Texas Agricultural Experiment Station, College Station, TX. PR-5142, pp. 112-116.

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