SAND-CAPPED BUILT-UP SYSTEM FOR HIGH TRAFFIC AREAS

Michigan Turfgrass Foundation 2007 Research Proposal

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Executive Summary

The majority of Michigan's high school athletic fields are constructed on native soil, incapable of providing adequate drainage during periods of heavy rainfall. This construction type, in combination with heavy use, results in turfgrass failure, and reduced playability. Current solutions include complete field renovation. These processes are very costly and render the athletic surface temporarily unusable. Therefore, not an option for schools systems with minimal budgets and high annual use requirements. A possible alternative to complete renovation is the installation of a subsurface drainage system and subsequent sand topdressing applications. Drain tile instillation and subsequent sand topdressing applications will provide high school athletic fields with a cost effective solution to impeded field playability that does not interrupt field us for an extended period of time.

Introduction

The typical Michigan high school athletic field serves as a focal point for social gathering and community pride. It is typically one of the few fields in town with lights, making it host to a variety of after school, and work events including football, lacrosse, soccer, cheerleading, and band. Therefore having an aesthetically pleasing and functional high school athletic field is often important to a variety of members in the average community.

The large majority of Michigan's high school athletic fields are constructed on native soil. These fields rely on surface drainage during periods of heavy rainfall, failing to provide adequate drainage of surplus water during periods of extreme conditions. Saturated field conditions substantially reduce soil cohesion, adversely affecting traction and stability. This in combination with heavy use, typical of a fall athletic season, result in turfgrass failure, decreased overall playability and visual aesthetics. Current solutions to this problem include complete field renovation to a synthetic, or sand based turfgrass system. These processes are very costly and render the athletic surface temporarily unusable during the renovation process (Adamson, 2006; Fresenburg and Adamson, 2005). The installation of a synthetic athletic field ranges from $600,000 – 1,000,000, with an additional annual maintenance fee of $5,000 – 20,000. Installation of a sand-capped system with a six inch sand root zone ranges from $150,000 – 300,000, with an annual maintenance fee of $25,000. These staggering upfront prices are often not an option for high schools and municipal areas with minimal budget allocations to grounds maintenance, and high annual use requirements.

A possible alternative to complete renovation is the installation of a subsurface drainage system and subsequent sand topdressing applications. Through the application of multiple sand topdressing layers this process, while never rendering the field unusable for an extended period of time, will result in a built-up sand-capped system. Estimated initial cost for a "sand-capped built-up" soil system is $40,000 – 80,000, providing an alternative cost effective solution that does not interrupt with field us for an extended period of time. Since the two components, drainage and sand root zone depth, are largely linear expenses, investigations to identify minimal acceptable levels are warranted. Levels that would provide acceptable playing conditions would translate to further savings form this type of renovation/construction.

Overall Objective

1) Develop a cost effective solution for failing Michigan native soil athletic fields using drain tile installation and sequential sand topdressing to develop a "sand-capped built-up" soil system.

Chapter 1: EFFECTS OF VARIOUS SAND TOPDRESSING RATES

Sand topdressing provides a number of advantages to a playing surface including increased infiltration, decreased organic matter build up, and a uniform playing surface (Stier *et al.*, 2000; Vermeulen and Hartwiger, 2005). However sand based root zone systems rely on turfgrass interwoven roots for stability, therefore if topdressing application rates far exceed root system development stability will be compromised (Henderson, 2000.). High sand topdressing application rates can also smoother the turfgrass particularly during period of high relative humidity. Increasing sand topdressing application rates will decrease the duration of time required to accumulate an adequate sand root zone over the existing native soil. Stier *et al.* (2000) suggest that athletic fields receive topdressing at rates ranging from 0.16 – 0.64 cm.

Objectives:

1) Evaluate the effects of various sand topdressing application rates on overall turfgrass health and playing surface stability.

Hypothesis:

1) Increasing sand topdressing application rates with eventually decrease overall turfgrass health and playing surface stability.

Materials and Methods

Preliminary research will be conducted to determine the maximum single application rate of sand topdressing. A variety of rates ranging from 0.16 – 1.27 cm will be applied to established *Poa pratensis* L. (Kentucky bluegrass). Research will be evaluated for turfgrass injury and reduction in surface stability at the Michigan State University, Plant Science Greenhouses, East Lansing, MI. The high temperatures and relative humidity in the greenhouse will generate a worst case scenario in relation to potential turfgrass smothering.

Field research will be conducted on sand application rates at the Hancock Turfgrass Research Center (HTRC) beginning March 2007. Sand topdressing will be applied at a variety of rates ranging from 0.16 – 1.27 cm depth on established *Poa pratensis* L. (Kentucky bluegrass) plots. Applications will be made weekly then trafficked using the Cady traffic simulator to determine effects of topdressing rates and accumulation on turfgrass health and stability (Henderson *et al*., 2005). Simulated traffic throughout the sand application period will be applied using a split-block design, allowing for a comparison of trafficked and non-trafficked plots (Kuehl, 2000). Traffic applied at this time will simulate off season use and therefore be applied at a minimal level. Sixteen consecutive weekly sand applications will be made from May – August, providing depths ranging from 2.54 – 20.3 cm. At the conclusion of the weekly sand application regime August 2007, traffic will be applied to all plots at an increased intensity simulating in season high school football athletic field use. Determining a sand topdressing intensity that does not decrease turfgrass health and surface stability, but provides an adequate sand layer for drainage in a minimal time period is crucial to this justification of research.

Data will be analyzed as a factorial randomized split-block design, with three replications, using SAS (SAS Institute, 2002). Sand topdressing application rates ranging from 0.16 – 1.27 cm [0.0 (control), 0.16, 0.32, 0.64, 0.95 1.27 cm depth)] randomly applied; while

trafficked and non-trafficked applications will be applied in random perpendicular strips in relation to sand topdressing.

Data

Data collection will be used to evaluate the effects of sand topdressing on turfgrass health and stability. Data used to determine effects on turfgrass health will include weekly color and quality, based on the National Turfgrass Evaluation Program (NTEP) system of rating, and percent surface coverage, and clipping yield. Stability data will include shear strength, evaluated using the Eijkelkamp shear vane (Eijkelkamp, Giesbeek, the Netherlands) and Clegg Turf Shear Tester (TST) (Baden Clegg PTY Ltd., Wembley DC, WA, Australia).

Chapter 2: EFFECTS OF SAND DEPTH AND DRAIN TILE SPACING ON ATHLETIC FIELD DRAINAGE

A sand root zone does provide increased infiltration and surface drainage; however the amount of excess water that can be removed in a timely fashion is limited by subsoil infiltration rates, surface slope, root zone depth, and distance to intercepting drains (McAuliffe, 2001). Puhalla *et al*. (1999) suggest a surface slope of 1-1.75%, and drain tile spacing of 20 ft for native soil game fields. Sand-capped athletic fields are designed with a slope of 0.5 – 1% slope, sand root zone ranging from 10.16 cm – 15.24 cm, and drain tile spacing ranging from 3.1 – 6.1 m (Rogers, J.N. and J.R. Crum, personal communication, November 2006). As drain tile spacing decreases the sand root zone necessary to provide adequate surface drainage decreases. Soil physics can be used to estimate the root zone depth and drain tile spacing for various rainfall intensities and durations.

Objective:

1) Establish sand depth and drain tile spacing necessary to prevent prolonged saturated soil conditions during periods of heavy rainfall, and use.

Hypothesis:

1) Installation of a subsurface drainage system and sequential sand topdressing treatments will provide a renovated playing surface equivalent to a sand-capped athletic field.

Materials and Methods

Field research on accumulating sand root zone depth and drain tile spacing will be conducted at the HTRC beginning March 2007. Michigan native soil will be constructed at a 1.0% slope. Plots will have drain tiles installed and back filled with sand perpendicular to the slope at a variety of spacing ranging from 2.4 – 6.1 m, including a control treatment without drain tiles. Drain tiles will be installed at a 30.5 cm depth. Following drain tile installation research plots will be seeded with Kentucky bluegrass. Turfgrass will be given sufficient time to establish, following establishment sand topdressing will be applied weekly at 0.64 cm depth. Sand topdressing will be applied until sand depth ranging from 2.54 – 10.16 cm, including a control which does not receive sand topdressing, are obtained. In the fall of 2007, traffic will be applied using the Cady traffic simulator conforming to the high football athletic season, to determine effects of sand topdressing depth and drain tile spacing on surface playability under natural field conditions. In 2008 this research will be repeated, and the original research plots will receive regular maintenance then a second phase of traffic treatments in the fall of 2008.

Data will be analyzed as a factorial randomized split-block design, with three replications, using SAS (SAS Institute, 2002). Factors will include total sand topdressing depths ranging from 2.54 – 10.16 cm [0.0 (control), 2.54, 5.08, 7.62, 10.16 cm depth)] randomly

applied, and drain tile spacing will be applied in random perpendicular strips ranging from 2.4 – 6.1 m [0.0 (control), 2.4, 3.0, 4.6, 6.1 m)] in relation to sand topdressing and slope.

Data

Data collection will be used to evaluate the effects of sand topdressing depth and drain tile spacing on playability, turfgrass health, stability and infiltration, during the fall high school athletic season. Data used to determine effects on turfgrass health will include weekly color and quality, based on the National Turfgrass Evaluation Program (NTEP) system of rating, and percent surface coverage, plant counts, and clipping yield. Stability data will include shear strength, evaluated using the Eijkelkamp shear vane and Clegg TST. Infiltration rates will be evaluated using a double ring infiltrometer, and artificial rain simulation before and after the traffic simulation period, conforming to a variety of intensities and durations to develop an understanding of how the field would function with various sand depths and drain tile spacing under a variety of environmental conditions.

Demonstration

The goal of this research is to provide Michigan school with an alternative cost effective solution to native field that regularly fail to due prolonged periods of saturation during athletic competition. It is the intent of this research team to institute this practice in the upcoming spring at high school currently possessing native soil athletic fields that have experienced turfgrass failure in the previous athletic season. A variety of high school in the Lansing and Detroit are a being considered and perused for this practice (Image 1).

Image 1: Haslett high school football field, turfgrass failure observed late in the 2006 athletic season as a result of extended periods of soil saturation in combination with heavy foot traffic, Haslett Michigan, November 2006.

2007-09 Budget Request from MTF

Sand Capped Study	2007		2008		2009	
	Research	Support	Research	Support	Research	Support
Graduate Assistantship	$20,000		$21,000		22,000	
Student Labor	2,000		2,000		2,000	
Travel		1,000		1,000		1,000
Data collection and Testing	1,000		1,000		1,000	
Total	**$24,000**		**$25,000**		**$26,000**	

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