IMAGE 3

USING DRAIN TILE INSTALLATION & SAND TOPDRESSING TO DEVELOP A BUILT-UP SAND-CAPPED SYSTEM OVER TIME

ALEXANDER KOWALEWSKI, JAMES R. CRUM & JOHN N. ROGERS, III., CROP & SOIL SCIENCE DEPARTMENT, MICHIGAN STATE UNIVERSITY

High school athletic fields constructed on native soil relatively high in silt and clay are incapable of providing adequate drainage during periods of heavy rainfall. This, in combination with heavy use, will result in turfgrass failure, reduced traction and stability, and compaction, which will only worsen infiltration and future turfgrass health and vigour. Current solutions to this dilemma include complete field renovation. However, these processes are very costly (all figures that follow are in USD) and render the athletic surface temporarily unusable.

For instance, renovation costs range from $600,000 to 1,000,000 for a synthetic field; $400,000 to 600,000 for a conventional sand-based athletic field with a 30 cm sand-based root zone over a 10 cm gravel layer and a subsurface drain tile system (Image 1, pg. 14); or $200,000 to 300,000 for a sand-capped system with a shallow (10-15 cm) sand-based root zone directly over the underlying native soil and a subsurface drain tile system (Image 2, pg. 15).

These staggering upfront prices are not an option for school systems with minimal budgets and high annual use requirements. A possible alternative to complete renovation is the installation of a subsurface drain tile system and subsequent sand topdressing applications, providing a built-up sand-capped system over time. A built-up sand-capped system, which can be done in four simple steps for $53,400-99,000 [price includes irrigation system installation ($15,000), 2-6 m drain tile spacing ($60,000-14,400, respectively), and 5 cm sand layer ($24,000 for labour and materials)], would provide high schools and other municipalities with a cost effective solution to impeded field playability that does not interrupt field use for an extended period of time.

Above (Image 3): Water Management Inc. cutting drain lines and installing drain tiles, Intramural Field, Michigan State University, East Lansing, Michigan, July 2008.

IMAGE 4

IMAGE 5

The concept behind the built-up sand-capped system is to combine the advantages of the sand cap system (drainage and sand root zone playing surface) while providing almost uninterrupted availability. The idea is to cut drains in the existing field running lengthwise, put drain tile in the lines, and back fill with pea stone and then sand, or coarse sand alone (Image 3, pg. 13 and Image 4 pictured above).

If the existing field does not already have irrigation, installation of an irrigation system prior to drain tile installation is necessary at this time as turfgrass grown on a sand-based system requires regular watering. It is also important to correct any low (wet) spots in the existing slope by leveling them with topsoil; soil removed during drain line installation would be appropriate for this task. Subsequent repair to any irrigation line damage is necessary.

An aggressive sand-based topdressing program would begin during the summer with a "specific high sand-based material" (approximately 90% well-graded sand sized particles). Sand topdressing would be coupled with an annual field renovation program (including reseeding, cultivation, etc.). During this period, it is also important to regularly clean and maintain irrigation heads to prevent sand from damaging the system. The topdressing stops in early August to allow settling prior to usage in the fall. During the first year, the sand may not reach the level necessary to prevent saturated surface conditions, particularly in low lying areas. However, the drain tiles will prevent standing water from developing, providing a system that is better than the original. The next spring, the topdressing process would begin again to add the rest of the material, further increasing drainage capacity. The end result is a well drained, stable, sand-based field for a fraction of the cost required for other renovation processes.

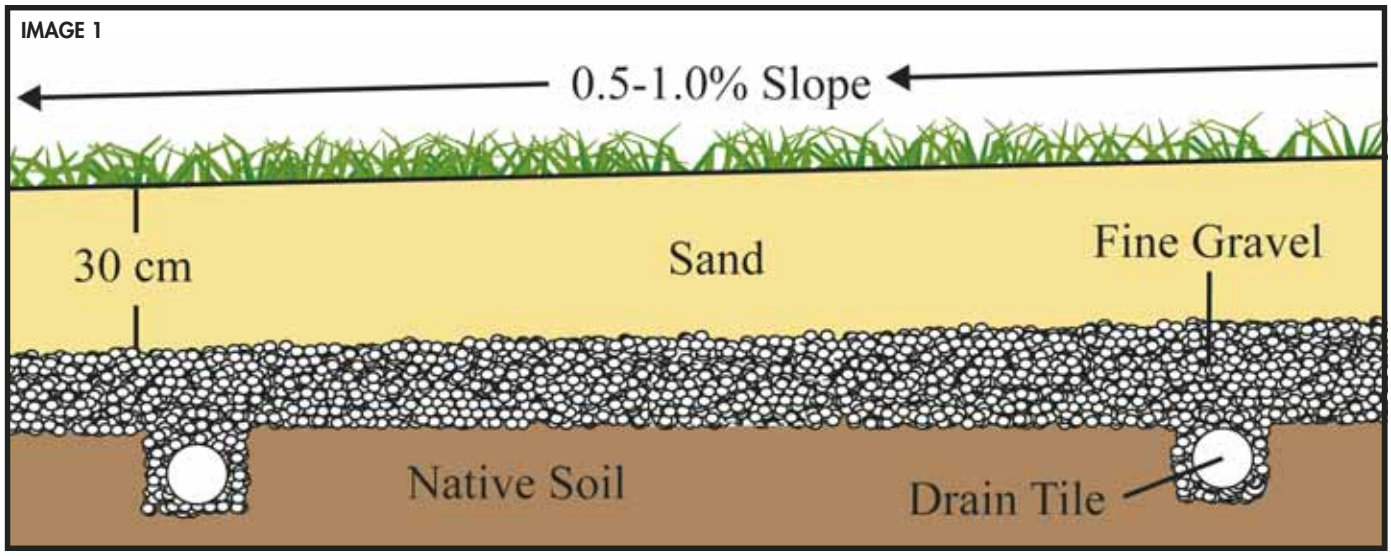
The built-up sand-capped system will not only reduce the annual repair costs required for a native soil field, but also reduce the initial cost of field renovation. To install the drainage and backfill a field with 2 m centres (would have approx. thirty 122 m x 10 cm drain lines @ $13-16/linear metre) would cost $48,000-60,000 installed, while a field with 4 m centres would cost $22,400-28,000, and 6 m centres would cost $14,400-18,000. Then

Below (Image 1): Conventional sand-based athletic field schematic.

Top Left (Image 4): Water Management Inc. backfilling lines with a sand-based root zone material, Intramural Field, Michigan State University, East Lansing, Michigan, July 2008.

Top Right (Image 5): Cady traffic simulator, designed at Michigan State University, East Lansing, Michigan, for simulation of athletic field traffic.

IMAGE 1



topdressing would begin on the field during the summer with each centimetre of material costing about $4,800 (120 tonnes of sand for $3,200 and $1,600 for labour).

However, a number of questions arise when considering the built-up sand-capped renovation procedure, such as what is the optimum topdressing regime capable of accumulating an adequate sand layer without being detrimental to turfgrass vigour and wear tolerance? Can athletic field use continue throughout the topdressing regime? And, what is the optimum drain tile spacing in combination with sand topdressing depth, accumulated over time, necessary to prevent prolonged saturated field conditions which would otherwise compromise stability?

A series of research projects were initiated in the spring of 2007 at the Hancock Turfgrass Research Center, Michigan State University, East Lansing, Michigan, to explore the feasibility of a built-up sand-capped system. Objectives of this research were threefold: 1) to evaluate the effects of cumulative sand topdressing rates on the fall wear tolerance of a cool-season turfgrass stand; 2) to determine the effects of traffic applied during the topdressing regime on the fall wear tolerance of a cool-season turfgrass stand; and 3) to establish drain tile spacing, in combination with sand topdressing, necessary to improve drainage characteristics, wear tolerance and surface stability of a cool-season turfgrass stand.

FIGURE 1: EFFECTS OF ANNUAL TOPDRESSING RATE ON COST (LABOUR AND MATERIALS) AND FIELD STABILITY.

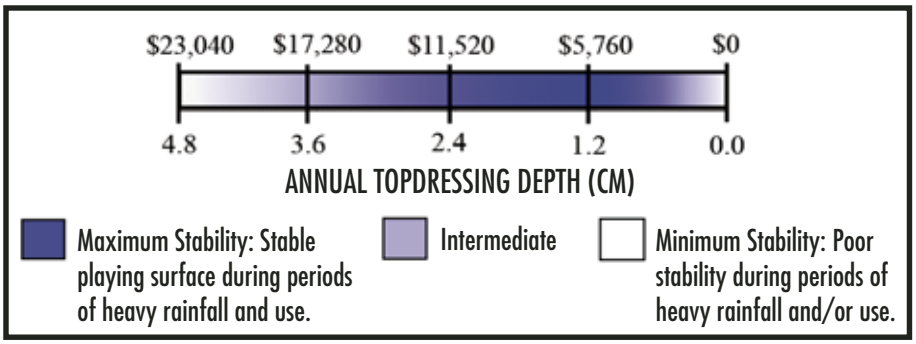
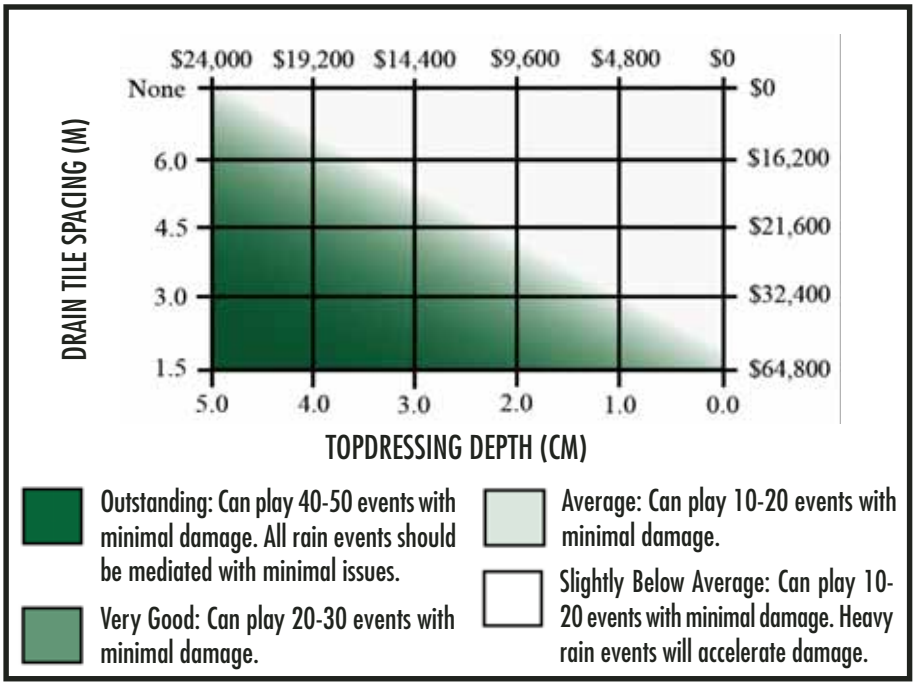
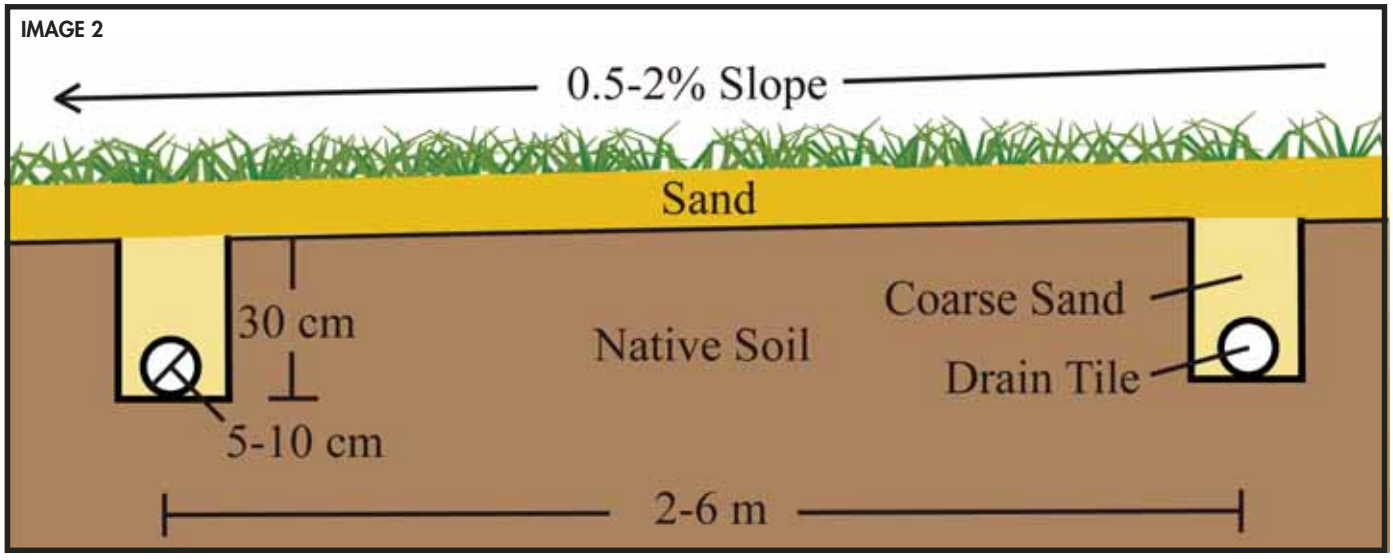


FIGURE 2: EFFECTS OF DRAIN TILE SPACING AND TOPDRESSING DEPTH ON THE COST OF INSTALLATION AND WEAR TOLERANCE.



Below (Image 2): Sand-capped athletic field system schematic.

IMAGE 2



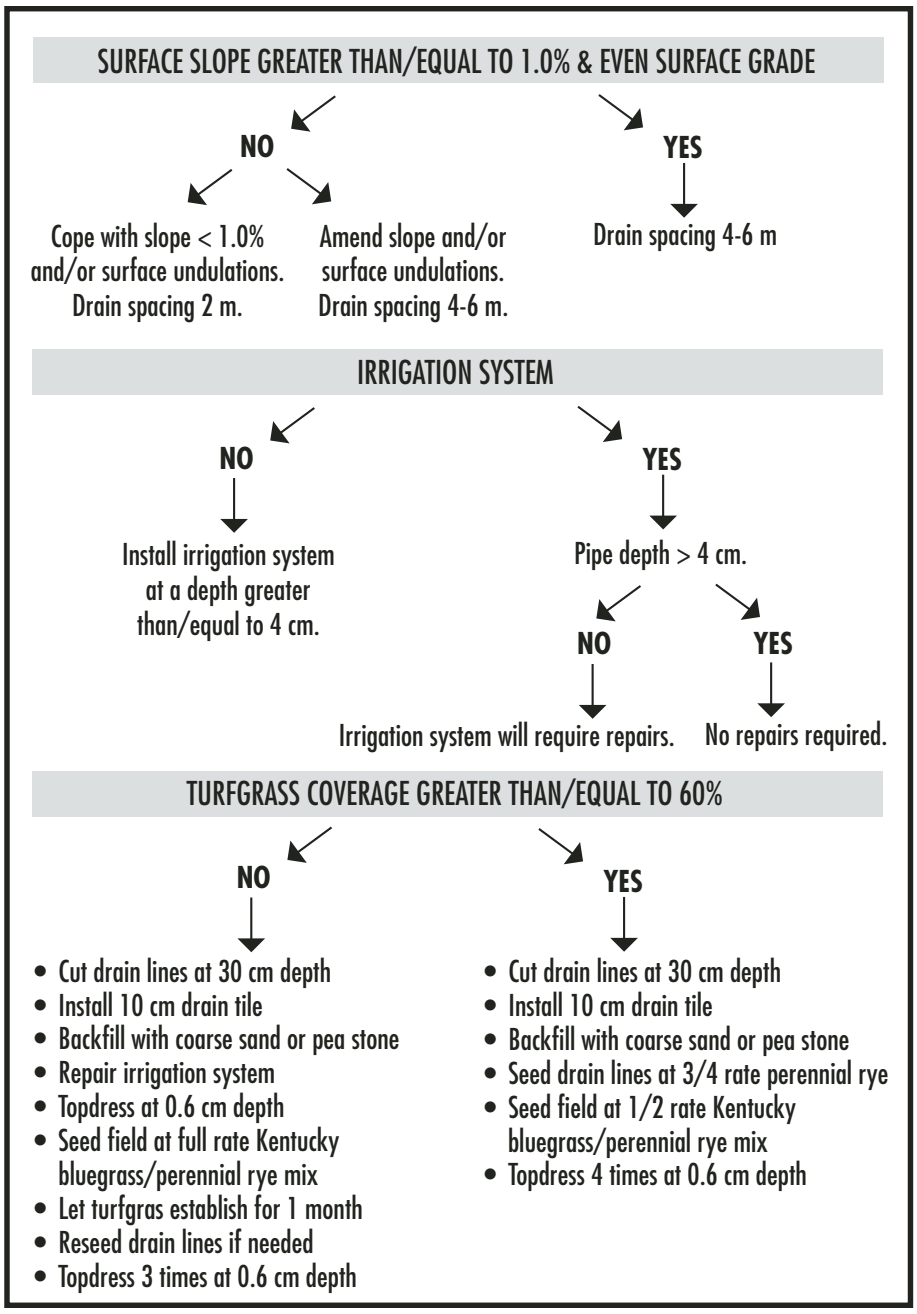
All research was conducted on a 90% *Poa pratensis* – 10% *Lolium perenne* mixture established from seed on a compacted sandy loam soil with a 1% surface slope in relation to drain tiles. The turfgrass established for these projects received summer sand topdressing applications applied over a five week period at a 0.6 cm depth per application, then simulated athletic field traffic was applied using the Cady traffic simulator in the subsequent fall for two consecutive seasons (Image 5, pg. 14).

Topdressing rate results obtained from this research suggest that when topdressing is used to develop a sand layer over an existing native soil athletic field, a conservative topdressing regime, 1.2 cm applied over a five week period in the summer, will provide field managers the greatest results, wear tolerance and surface stability in the subsequent fall (Figure 1, pg. 15). Results also suggest that if a spring re-establishment prior to the initiation of sand topdressing is required, restricting summer traffic will provide the best results in the subsequent fall.

Findings from this research also indicate that if spring re-establishment is not required, effects of summer traffic will be inconsequential to turfgrass wear tolerance and surface stability characteristics in the ensuing fall. As little as 1.2 cm of sand topdressing ($5,760) was shown to substantially reduce the surface moisture content of a native soil athletic field, implying that this cultural practice alone could substantially improve the drainage characteristics of a native soil athletic field.

Regarding drain tile spacing in combination with sand topdressing, results suggest that as topdressing is being accumulated from a 0.0 to 2.4 cm depth in the first year, the 2.0 m drain tile spacing will provide the greatest overall drainage, wear tolerance (ground cover) and surface stability (shear strength and surface hardness) characteristics. However, the 4.0 m drain spacing provides drainage and surface stability characteristics equivalent to the 2.0 m drain spacing. These findings indicate a drain tile spacing of 4 m, which will substantially reduce installation costs ($22,400-28,000), is adequate to provide sufficient drainage and stability when 2.4 cm of sand topdressing ($11,520) has been applied (Figure 2, pg. 15).

FIG. 3: RENOVATION FLOW CHART DESIGNED FOR MAKING RENOVATION DECISIONS BASED ON A VARIETY OF FIELD CONDITIONS, PRIOR TO INSTALLATION OF A BUILT-UP SAND-CAPPED SYSTEM.



As topdressing depths were accumulated from 2.4 to 4.8 cm in the second year, minimal wear tolerance and surface stability differences were observed, suggesting that the effects of drain tile spacing on wear tolerance and stability are minimal once 4.8 cm of topdressing has accumulated. These findings suggest that if 4.8 cm of sand topdressing ($23,040) has been accumulated and an adequate surface slope is available (greater than/equal to 1%), drain tile spacing can be increased to distances of 6 m or greater. Drain tile installation at 6 m spacing would cost approximately $14,400-18,000. It is important to note that substantial surface runoff was still collected from the control treatment after 4.8 cm of sand topdressing was accumulated, suggesting that drain tiles are still required for the removal of surface runoff from low lying areas (Figure 3, above). ♦