A crew member prepares the field for an upcoming game.
Photo courtesy: Boston College

from late November until mid-April. When the tarp was removed and the turfgrasses began active growth, it became apparent this had resulted in some variation within the turfgrass species in the three different loads of sod as related to the area on the sod farm from which each was harvested. The three to four dwarf bluegrasses had variations in dominance, there was some poa annua in the center field section and some perennial ryegrass in the end lines. It's more a visual issue than a quality issue. Aggressive overseeding this past spring and again this fall, combined with the fertilization, aeration and topdressing program, should give us greater uniformity."

There's also a logistical challenge. The Law School campus is approximately 3 miles from the main campus in Chestnut Hill, where all the maintenance equipment except the ride-on triplex reel mower is stored. McCoy is on the field site daily; the rest of the crew is onsite two or three times a week. A pickup truck and trailer are used to transport the smaller equipment. Larger equipment, such as the tractor and topdresser, must be driven over city streets to the fields.

McCoy anticipates maintenance levels will increase for fall play. Between the men's and women's soccer schedules, 17 to 18 games will be played on the game field from early September to late October. If field conditions remain good and weather cooperates, he'd also like to allow the teams to use the game field for practice once or twice a week to sharpen their strategy on the bigger field.

John Kane, senior associate athletic director for Boston College, notes, "The field was a long time coming and we're pleased with the end result and with the professionalism demonstrated by Patrick Maguire and Geller Sport."

Vaughn Williams, assistant athletic director of facilities and operations, reinforced the statement made by both Maguire and McCoy: "The best part of the whole process is the reaction of the student athletes. It's great to see how happy they are to have such a tremendous playing surface."

Bob Tracinski is the business communications manager for the John Deere Worldwide Commercial & Consumer Equipment Division headquartered in Raleigh, N.C.

Spread Out! Tillers, Rhizomes and Stolons

by Mary Owen

Rhizomes, stolons and tillers are the lateral stems of the turfgrass plant. By their growth an individual turfgrass plant spreads vegetatively, providing for the initiation and development of new turfgrass plants. This sideways or lateral growth thickens a turf and influences its ability to recuperate from wear and other damage. The growth of a network of rhizomes or stolons is crucial to the production of strong sod. The continued development and growth of daughter plants ensures a continuous replacement of plants which naturally senesce and die, or are damaged beyond growth by traffic, wear or other factors. Through the growth of tillers, rhizomes and stolons, turf becomes an interconnected, dynamic community of plants. Let's consider these parts of the turfgrass plant, how they grow, how they function and what factors influence their growth.

The stems

Stems store food reserves needed for growth. The crown is the major storage organ for carbohydrates. The lateral stems, especially the rhizomes and stolons, also are storage areas for those products of photosynthesis, which, when broken down in the plant, provide energy for growth and development.

To understand how lateral stems arise, first understand some things about the crown. The crown itself is a tightly compressed stem. Being a stem, it has nodes, internodes and, at the nodes, it has meristems (growing points). These nodal meristems give rise to buds. These buds are capable of giving rise to new stems: tillers, rhizomes and stolons.

Tillers

Tillers begin to develop only after the grass plant has reached a certain level of maturity. This level may differ by type of grass.

Growing conditions and the level of carbohydrate reserves influence the rate of tillering. When energy status is high, tillers are produced at a greater rate.

When conditions of maturity and energy level are right, a crown nodal bud will begin to develop into a tiller. This new shoot grows upward within the surrounding leaf sheaths and eventually emerges as a new shoot. The new tiller will develop its own leaves and root system, relying less on the parent plant for sustenance as it matures.

When tillers are the only type of lateral stems produced by a grass, the result is a non-creeping growth habit.

Rhizomes

Rhizomes are lateral stems that grow underground. When conditions of plant development and energy status are right, a nodal bud will begin to develop into a rhizome. This new rhizome heads downward a short way, then levels off, growing horizontally and elongating. The rhizome then turns upwards until it reaches a position near the surface. There the presence of light and possibly the change in concentration of CO_2 causes the rhizome to stop elongating and begin the process of forming a new aerial shoot. High nitrogen levels, high temperatures and shortening days can stimulate the terminal growing point of the rhizome to turn upward.

In the presence of light, the leaves at the rhizome tip begin to photosynthesize. New leaves begin to form, and eventually a new crown develops. From the new crown's apical meristem will grow the new shoot, and from its axillary buds at the nodes it will grow tillers, rhizomes and stolons as well as a new root system, eventually functioning essentially on its own.

When a rhizome is cut, the tip turns upward quickly and becomes a new shoot. New shoots also develop from the nodes on each side of the severed stem.

This type of rhizome growth is called determinate, because the growing tip ends in a single plant. Kentucky bluegrass produces strong determinate rhizomes that can bore through dense soils with a circular, penetrating motion.

Bermudagrass produces rhizomes which do not necessarily culminate at a single plant. Each rhizome continues to grow until it is stimulated or physically forced to turn upward, or until the tip is damaged or removed. Even when the tip of the rhizome is intact, new shoots develop readily at the nodes along the stem underground. The result is a denser turf, with many more shoots and more extensive rooting per unit area.

Stolons

Stolons are lateral stems which begin their growth from a crown nodal bud, as does a rhizome, but stay above ground. Like rhizomes, stolons have nodes and buds at the nodes capable of forming new shoots and roots. Because they are above ground,

The thick, white rhizomes in this Kentucky bluegrass sod contrast with the darker, more fibrous roots. A network of rhizomes helps to make this sod strong. Courtesy: Mary Owen

exposed to light, they have the capability of forming new plants (shoots, crown, roots, tillers and lateral stems) wherever a node may contact the ground and form roots. New aerial shoots also may arise at the terminal if the tip of the stolon turns upwards. When the terminal of a stolon is removed during mowing or is damaged, the nodes along that stolon are further stimulated to grow.

The growth and development of lateral stems varies from grass to grass, and may be influenced by a host of factors, including temperature, plant stand competition, light, mowing, fertility and moisture.

Temperature

Cool season grasses tiller most vigorously when air temperatures are between 50 to 60 degrees Fahrenheit. At lower temperatures, Kentucky bluegrass tends to produce more rhizomes than tillers. Low temperatures may cause a more horizontal growth while warmer temperatures may stimulate more upright tillering. Photoperiod, the length of day, in combination with temperature, may influence the rate of tillering as well.

Warm season grasses tend to tiller prolifically at temperatures in the 80 to 90 degree Fahrenheit range.

Plant stand competition

Meeting recommended seeding rates is especially important for grasses that only tiller. These grasses, perennial ryegrass and tall fescue, are not able to fill the spaces between seedling plants as quickly as stoloniferous or rhizomatous grasses. Resist the temptation to use excessive amounts of seed. Turfgrass seedlings can compete with one another like weeds if too many are present, resulting in thin, weak plants.

Light

Both the duration and amount of light may affect the tillering and lateral stem growth of turfgrass.

Most turfgrasses grown for athletic fields, with the exception of bermudagrass, will increase the amount of tillering as the days shorten. The length of light duration also influences the growth habit of some grasses. Kentucky bluegrass tillers, for example, grow more upright when days are long and more prostrate when days are short.

As the amount of light available to the plant decreases, photosynthesis also decreases. With less photosynthesis, there are fewer carbohydrates available for plant growth and development and activity slows in areas of high energy demand, like newly growing stolons, rhizomes and tillers. Therefore, the less light available to the plant, the less lateral stem growth there will be.

Mowing

Close mowing of stoloniferous grasses such as bentgrass, bermudagrass and zoysiagrass increases the amount of tillering and development of stolons. As the tips of stolons are removed by mowing, the stolons are stimulated to branch and to develop new plants at each node.

Mowing too high within the mowing tolerance range for stoloniferous grasses will result in stemmy, puffy turf that is easily scalped. On the other hand, the lateral growth of tillering grasses like perennial ryegrass and tall fescue and of rhizomatous grasses like Kentucky bluegrass is slowed by close mowing.

Frequent mowing removes a small amount of leaf tissue at a time, leaving the maximum leaf residual. This allows the plant to maintain a high level of photosynthesis and production of carbohydrates that will be needed for new leaf tissue and lateral stem growth.

Fertility

Nitrogen nutrition has a profound impact on the development of tillers, rhizomes and stolons. Excessive nitrogen inhibits rhizome and stolon development. Stolons of heavily fertilized grasses may have shorter internodes. Phosphorous deficient turfgrass plants have reduced tillering. Good potassium nutrition increases the development and growth of rhizomes and stolons. With limited fertilizer budgets, schedule applications at periods conducive to tillering and lateral growth.

Moisture

Irrigation timed to provide moisture soon after mowing lessens plant stress and results in more tillers and lateral stems growth. Low moisture levels decrease tillering.

Aeration and cultivation

Cultural practices like core aeration, spiking, verticutting and slicing sever stolons and rhizomes. These practices increase branching of these stems leading to the development of many new shoots and lots of new crowns with buds ready to send out new tillers, stolons and rhizomes.

Tillers, rhizomes and stolons are critical for turfgrass recuperation, for renewal of turfgrass plants from natural senescence and for maintenance of a functional playing surface. Through good cultural practices, a sports field manager will keep the turfgrass plants spreading out to create and maintain a great playing surface.

Mary Owen is extension educator and specialist, University of Massachusetts Turf Program. She has served on the STMA board of directors and currently serves on the Certification and Conference Education Committees.

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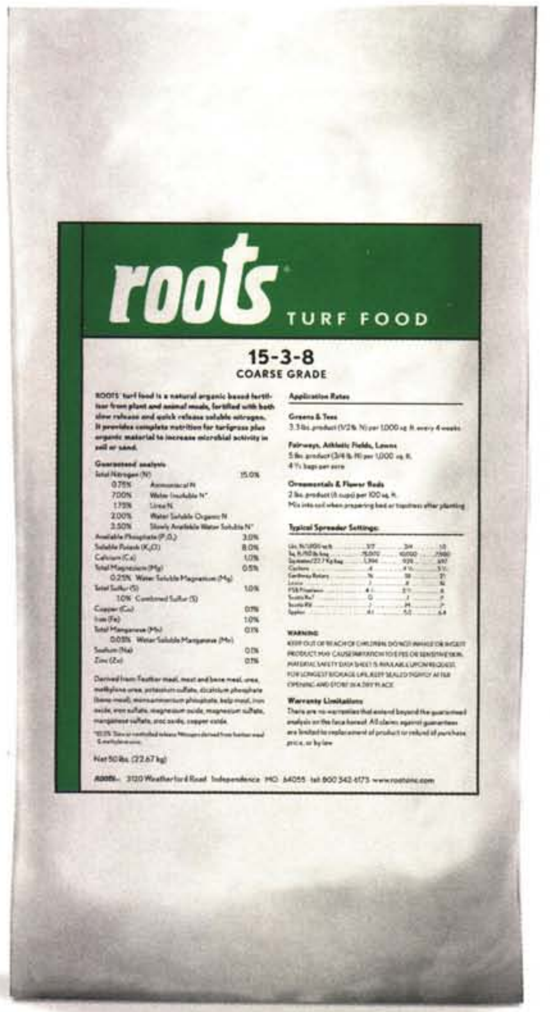

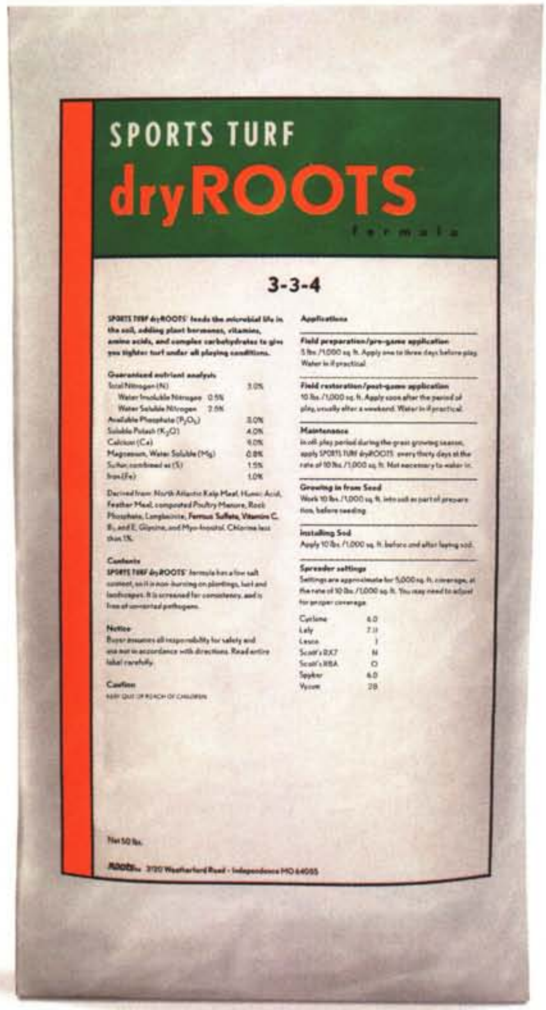

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Rootzone Materials for Athletic Fields in the United Kingdom

By Dr. Stephen Baker

Although USGA rootzone recommendations are widely used for golf green construction in the United Kingdom, for athletic fields the criteria for rootzone selection are somewhat different. Athletic fields, or what we would normally call winter games pitches, are mainly used for the sports of soccer, rugby and field hockey. As the name implies, these sports are played predominantly through the winter months, starting in the fall and finishing in the spring. For much of this period, rainfall greatly exceeds evapotranspiration and therefore good drainage is essential. In addition, temperatures and light levels are such that grass growth is very limited between November and March. These two factors have a major influence on the selection of rootzone materials for athletic fields; high sand contents are needed to ensure good drainage and adequate amounts of air-filled pore space.

On the other hand, in the absence of continued growth, grass cover will be lost on the more intensively used areas (eg. soccer goalmouths) and therefore finer sands are used to retain stability.

Research trials

It would be misleading to imply that all rootzones in the United Kingdom are based on sand-dominated materials. Indeed, the majority of public sector pitches are based on the native soil with pipe drainage and sometimes still drainage being installed. However, at the main stadiums used for professional sports, sand-dominated rootzones are now always used.

The selection of materials has been based on a considerable amount of research work over the last 20 years. One of the most significant early trials was a study that ran from 1984 to 1987. In this study, we examined 16 rootzone materials formed using four contrasting sands and four mixing ratios of sand to sandy loam soil. The sands were a medium-fine sand, a medium sand, a medium-course sand and a fourth sand with a very wide spread of particle sizes. The four mixing ratios ranged from a mix of 1 part sand to 2 parts soil to pure sand rootzones. In profile, the construction consisted of a 150 mm thick gravel drainage layer with pipe drains, a 50 mm blinding or intermediate layer of predominantly 0.25-2.00 mm grit and 250 mm of the rootzone material. All the experimental plots were replicated four times and the trial was sown with perennial ryegrass in July 1984.

All our trials of this nature received simulated wear using a differential slip wear machine, developed to replicate the compacting and tearing forces imposed by play. These treatments were applied throughout the main playing season (late August to the end of April) for three years. The measurement program included assessments of soil properties (water infiltration rates and levels of compaction), changes in grass cover and the playing quality of the surface (ball rebound, ball roll, hardness and traction or grip).

A summary of the main findings is as follows:

• Drainage rates and the amount of air-filled pore space increased with sand content and at least 90 percent sand-sized particles and preferably 95 percent were needed to ensure satisfactory soil physical properties after wear.

• The retention of grass cover during wear was greater on the sand-dominated rootzones. In the final season for the trial, ground cover after five month's wear varied from 8 percent on the mixes with the highest soil content

TABLE 1
Preferred range for sands for use in athletic field rootzones in the United Kingdom (Baker 1990)

Particle size (mm)	Percent passing by weight
2.0	100
1.0	98-100
0.5	75-100
0.25	20-65
0.125	0-5
0.063	0-2

For rootzone mixes, we also have guidelines for the physical properties after compaction in the laboratory. These also are similar to USGA figures except that only the minimum requirements are given.

Hydraulic conductivity = 150 mm/hr
Total porosity = 33 percent
Air-filled porosity = 15 percent
Capillary porosity = 15 percent

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to 45 percent on the pure sand rootzones.

• Playing quality was more consistent on the rootzones with high sand contents. On the soil-dominated rootzones, the surface was very soft and ball rebound low in wet winter weather but at the end of the playing season, when grass cover had been lost, the soil-dominated rootzones could be excessively hard.

• Sand type also had significant effects on soil physical properties. The coarser sands gave higher drainage rates and more air-filled pore space but featured lower levels of moisture retention.

• Where the sand had a wide spread of particles, it tended to become more compact because of interpacking, and hardness values were generally increased.

• For playing quality, the most important fact was that traction values were considerably lower when medium-coarse sands were used.

A further study in the late 1980s and early 1990s examined rootzone performance on real pitches receiving different intensities of use. Although pure sand rootzones had many advantages in terms of soil physical properties, they became very difficult to manage toward the end of the season as grass cover was lost through wear. Erosion hollows tended to develop on the intensively used parts of pitches. Although watering and rolling could be used to restore the stability of the otherwise loose sand, the high management input made pure sand constructions uneconomical.

Recommended size gradings

In 1990, the STRI published guidelines for Sands for Sports Turf Construction and Maintenance (S.W. Baker, 1990, 58 pages). This gave preferred and acceptable particle size gradings for a number of applications including sands for athletic fields and golf green rootzones, slit drainage and golf bunkers. The preferred and acceptable ranges for sands for use in athletic field rootzones are given in Table 1.

Future changes in rootzone materials

The main reason for selecting medium-fine rootzone mixes for athletic fields, compared to the medium-coarse mixes used for golf green construction, has been because of the potential problem of stability following ground cover loss through winter play. Two factors are now helping to address stability problems. Firstly, reinforcement materials in the form of polypropylene fibers either mixed or punched into the rootzone are quite widely used at our major sporting venues. Secondly, techniques for sod replacement for high wear areas of athletic fields have been greatly improved and in many stadiums the turf in goalmouths in particular is replaced during the playing season. Accordingly, there has been a recent trend at such sites to move from a medium-fine sand to a medium sand as the main component of rootzone mixes. This helps guarantee better drainage and usually promotes better root development, both important factors in the provision of rootzone materials for modern sporting venues.

Dr. Stephen Baker is the head of soils and sports surface science at the Sports Turf Research Institute in West Yorkshire, England.