Grass and Broadleaf Weed Control Products

Trade Name	Common Name	Turfgrass Species*
Certainty	sulfosulfuron	B, Bh, C, K, SP, StA, Z
Dimension Ultra	dithiopyr	B, C, K, SP, StA, Z, KB, TF, PR
Drive XLR8	quinclorac	B,SP, Z, KB, TF, PR
Katana	flazasulfuron	B, C, SP, Z
Manor	metsulfuron-methyl	B, C, StA, Z, KB
Monument 75WG	trifloxysulfuron	B, Z
Onetime	quinclorac + MCPP + dicamba	B, SP, Z, KB, TF, PR
Q4 Plus	quinclorac + sulfentrazone + 2,4-D + dicamba	B, KB, TF, PR
Quincept	2,4-D + quinclorac + dicamba	B, Z, KB, TF, PR
Revolver	foramsulfuron	B, Z
Solitare	sulfentrazone + quinclorac	B, C, SP, Z, KB, TF, PR
Tenacity	mesotrione	C, KB, TF, PR

Sedge Control Products

Trade Name	Common Name	Turfgrass Species*
Certainty	sulfosulfuron	B, Bh, C, K, SP, StA, Z
Monument	trifloxysulfuron	B, Z
Prosedge	halosulfuron-methyl	B, Bh, C, K, SP, StA, Z, KB, TF, PR
Sedgehammer	halosulfuron-methyl	B, Bh, C, K, SP, StA, Z, KB, TF, PR

read all precautions on turfgrass sensitivity to products and timings.

Company websites readily allow access to and the downloading of product labels and MSDS's. Manufacturers and suppliers maintain toll-free numbers for the purpose of providing answers to any technical question you may have on their specific products. You can also contact your local extension office. ■

Brad Fresenburg is an assistant extension professor for the University of Missouri in Turfgrass Sciences. He can be reached by email at fresenburgb@missouri.edu.

TURFGRASS KEY:

*Bermuda (B),
Bahiagrass (Bh),
Centipede (C),
Kikuyugrass (K),
Seashore Paspalum (SP),
St. Augustine (StA),
Zoysia (Z),
Ky. Bluegrass (KB),
Tall Fescue (TF),
Perennial Ryegrass (PR)

>> **HEALTHY ROOTS** are white, substantial, and vigorous. These St. Augustinegrass roots are particularly thick, much wider than most cool season grass roots. As roots mature they are able to branch and so become more efficient in absorbing water and nutrients.

ROOTS 101:

building tough turf from the bottom up

Roots are the foundation of a turf. They perform functions vital for plant growth. This article will discuss the structure and function of roots, the effects of the environment and cultural practices on root growth, and strategies for increasing rooting.

ROOT SYSTEMS

Turfgrasses have two different root systems during their lives. The primary system develops from the embryo and emerges directly from the germinating seed. This root system provides for water and nutrient uptake for the tiny seedling and functions actively for 6 to 8 weeks. Shortly after the first leaf emerges, a secondary, adventitious root system begins to form. This root system originates from buds at nodes on the lower part of the crown. It will become the main functioning root system for the plant. Adventitious roots will also form from buds at nodes on the new crowns of the lateral stems: stolons, rhizomes and tillers. These root systems support the new plants and are critical to increasing and maintaining a dense turf shoot system.

Turfgrass roots are fibrous and multi-branched. The tip of each root is covered by a thickened cap which protects the tender meristem (growing point) right behind it as the root bores through soil. The meristem replenishes the root tip and provides for growth of new cells in the root. As more new cells are created, the older cells behind the meristem stretch and lengthen. This enlarging and elongating action pushes against the root cap and is what helps to make the root grow longer and wider.

As a root matures some of its cells become specialized. The cells of the endodermis (the outer layer of the root) behind the area of cell elongation are able to develop the long, slender, almost microscopic extensions called root hairs. These hairs greatly increase the root surface area that is able to actively absorb water and nutrients. While the roots of most cool season grasses can only form root hairs from specialized cells in the epidermis called trichoblasts, warm season grasses have the advantage of being able to develop root hairs from almost all cells in the epidermis.

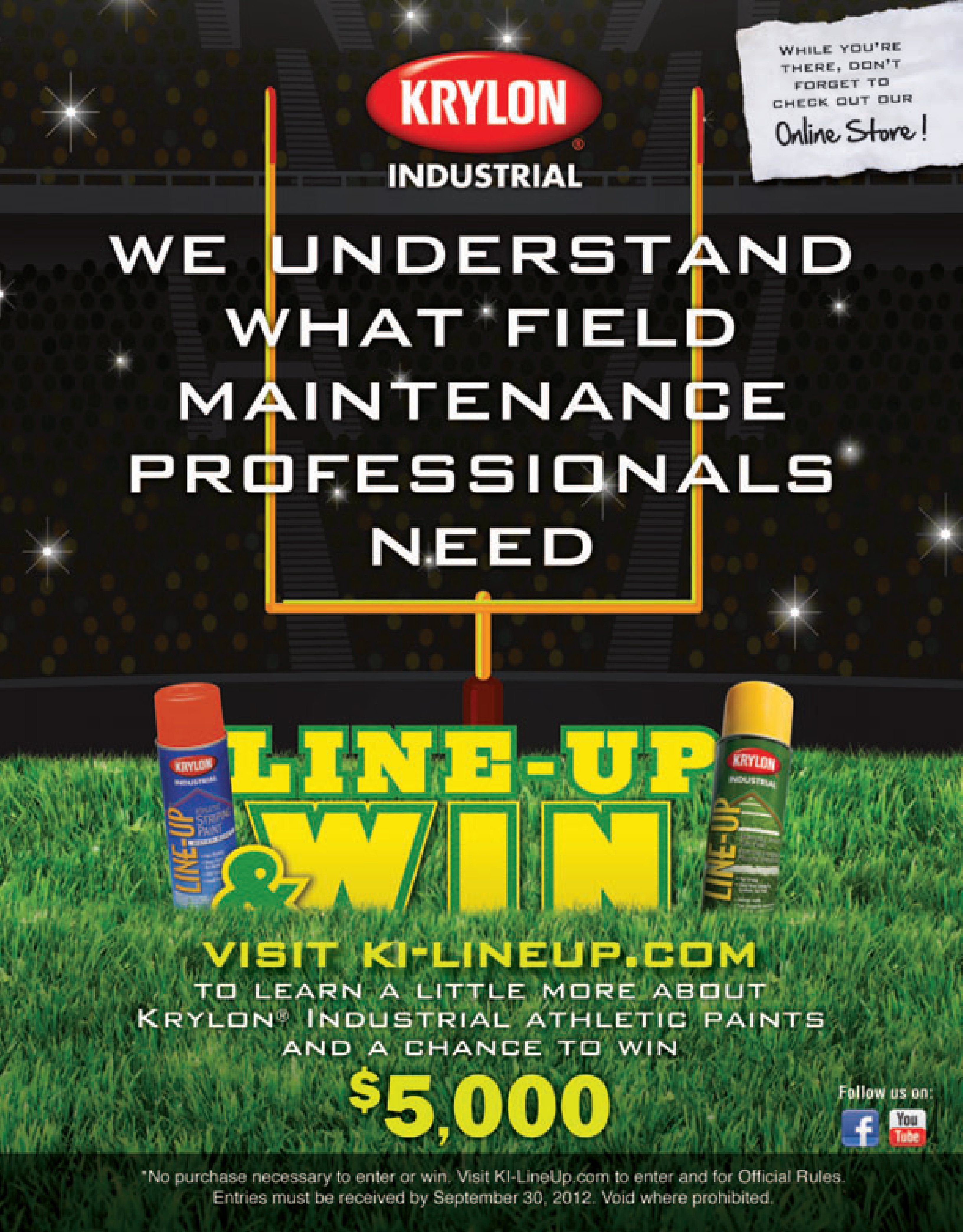
Healthy turfgrass roots are well branched. In fact, the ability of a turfgrass plant to effectively compete for water and nutrients is directly related to the extent of branching.

Just as different grasses vary in their leaf texture or color or growth habit, so too do they vary in the size, depth and distribution potential of their root systems. Warm season grass root systems have the potential to grow more deeply and more extensively than the finer, shallower systems of cool season grasses.

A new root is white and slender. As it

Continued on page 16

Healthy turfgrass roots are well branched. In fact, the ability of a turfgrass plant to effectively compete for water and nutrients is directly related to the extent of branching.



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FIELD SANITATION JUST GOT A WHOLE LOT EASIER

The day has arrived when field safety can be achieved without the use of harmful chemicals and scarce water resources. Facility Managers can now address the risks of MRSA and HIV on all sports surfaces and do so in the most cost effective manner possible. Designed by GreensGroomer WorldWide®, the GreenZapr® uses the power of UVC technology to destroy harmful germs inherent in sports turf surfaces.

STERILIZATION WITHOUT CHEMICALS	SAFE & EASY TO USE	PROVEN BY INDEPENDENT STUDIES
DELIVERS 99.9% KILL FACTOR	OBLITERATES THE ORGANISM's DNA	RELIABLE ON-BOARD POWER

The high cost of current sanitation techniques makes it virtually impossible to address needs on a frequent or immediate needs basis. The GreenZapr makes pre or post event sanitation possible and rapidly pays for itself by avoiding high cost, repetitive chemical treatments. Over the long haul, the fiscal argument is clear — not to mention that ultimate safety is addressed with such a simple, proven solution. Get all the facts, studies, white papers, and product data at our website - **GreensGroomer.com or contacts us toll free at (888)298-8852.**

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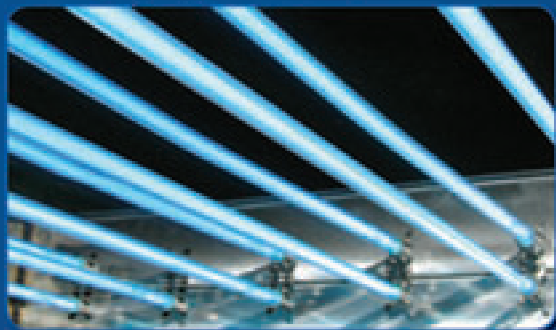
GreenZapr™

Germicidal UVC has been used in the eradication of pathogens, viruses, mold, and fungus for over 100 years. Now adapted for mobile use, the GreenZapr uses the strength of UVC in a simple tow-behind unit. With an on-board generator with intelligent power regulator, the GreenZapr efficiently sends and controls power to the light banks. The spring tine rake module lifts material, preparing it for exposure. Total immersion in the UVC is executed with a three-pass technique that results in a 99.9% kill factor.

The spring tine rake attachment is equipment with 42 tines that comb through the turf surface, lifting fiber and infill, preparing the turf for exposure.



The two 3' x 3' light banks, housing 16 shatterproof bulbs, provide the UVC energy required to kill dangerous MRSA & HIV.

The miniZapr is also available, which is a great solution for hard to reach spaces, locker rooms, weight rooms, fitness areas, bathrooms, and all athletic surfaces.

Continued from page 12

matures, it turns brown and becomes thinner. Its ability to absorb water and nutrients declines. Eventually the whole root will die and will slough off just below the crown. This cycle of root growth, maturity, senescence, death and replacement is a natural and ongoing process. Its rate can be dramatically influenced by the environment, climate, soil conditions or cultural practices.

HOW DO TURFGRASS ROOTS GROW?

Cool-season grasses. To understand the cycle of cool-season grass root growth, consider the cycle of carbohydrate production and use. In photosynthesis, plants use the energy of sunlight to produce carbohydrates from CO_2 and H_2O. These carbohydrates, when broken down through the process of respiration, provide energy to the plant. Roots do not contain chlorophyll and so cannot photosynthesize. They depend on the shoot system for carbohydrates for their energy needs. The absorption of nutrients from the soil by the roots and the movement of water and nutrients from cell to cell within the root require energy.

The roots of cool-season grasses grow and function most vigorously when soil temperatures are cool. The most intense period of root initiation and growth is in the spring. A slightly less active period occurs in the fall. The temperatures for maximum root growth are slightly lower than those for maximum shoot growth, and so roots will be functioning and growing before shoot growth begins in the spring and as shoot growth slows and stops in the fall. Carbohydrates are moved into stems and to a lesser extent into roots as late season growth winds down, providing for slow but continued growth in cold (not frozen) soils until active growth resumes in spring.

Cool-season grass shoot growth is most efficient at air temperatures of 60–75F while root growth is most efficient at soil temperatures of 55–65F.

When air temperatures rise in summer, the efficiency of photosynthesis in cool-season grasses is reduced. The leaves produce fewer carbohydrates. Energy available for root growth and work is reduced and as a result root growth slows. As root growth slows, the root system becomes limited in its ability to absorb water and nutrients from the soil and transmit them to the other parts of the plant.

>> **EXCELLENT ESTABLISHMENT PRACTICES,** proper watering and prudent fertility lead to the growth of deep roots, as seen in this sample from a seedling sports turf.

As air temperatures rise, soil temperatures will follow. As soils warm, root respiration in cool season grasses increases. As respiration increases more carbohydrates are used up. So, when temperatures warm, the use of carbohydrates increases while the supply decreases. Eventually this can lead to root starvation and death. Roots will not be replaced, and the result will be a net loss of roots to sustain the rest of the turfgrass plant until cool weather resumes.

Under drought conditions, some grasses actively shift carbohydrates to the roots, particularly the roots which are in the lower, moister part of the rootzone. This shifting of carbohydrates can serve to sustain the root system where it can harvest water, and thus provide a direct benefit to the shoot system.

Warm-season grasses. Photosynthesis is more efficient in warm-season grasses than in cool-season grasses. As temperature and light increase, so too do shoot and root growth. Root initiation and activity peak in late spring and summer. When temperatures cool down, root as well as shoot growth slows. When the plant enters dormancy, root growth ceases. The peak loss of roots for warm-season grasses occurs in winter, particularly late winter. Warm season shoot growth is most efficient at air temperatures of 80–95F while root growth is most efficient at soil temperatures of 75–85F.

WHAT DO TURFGRASS ROOTS DO?

Roots absorb water. Roots are the principal entryway for this essential compound. Water is needed to maintain turgor, for photosynthesis, for the transport of materials, and for many other processes in the plant. Water is needed to replace transpirational loss as well as that lost through mown leaf ends.

Roots absorb nutrients. While carbon, hydrogen and oxygen, the main building blocks of organic compounds, are derived from the atmosphere and from water, the remaining essential mineral nutrients are principally absorbed from the soil by the roots. Nutrients do not just “seep into” or passively move into roots. The process of nutrient uptake and absorption requires en-

John Mascaro's Photo Quiz

John Mascaro is President of Turf-Tec International

Can you identify this sports turf problem?

Problem: Green line behind field
Turfgrass area: Soccer fields
Location: Callaway, FL
Grass Variety: 419 Bermudagrass

Answer to John Mascaro's Photo Quiz on Page 33

Background illustration courtesy of istockphoto.com

>> **AERATION IS AN IMPORTANT TOOL** for enhancing root growth. This single plant was taken near the side of an aeration hole on a grass tennis court in early spring. Note the improved rooting that is beginning as a result of aeration.

ergy. This energy comes from respiration: the breakdown of carbohydrates in the presence of oxygen with a subsequent release of energy. When carbohydrate reserves are low or not available, roots will not have the energy needed to absorb nutrients.

Deep, extensive root systems are able to access more nutrients and more water from a larger volume of soil than can weaker, shallower root systems.

Roots anchor plants. Plants with extensive root systems are less likely to divot and slip. Plants with deep and extensive roots provide a more stable and safer playing surface.

Roots encourage microbial activity. Healthy functioning roots exude organic materials that can serve as an energy source for the populations of various microorganisms in the zone immediately around the root, the rhizosphere. Many of these microbes have the capacity to mineralize organic matter, that is, break down organic matter into compounds that can provide for some of the nutritional needs of the plant. The amount of root exudates can highly influence soil microbial communities. When grass growth is suppressed by high temperature stress, as may happen with cool-season grasses, the production of root exudates has been shown to decline. This decline is likely the result of the lack of initiation of new roots in combination with root mortality.

HOW CAN YOU ENHANCE ROOT GROWTH?

Know the factors that will compromise root growth, and manage so as to minimize their negative effects. Excessive wear and compaction, shade, incorrect watering practices including excessive or inadequate irrigation, drought, temperatures not conducive to root development, and excessive or inadequate fertility will all lead to reduced rooting.

Pay attention. Make regular inspection of the root system a habit. Note its depth and distribution. How does its condition relate to time of year, climate and your management? Increased depth and breadth of rooting allow the roots to harvest from a greater volume of soil, thus requiring less need for irrigation and applied nutrients, particularly nitrogen. Making good roots makes good environmental sense.

Maintain a well aerated rootzone. The depth and extent of roots as well as root branching increase when the rootzone is kept well aerated. Roots expend less energy as they bore through the soil. Roots in poorly aerated soil tend to be thicker in diameter and less branched than roots growing in well aerated soil. These roots are inefficient at water and nutrient uptake.

Good drainage, both surface and subsurface, management of thatch, relief of compaction and appropriate topdressing in conjunction with aeration practices will ensure a well aerated soil.

Manage thatch. While a small amount of thatch can be beneficial to the performance of a sports field, excess thatch can cause problems. In addition to interfering with proper water and air movement, thatch provides a harbor for insects and disease organisms. Excess thatch will result in reduced rooting with a subsequent reduction in water and nutrient uptake. Roots that do develop within the thatch layer will find little nutrients to absorb there, and will have difficulty absorbing water. The sports field management plan should provide steps that keep thatch in check.

Manage traffic. Wear can lead to a significant reduction in rooting. Using agronomic and field scheduling strategies that minimize wear and encourage shoot density can result in increased root biomass and depth. The greater the mass and the deeper the roots, the more nutrients and water the plant can access to support the shoot system.

Irrigate intelligently. Irrigation events should be spaced as far apart as possible without sacrificing turf quality. Frequency and duration of irrigation will be determined by type of rootzone, environmental conditions, amount and intensity of traffic, and many other factors. Turf watered deeply and infrequently, using a wilt-based irrigation strategy, has been shown to have a deeper, more extensive and efficient root system than turf watered frequently and shallowly.

New seedings should be watered so as to provide adequate moisture for the germinating and developing seedlings. Keeping the seedbed moist and gradually decreasing the frequency and increasing the duration of irrigation events as the seedlings grow are critical to encouraging rapid and deep rooting and successful establishment.

Overwatering results in reduced rooting. As water fills the spaces in the soil, less oxygen is available for respiration, and the result is less energy available for the grass roots to take up and absorb not only water but also nutrients.

Fertilize judiciously. Provide adequate nutrients at the proper time for balanced turfgrass shoot and root growth, with particular emphasis on prudent use of nitrogen.

As the levels of N applied to turfgrasses increase, the amount of shoots increases while the amount of rooting decreases. Focus on providing the lowest amount of N possible without sacrificing the quality needed for sports field performance and safety. The goal should be a dense, wear and stress tolerant shoot system and a deep, dense, stress tolerant root system.

While encouraging rooting, the practice of keeping N levels at the minimum needed has the added benefit of also lowering evapotranspiration (ET), and so contributes to water use efficiency.

Time nitrogen applications so as to maximize root growth; strive to maintain a healthy balance between root and shoot growth. Apply potassium before expected stresses of heat, cold and possible drought may occur. Take care not to overly stimulate shoot growth during periods environmentally unsuitable for root growth (i.e. in the summer for cool-season grasses).

Maintain soil pH at 6.0 – 6.8. Turfgrass roots grow very poorly at reduced pH, especially at pH less than 5.0.

Mow appropriately. Maintain turfgrasses at the highest height of cut (HOC) within their mowing tolerance range to encourage deeper and more extensive rooting. Select cultivars of turfgrass species that have been selected for their adaptation to the mowing height required of the sport.

Warm-season grasses are less dramatically affected by low mowing. Bermudagrass especially will tolerate low mowing without significant reduction in rooting.

Mow cool-season grasses as high and as infrequently as possible given the use of the turf. This is especially important during times of environmental stress. Low mowing can dramatically reduce the depth and extent of roots of cool-season grasses, though bentgrass is not as severely affected as the others.

Maximize available sunlight. Turfgrasses grown in reduced light situations are more prone to have weak, sparser root systems. Where shade can be remedied through tree canopy pruning, it should be done. Where shade cannot be remedied, then shade tolerant species and cultivars should be chosen. Cultural practices should be adjusted: reduce traffic, irrigation and fertility. Some professional stadia are experimenting with supplementary lighting to deal with shade.

Take care with herbicide applications. Avoid using herbicides when turf is under stress or when root growth is restricted. Bensulide, benefin, oxadiazon, oryzalin, pendimethalin, prodiamine, siduron, DCPA and other herbicides may inhibit root growth. Healthy turf may be able to recover from this quickly. However, a turf stressed by drought, heat, traffic or with a compromised root system may be more seriously damaged and take a longer time to recover.

Roots are the foundation of a turf. Attention to the growth, development and health of the root system can ensure not only a vigorous, highly performing sports field, but also result in the conservation of precious environmental resources. ■

Mary Owen is extension educator & turf specialist, University Of Massachusetts,

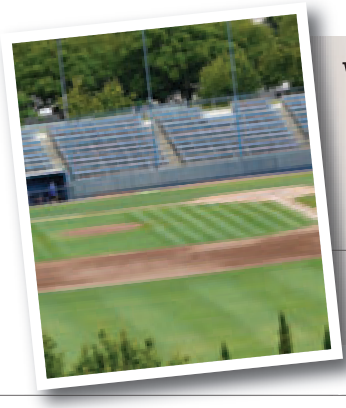
Economic solutions and the environmental benefits at UC-Davis

» **SPORTS TURF MANAGER MARK LUCAS** is part of a campus-wide sustainability effort at the University of California, Davis.

IT ALL STARTED IN 2008 with the economic downturn. Budgets were reduced and we laid off one groundskeeper on the sports turf crew. I didn't think the state level of funding would be improving in the foreseeable future. I also realized that my customers' expectations were not going to change like the value of my house. Most coaches' expectations would only continue to rise with every road trip to schools with larger budgets. The competition for recruiting athletes is impacted by our facilities.

With consideration for the budget and our needs for high-quality athletic facilities, I started out trying to find ways to maintain our sports fields at UC-Davis with less funding. This is when I began to use organic fertilizer on our campus common turf area that we call the Quad. It is 5 acres and has very heavy traffic. Any given day we see hundreds of students playing Frisbee, having lunch, relaxing, enjoying live music and holding rallies.

I wanted to see if we could achieve acceptable levels of turf quality with organic materials, building the soil for a more sustainable nutrient release. By feeding micro-organisms we are creating a living system in the soil that produces carbon, with an even flow of nutrients to the plant. We started using a bio-solid type (6-7-0) of fertilizer that is a by-product of sewage treatment. The results were very positive with just two applications per year the



We started using a bio-solid type (6-7-0) of fertilizer that is a by-product of sewage treatment. The results were very positive with just two applications per year the quad had a deeper green color with good growth.

» **EVERY COLLEGE TURF MANAGER** knows that facilities are very important in recruiting athletes.