Turfgrass Root Basics

James B Beard

Perennial turfgrasses are characterized by an extremely fine, fibrous root system. This leads to considerable frustration on the part of researchers due to the time-consuming, costly procedures required to accurately study and measure turfgrass roots. Nevertheless, the monitoring of rooting depth and functional viability on a regular basis is an important dimension in any turf manager's information assemblage for key decision-making activities. Roots are a hidden, but major component of a turfgrass plant. Roots function in water absorption, nutrient uptake, anchorage, and sod strength. Actually, **the unique, extensive, fibrous root system of turfgrass has a extraordinary ability to take up nutrient elements, and thereby protects the quality of groundwater.**

Turfgrass shoots/leaves have their meristematic region and allied cell division and elongation activities located at the base. Thus, the leaf tip is the oldest portion of the leaf and the leaf base the youngest. As a result the oldest part of the leaf is cut off during mowing. Just the opposite exists for roots, where **the tip of the root most distant from the originating turfgrass crown or stem node region is the youngest part of the root. Thus, in harvesting sod the meristems or growing tips of the roots are cut off.** Consequently, new root initiation must originate from the meristematic tissues in the crowns and the nodes on lateral stems, such as stolons and rhizomes. This basic principal dictates that the shallower the soil depth cut during sod harvesting, the more rapid the rate of sod transplant rooting, assuming there is no water stress.

The principle sites through which water and nutrients are taken up from the soil solution into the roots and translocated upward to the shoots are via the root hairs. These are very delicate, whitish, outward extensions of individual epidermal or surface root cells. These root hairs are microscopic and thus cannot be seen by the naked eye. However, the surface area of these roots is 5 to 10 times greater than the primary and secondary root system that is visible to the eye. Therefore, understanding how environmental factors, cultural practices, and chemicals affect root hairs is a major concern in relation to maximizing the ability of turfgrasses to take up vital water and nutrients.

Most turfgrasses are perennials, but **certain perennial species have root systems that behave as an annual.** Included among the annual-type root systems are such cool-season turfgrasses as perennial ryegrass (*Lolium perenne*), bentgrass (*Agrostis* spp.), and rough bluegrass (*Poa trivialis*). **The critical period in the loss of root systems of cool-season turfgrasses is during mid-summer when soil temperatures at a 4-inch (100 mm) depth exceed 80°F (17°C)** (Figure 1). Warm-season turfgrasses may be characterized as having annual root systems on occasions when spring root decline (SRD) occurs. **The critical time in terms of a limited root system for warm-season turfgrasses is in the spring when soil temperatures at a 4-inch (100-mm) depth reach 64°F (18°C)** (Figure 2).

The genetic rooting ability of various turfgrass species and cultivars in terms of depth and mass varies considerably (Table 1). They range from very deep-rooted species, such as the bermudagrasses (*Cynodon* spp.), with a depth of 7 to 8 feet (2.1–2.4 m) under mowed conditions, to the shallow root systems of the zoysiagrasses (*Zoysia* spp.), American buffalograss (*Buchloe dactyloides*), and

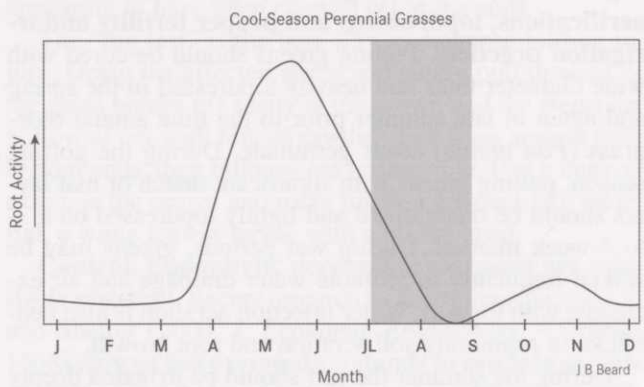

Figure 1

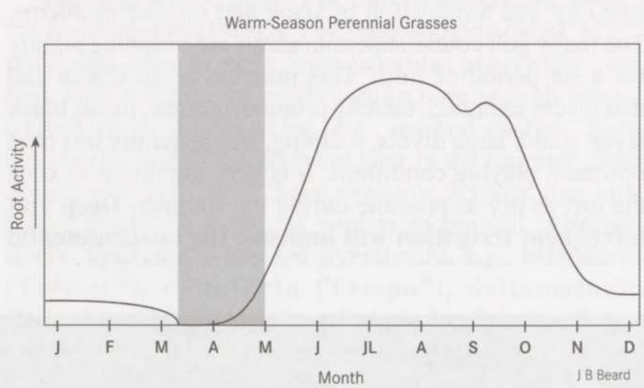

Figure 2

Continued on page 5

Turfgrass Root Basics

Continued from page 4

many cool-season turfgrass species where the root system typically is less than 18 inches (0.3 m).

The wide range of environmental factors that may affect turfgrass root growth are summarized as follows:

- **Soil texture**—sandy to sandy loam root zones typically allow maximum rooting.
- **Soil temperature**—optimum root growth of cool-season turfgrasses occurs at soil temperatures of 50 to 65°F (10–18°C), while optimum root growth of warm-season turfgrasses occurs at soil temperatures of 75 to 85°F (24–29°C).
- **Soil reaction**—a soil pH between 6.0 and 7.5 is preferred, with pHs below 5.5 to be avoided.
- **Soil compaction**—on intensively trafficked, small areas construction with a high-sand root zone will be required to maximize rooting; while on more extensive, low-budget sites, the primary option is turf cultivation, such as coring and slicing, usually are needed based on the intensity of traffic/soil compaction.
- **Soil waterlogging**—saturated soils lead to rapid death of the root system, and particularly the root hairs. Thus, it is important to ensure proper surface and subsurface drainage, plus appropriate irrigation in which the rate of water application does not exceed the rate of soil water infiltration.
- **Soil aeration**—soil oxygen is critical to support the vital cellular life system of turfgrass roots. Thus, proper soil non-capillary pore space is needed to ensure the downward movement of soil oxygen and the outward movement of potentially toxic gases.
- **Soil salinity**—roots can be adversely affected by high salt levels in the soil solution. This problem is minimized by periodic deep irrigation involving amounts of water in excess of the evapotranspiration rate to ensure downward leaching of salts beyond the root depth.
- **Hydrophobic dry patch**—soils will repel water due to an organic coating surrounding the individual sand particles that results from the death of mycelial growth associated with soil fungal basidiomycetes. The best option available to correct these problems is the timely use of an wetting agent that is effective on hydrophobic dry spot. Note there are other types of hydrophobicity.
- **Shade**—turfs growing in the shade usually have a reduced root system due to a lack of sunlight used in photosynthesis that supplies the carbohydrates needed for root growth.

Table 1. The comparative mid-summer rooting depths of 20 turfgrasses, when grown in their respective climatic regions of adaptation and preferred cultural regime.**

Relative Ranking	Turfgrass
superior	*bermudagrasses
excellent	St. Augustinegrass seashore paspalum carpetgrasses
good	bahiagrass crested wheatgrass zoysiagrasses
moderate	tall fescue centipedegrass American buffalograss
fair	creeping bentgrass hard fescue perennial ryegrass colonial bentgrass Chewings fescue red fescues
poor	Kentucky bluegrass
very-poor	rough bluegrass creeping bluegrass annual bluegrass

* Significant variability occurs among cultivars within the species.

** Based on the most widely used cultivars of each species.

There are a number of **cultural factors that strongly influence turfgrass rooting,** which fortunately are under the turfgrass manager's control. They include the following:

- **Mowing height**—the higher the cutting height, the greater the leaf area for photosynthetic activity to produce carbohydrates in support of increased root growth.
- **Nitrogen nutritional level**—moderate nitrogen nutritional levels allow a balanced supply of carbohydrates to support both shoot and root growth of cool-season turfgrasses. Excessive nitrogen levels force shoot growth, with the shoots having priority for the available carbohydrates, thereby resulting in death of the root system.
- **Potassium and iron levels**—high potassium levels throughout the year are important in ensuring deep rooting, which in turn contributes to drought resistance. Iron provides some of the same benefits.
- **Irrigation**—in most situations irrigation water should be applied on an infrequent deep basis to the full depth of the root system. One exception is where the root depth is very shallow, as caused by very close mowing and/or heat stress. Surface soil water saturation via light daily watering encourages shallow rooting.

Continued on page 7

Disease Alert

A root rot fungus is causing extensive damage on St. Augustinegrass (*Stenotaphrum secundatum*) according to Dr. Phil Colbaugh of the Texas Agricultural Experiment Station in Dallas. The damage to St. Augustinegrass lawns extends from Texas eastward along the Gulf Coast. Recent diagnoses also have been made in Arizona and California. The disease is caused by ***Gaeumannomyces graminis* var. *graminis*, with the initial symptoms being a yellowish chlorosis of the leaves and a root system that is basically dead. The lawns typically thin and eventually the turf may die in large irregular patches.** Dr. Colbaugh is finding that good control can be obtained for this root rot problem by a combination spray of thiophanate-ethyl (Cleary's 3336®) plus mancozeb (FORE®) at a 4 ounce (113 g) rate. The use of TeeJet 8004 nozzles to increase the spray volume to 2 to 4 gallons (7.6–15.1 L) of spray has proven beneficial.

A Global View of Landscape Use

Continued from page 6

have been maintained as well-swept dirt ground. The soil had become severely compacted and many areas were groomed each morning by a large number of broom-wielding workers.

More than 15 years ago I was contacted by Chinese government officials concerned with the development of a revegetation plan for urban open spaces, such as the city of Beijing. The elimination of green vegetative covers that stabilize the soil had resulted in a major increase in atmospheric pollution within the city in the form of flying dust and even dust storms that reduced visibility. **More importantly, the increases in a number of serious human diseases were occurring at a much greater rate than in any other major non-Chinese city in the world. Their interpretation was that the lack of green vegetative cover and its associated living biological ecosystem of antagonists to the disease-causing bacterial and viral organisms had resulted in a major increase in disease causing organisms which were readily disseminated by the windblown dust particles.** Similar problems were occurring in many other large cities in China. Unfortunately, I never was given the opportunity to review the actual documents on which these conclusions were drawn.

In an attempt to eliminate these serious urban pollution and human health problems, the Chinese governments in these major urban centers have embarked on a major program to revegetate the open spaces by planting turfgrasses in parks, on sports-recreation areas, along roadsides, and around major government facilities. Even the famous Tiananmen Square now has distinct turfed lawn areas.

- **This series of historical events ranging between the extremes of bare dirt versus the use of turfgrass emphasizes the important values of turfgrasses not only from an aesthetic standpoint, but also from the beneficial effects in reducing air pollution, protecting human health, and enhancing the quality-of-life in densely populated urban areas.**
- This experience also emphasizes the impact that the presence of turfgrasses have on the environment and on the human population.

Turfgrass Root Basics

Continued from page 5

- **Thatch**—cultural practices should be adjusted to avoid an excessive thatch accumulation of dead organic matter. An excessive thatch causes the roots to remain in the thatch layer rather than growing into the underlying soil root zone; thus, resulting in increased proneness to disease, insect, drought, heat, and cold stresses.
- **Preemergence herbicides**—a number of preemergence herbicides exhibit varying degrees of toxicity to turfgrass roots, even though there are no direct visible effects to the aboveground shoots. Thus, such preemergence herbicides should only be used as needed to correct a serious developing weed problem.
- **Insects, nematodes, and diseases**—wherever there is a developing pest problem that may cause extensive loss of the root system and allied turf, it is important to implement the appropriate pesticide application that is targeted specifically for the individual problem.