Managing turf for maximum root growth

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MANAGING FOR BETTER ROOTS

WHAT TO DO	HOW TO DO IT
1) Select species/cultivars with the best rooting potential	. . .examine use, soil properties, management regime
2) Promote maximum net carbohydrate production:	
optimize leaf area	. . .mow as high as feasible
	limit wear damage
	control disease and insects
optimize leaf chlorophyll content	. . .avoid deficiencies in N, Fe, Mn, Mg, S
	correct conditions that promote leaf color loss such as waterlogging, low soil oxygen or prolonged drought stress
promote good light conditions	. . .remove excess clippings
	prune lower limbs of trees and selected crown branches
3) Avoid depletion of carbohydrates	. . .avoid excessive nitrogen application
4) Correct soil physical conditions.	
high soil strength	. . .cultivate
	modify with peat
	modify soil with gypsum on sodium-affected soil
low soil oxygen	. . .cultivate
	provide surface and subsurface drainage
soil layers	. . .cultivate
water deficits	. . .irrigate
	increase water-holding capacity with organic matter
keep soil temperatures moderate	. . .irrigate
maintain dense turf	. . .mow as high as feasible
modify cold soil in spring	. . .assure proper drainage
	cultivate
5) Correct poor soil chemical conditions.	
acid, high aluminum soil	. . .lime
very alkaline soil	. . .if no free $CaCO_2$ exists, use S, H_2SO_4 or acidic N carriers
infertile soil	. . .fertilize, especially with N, P and K
avoid toxins	. . .limit excessive use of some herbicides
	limit soil amendments with heavy metals
	do not overuse micronutrients
cure salt-related problems	. . .cultivate or add gypsum or sulfur to improve drainage or use an alternate water source, depending on source of problem
6) Correct poor soil giological conditions.	
root-feeding insects	. . .take chemical and biological control measures
root diseases	. . .make appropriate cultural and chemical preventive and control treatments
nematodes	. . .use chemical controls
thatch	. . .mechanically remove
	promote microbial degradation

SOURCE: DR. R.N. CARROW

Roots are very important to successful turfgrass culture. Their five main functions are:

1) Anchor: a very basic role when the cleats of football players tear up large pieces of turf, or a golfer's iron shot pulls up a large divot from a golfer's iron shot, or sod easily lifts after grubs have damaged roots.

2) Absorb and translocate water: necessary for the cells to maintain biological functions and turgor pressure, and for transpirational cooling.

3) Absorb and translocate nutrients: for producing thousands of enzymes, carbohydrates, lipids and other compounds used in growth and development.

4) Synthesize and transport certain hormones: like cytokinins, gibberelins and abscissic acid.

5) Sink for carbohydrates produced in the shoots: roots depend on carbohydrate production via photosynthesis for their growth.

Root characteristics

Root systems are dynamic. Seasonal weather conditions trigger hormonal changes in turfgrass plants, resulting in growth cycles. Management practices to achieve maximum rooting must be timed to take advantage of the natural periods of rapid growth.

Scientists have identified the maximum rooting depth capability of different grasses under ideal conditions, which is important for knowing a grass's genetic potential to produce a root system when there are no limiting factors. Breeders now know that it is possible to breed or select for deeperrooted grasses within species.

Root hairs, which differ dramatically with species and cultivars in sand or water, greatly increase the root surface area for nutrient and water uptake.

Normally, live roots are water permeable, but they may become partially impermeable under low soil oxygen. These roots are less functional. Also, as roots age, some of the cells can die. On a large scale, it's called root dieback. Dead or partially dead root tissues take up less nutrients and water.

Roots usually live six months to two years, depending on the species, management conditions and environment. For example, certain spring climatic conditions can "prune" bermudagrass roots.

Finally, mycorrhizal relationships such as the influence of micro-organisms on roots may enhance water and nutrient adsorption.

Root limiting factors

Why does a bermudagrass exhibit a rooting depth of a few inches on a particular site when it has the genetic potential to develop a root system several feet deep?

Shoot factors—Factors that can limit actual rooting to much less than the genetic potential are either shoot-related (above ground) or soil-related.

Maintaining old roots and growing new ones depends on net food (carbohydrate) production in green shoot tissues by photosynthesis.

Roots get carbohydrates for growth only if enough are manufactured for cell maintenance and shoot growth. Anything that decreases photosynthesis or increases respiration will eventually reduce root growth; if severe, roots can die.

Anything that reduces leaf area—close mowing, leaf-feeding insects, and diseases—reduces rooting. It also tends to cause a temporary increase in respiration.

Chlorophyll, the light-absorbing pigment, is also necessary for photosynthesis. Low chlorophyll (a yellow plant) is often a result of:

- ▶ deficiencies of nitrogen, iron, manganese, magnesium and/or sulfur;
- ▶ low soil oxygen through compaction or waterlogging, drought stress, and burn from some pesticides and nitrogen sources.

If any of these conditions persist for more than a few days, root growth is likely to be impaired.

Because light is also needed for photosynthesis, anything that covers the leaves, such as excess clippings or shade, hinders rooting.

Persistent drought stress, which can cause leaf stomata to close and reduce CO_2 uptake, will also slow photosynthesis and retard rooting potential.

Above-ground factors—Mechanical, disease or insect injury can increase respiration rate, which causes greater use of carbohydrates and less root growth.

Higher temperatures, which also increase respiration and carbohydrate depletion, are a major contributor to root deterioration of cool-season grasses during the summer.

Soil factors—Many soil conditions can limit rooting:

1) Each species has a genetic-based tolerance for factors like low soil O_2, high aluminum and mechanical strength. But breeders can develop cultivars with broader tolerance. For example, more aluminum-tolerant tall fescues could be developed for very acid, high-aluminum situations.

2) Within the genetic tolerance range, management practices can often correct a specific limiting factor. For example, cultivation can improve low soil O_2 and/or high mechanical strength.

Broader genetic tolerance and management to correct or prevent a poor soil condition can improve rooting.

To choose cultural approaches on your site, identify the specific soil-based factors that actually inhibit rooting. To be successful, know your soil's properties and be able to evaluate each soil in terms of the physical, chemical and biological characteristics. □

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