MAINTAINING HEALTHY ROOTS: GET TO THE ROOT OF THE PROBLEM

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Root Functions

1. Absorption and translocation of **water** for
   - transpirational cooling
   - as an input in many important plant metabolic processes
   - as a carrier of materials

2. Absorption and translocation of **nutrients** for
   - production of hundreds of compounds the plant requires

3. Synthesis and transport of certain compounds need by shoot tissues, especially some **hormones** (ex. cytokinins)

4. **Anchorage**. Roots not only "anchor" the plant but also stabilize the soil from wind and water erosion and traffic stresses.

Root Characteristics

Roots are **living organs** that require essential input of food (carbohydrates from photosynthesis in above-ground green tissues) and oxygen (O_2) for respiration (from the surrounding soil). Thus, roots like any living organ, can initiate growth, grow, or die — roots are dynamic or ever-changing. Characteristics of roots that are dynamic are:

- seasonal growth rates
- depth of rooting
- root length density by soil depth
- root viability or vitality
- root hair numbers
- life span
- mycorrhizal relationships

Developing and Maintaining Roots

1. **Promote** maximum net **carbohydrate production** through enhancement of **photosynthesis**.
   - optimum leaf area
   - optimum leaf chlorophyll content and activity
   - adequate light for photosynthesis
   - avoiding stomata closure (CO_2 uptake)
2. **Reduce** excessive **depletion of carbohydrates**.
   - avoid unnecessary growth (N, water)
   - avoid scalping

3. Select species/cultivars that have the best potential to develop and maintain roots. Of special importance are:
   - indirect high temperature tolerance of cool-season grasses. Carbohydrate depletion during extended high temperature periods leads to root starvation.
   - genetic potential to develop deep roots under good soil conditions
   - genetic based tolerance to soil stresses that limit rooting.

   The primary soil stresses that limit root growth and viability are:
   - high soil strength
   - low soil O_2
   - excessive soil drying (drought)
   - high soil temperatures (direct injury)
   - acid soil complex
   - salt toxicities
   - biotic stresses

4. Correct **adverse soil physical** conditions.
   - high soil strength — cultivate; soil modification with peat; gypsum on sodium-affected soil.
   - low soil O_2 — cultivate; provide surface and subsurface drainage.
   - soil layers — cultivate.
   - water deficits — irrigate; increase water-holding capacity with organic matter.
   - modify excessively high soil temperatures — irrigate periodically; maintain a dense turf; mow as high as feasible.
   - Modify excessively cold soils in the spring — drainage, cultivation.

5. Correct **poor soil chemical** conditions, including:
   - acid, high AL soil — by liming.
   - excessively alkaline soil — if no free $CaCO_2$ exists use S, H_2SO_4 or acidic N-carriers.
   - infertile soil — fertilize to provide optimum nutrient levels and balances for root growth, especially for N-P-K.
   - avoid toxins — toxins include excessive levels of some herbicides, heavy metals in soil amendments, natural toxins from waterlogged soils and overuse of some micronutrients.
   - salt-related problems — depending on the specific problem, cultural measures could be cultivation, gypsum or S addition, leaching, improved drainage or use of an alternate water source.

6. Correct **poor soil biological** conditions:
   - root feeding insects — chemical and biological control measures.
   - root diseases — appropriate cultural and chemical preventative and control treatments.
   - nematodes — chemical control.
   - thatch — thatch is a combination of dead and live biologically produced organic matter that can inhibit good rooting. Control practices include preventive measures, mechanical removal, and promotion of microbial degradation.