SOIL FOOD WEB
The foundation of turfgrass growth and health

Soil, as the growing medium, has significant impacts on many plants, including turfgrass. Topsoil, the outermost layer of soil, usually the top 20 cm, has the highest concentration of organic matter and microorganisms and is where most of the Earth’s biological soil activity occurs (USDA, 1993). Studies have shown that most soil microorganisms and microarthropods are found in the top 10 cm of soil (Rey et al., 2002). Associated with these organisms, plant root density is usually higher in topsoil compared with subsoil (Rey et al., 2002), and total C, total N, and SOM contents are significantly higher in topsoil than in subsoil (Kuhlmann and Baumgarten, 1991).

One of the major reasons that topsoil is so productive is that topsoil is usually associated with an active food web, which has the potential to increase the resistance and resilience of plant ecosystems via a number of different mechanisms. There is evidence for these mechanisms below in various plant ecosystems, including turfgrass ecosystems.

1. Better soil structure: An active soil food web significantly affects the soil structural stability and pore space, leading to better soil moisture balance and air penetration, which results in less physiological stress on plants (Weil and Magdoff, 2004).

2. Bottom-up effects on the above ground autotrophic food chain: The soil food web provides better synchrony with plant requirements, providing better mineral balance for the plant metabolic machinery, which optimizes growth while suppressing herbivory and disease (Phelan et al. 1996).

3. Top-down effects on pests: An active soil food web increases epigeic fauna, making aboveground trophic interactions more web-like by providing alternative prey for generalist predators when pests are limited (Wise 1999).

4. Effects on crop-weed competition: Eutrophication has broad destabilizing effects on natural and managed plant ecosystems. High nutrient levels cause a shift in plant communities to a few fast-growing species, reducing plant diversity (Tilman 1987). Compared to chemical fertilizer, C-based nutrient sources resulted from active soil food web are less likely to produce eutrophic conditions, reducing pressures by fast-growing early successional weeds that are responsive to high nutrients (Tilman 1987).

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Do not apply Certainty to golf course putting greens or within four feet of the greens.
5. Stabilization of soil microbial populations: The regular influx of organic matter increases resilience in microbial populations and suppresses pathogens and plant-parasitic nematodes by supporting functional redundancy in soil microbial communities and increasing the competitive advantage of nonpathogenic microbes (van Bruggen et al. 2006).

6. Induction of plant-defense pathways: Elicitation of plant signaling systems by beneficial rhizobacteria and fungi increases resistance of aboveground portions of the plant to foliar pathogens (Vallad et al. 2003).

7. Tightening of nutrient cycles: With the availability of C energy sources, a greater portion of nutrients are stored in the microbial component of the soil and retained relatively locally.

In the cases of grass and turfgrass ecosystems, I oftentimes use these two examples below to indicate the importance of soil food web to grass growth and health. Figure 1, a re-draw from a USDA-NRCS graph, clearly shows that the addition of bacteria and nematodes had positive effects on blue grama grass growth. Figure 2, a re-draw from one of my own studies (Cheng and Grewal, 2009), clearly shows that with a more active soil food web, topsoil resulted in significantly better turfgrass quality compared with subsoil. Therefore, preservation of topsoil and promoting active soil food are critical in turfgrass management.

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References


