Nematodes, ecosystem services and soil health

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Nematodes play major roles, both negative and positive, in the component processes of many ecosystem services. They inhabit almost every environment that provides water, carbon and energy. In soil systems, their range of food sources includes higher plants, fungi, bacteria, algae, protozoa and other nematodes. Assemblages of soil organisms, and their ecosystem functions, respond to spatial and temporal changes in plant diversity, to subsidies of organic matter, and to heterogeneity of the soil environment. Besides their direct contribution to ecosystem functions, nematodes are indicators of the activities of other organisms. The magnitude of contribution to ecosystem services by soil organisms depends on their biomass and activity which, in turn, depend on the availability of resources and on mitigation of environmental constraints to their survival and function. When conditions are such that a desired function is not performed by any of the contributing species, the soil is no longer healthy relative to that function. Species diversity increases the amplitude of each function and consequently the health of the soil. Nematode assemblages are indicators of three attributes of the biological component of soil health: the range of ecosystem services available; the magnitude of the services; and the complementarity of services across microhabitats and in a successional context. Functional guilds of nematodes are comprised of species that contribute similarly to an ecosystem service. For example, nematodes in decomposition food web channels can be assigned to functional guilds based on the nature of their prey (bacteria or fungi) and their life course characteristics. Their species diversity can be partitioned into the diversity of guilds and the within-guild diversity. Within-guild species diversity ensures that the ecosystem service is provided across physical and chemical heterogeneity; diversity of guilds provides a measure of continuity of ecological services as conditions change. Management to ameliorate the disservices of plant-parasitic species often results in long-lasting, collateral disruption of higher trophic levels. The challenge in promoting soil health and sustainable production systems is to manage the disservices of soil nematodes and other pest organisms within the context of the stewardship of beneficial species and their services. Current and anticipated advances in molecular techniques for determination of nematode abundance, diversity and function will facilitate application of bioindicator-based measures of soil health.