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Organic management effects on the dynamics of soil organic carbon and nitrogen pools

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Compost application is a common practice in organic farming to supply nutrient to the crops and to sustain soil fertility. This practice enhances soil organic matter (SOM) quantity and is particularly beneficial in arid and semi-arid agroecosystems, often impoverished in SOM, contributing to both the nutritional and physical quality of the soil. Research objectives were to characterize: 1. the influence of organic fertilization compared with chemical fertilization on soil carbon (C) and nitrogen (N) reservoirs; and 2. The relationship between soil C and N reservoirs and soil microbial biomass (i.e. long-term effects) and between the soil microbial biomass-C and -N pools and plant-available soil C and N pools (i.e. seasonal, short-term effects).
A long term experiment, held in Gilat Research Center (Northern Negev, Southern Israel), where three application rates of a cow manure-based compost (20, 40 and 60 m3 ha-1 yr-1) are compared with chemical fertilization using urea applied at a rate equivalent to the lowest compost dose with respect to N as a control treatment. Each management type run in five random replicate plots.
Organic fertilization management induced significant long-term (i.e. 6-year period) increases in TOC, TN, and cold and hot water extracted organic carbon and nitrogen (DOC, DON, HWEC and HWEN); all were positively related to compost dose. Ultraviolet (UV) absorbance at 254 nm (ABS254) of the cold water extract increased with the dose of applied compost. Specific ultraviolet absorbance (SUVA = ABS254 /DOC) indicated a change in organic matter composition that was related to compost load immediately after compost application and the differences decreased with time. Microbial C and N pools (determined using the chloroform fumigation-extraction technique) also increased with the compost dose. Yet, the seasonal dynamics of the microbial C and N (MBC and MBN) showed fluctuating pattern. The microbial growth increased sharply following compost and urea application events as well as temporary (i.e. one month) increase in response to rain events. A negative relationship between microbial biomass and available N pool indicated N immobilization. DOC and DON dynamics with time showed similar patterns as the MBC and MBN. Yet, hot water extracted carbon and nitrogen correlated with TOC and TN, respectively and demonstrated stable values with time.
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The sensitivity of the microbial and dissolved nutrient pools to fertilization management with respect to short and long term emphasizes the contribution of compost to soil nutritional potential. Conversely, hot water extracted C and N can be used as indicators for total soil organic C and N. Microbial immobilization of nitrogen may constitute a mechanism for preserving surpluses nitrogen in the short term while allowing slow release in the long term through the microbial biomass "turnover" processes. Therefore, microbial indices can be useful in assessing soil's nutritional status.