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ROOTS OF THE FUTURE
Suolo e pianta nel cambiamento globale: tecnologie, degrado, sostenibilità

LIBRO DEGLI ABSTRACT

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SESSIONE 2

Vocazionalità, fertilità dei suoli e nutrizione delle piante: costruire filiere forestali e agroalimentari resilienti e tracciabili

BELOW-GROUND DYNAMICS UNDER SUSTAINABLE AGRICULTURAL PRACTICES: EVIDENCE FROM A MEDITERRANEAN CEREAL SYSTEM

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Sustainable agriculture hinges on plant–soil–microbe cross-talk that drives nutrient cycling, stress resilience, and biodiversity. Microbe-rich root zones, the rhizosphere and rhizosheath, are dynamic hotspots that sustain nutrient turnover and plant growth. In a two-year field study in Caselle in Pittari (Salerno, Italy), we tested how management shapes soil biological (enzymatic activities, 16S rRNA profiles) and physico-chemical properties. We ran two trials: (1) wheat under organic amendment (SUST) versus mineral fertilization (CONV); and (2) pollinator-friendly mixes (Eco-plus, Rustico) aligned with EU CAP eco-schemes. In both trials, an unmanaged control (CTRL) with spontaneous vegetation was included. Samples were collected from bulk soil, rhizosphere (rp), and rhizosheath (rs) at pre-sowing and flowering.
An initial survey identified time as the main driver, with all enzymatic activities peaking at flowering, indicating stronger microbial stimulation during active growth. Spatial differentiation was also evident, as rhizosphere (rp) and rhizosheath (rs) diverged from bulk soil, reflecting root-driven filtering. In trial 1, PERMANOVA showed no significant differences among CONV, SUST, and CTRL, whereas NMDS revealed early spatio-temporal structuring. Dehydrogenase activity (DHA) was higher in rp than in bulk soil ($p < 0.05$), and SUST increased labile C in bulk soil, with micronutrient shifts paralleling microbial-community changes. Diversity, enzyme activities, and organic matter covaried positively, although plant stage explained most separation, with biodiversity highest at flowering. In trial 2, plant mixes significantly affected soil properties (PERMANOVA, $p < 0.05$): Rustico showed higher DHA and urease than Eco-plus ($p < 0.001$), indicating stronger plant-driven microbial responses. High enzymatic activity often coincided with lower microbial diversity, suggesting functionality concentrated in dominant taxa. Overall, time primarily shaped soil microbial functioning, with activity peaks tracking crop stages. Rustico enhanced above-ground biodiversity while intensifying below-ground processes. Soil-health assessment should therefore integrate temporal variability and root-associated microenvironments; combining diverse plant mixes with reduced mineral inputs appears crucial for preserving soil ecosystem services.

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