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Soil health responses to tillage, residues, and manure in potato rotation systems in Peru

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Abstract

Soil degradation, salinity, and unsustainable management practices threaten potato production systems in the coastal region of Lima, Peru. Regenerative agriculture practices, including minimum tillage (MT), crop residue incorporation, and the application of organic manure, have been proposed as strategies to improve soil health under such conditions. This study evaluated the effects of these practices on soil physical, chemical, and biological indicators, and developed a Soil Health Index (SHI) to assess overall soil health in a potato rotation system. A field experiment was conducted using different combinations of tillage practices, residue management, and sheep manure application rates. Soil indicators including bulk density (BD), aggregate stability, penetration resistance, hydraulic conductivity, soil pH, soil organic carbon (SOC), electrical conductivity (EC), and biological activity (macrofauna abundance and diversity and decomposition rates) and potato yield were measured and integrated into a normalized SHI. Results showed that sheep manure application significantly improved several soil indicators, including SOC, aggregate stability, BD, macrofauna abundance, and SHI. Minimum tillage significantly reduced EC, while residue incorporation significantly improved aggregate stability. However, most soil indicators were not significantly influenced by tillage or residue management alone. SHI responses showed a general increasing trend with manure application, although differences among treatment combinations were not consistently significant. Potato yield was not significantly influenced by any of the management practices. Overall, manure application was the primary driver of soil health improvements in the short term, while the effects of MT and residue incorporation were limited. These findings highlight the importance of organic amendments for rapidly improving soil health in saline, sandy soils, and suggest that short-term changes in soil health may not directly translate into yield responses.

Keywords: Crop residue incorporation, minimum tillage, Peru, potato rotation, regenerative agriculture, sheep manure, soil health index, soil indicators, soil salinity

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