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“Reconcile land system changes
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Enhancing potato productivity and soil health through digestate application: A circular approach for sustainable agroecosystems in Morocco

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Abstract

Morocco annually generates around 62 million tons of organic waste, predominantly from agriculture, posing significant sustainability challenges, particularly for climate-vulnerable crops like potato. The potato sector suffers from severe soil degradation, water scarcity, and heavy reliance on synthetic fertilisers. Anaerobic digestion (AD) presents an eco-friendly solution by converting organic waste into digestate, a nutrient-rich organic fertiliser enhancing soil fertility, improving water retention, and reducing greenhouse gas emissions compared to conventional waste disposal methods. Despite its widespread adoption in Europe, digestate use remains minimal in Morocco due to knowledge gaps, financial constraints, and limited local efficacy data.

This research evaluates the impact of digestate application on potato yield and soil health under field conditions in Meknes, Morocco, during the 2023–2024 season. A randomised block design was employed with three replicates and six treatments: control (unamended soil), mineral fertiliser (NPK 10:30:20), and digestate applications at 10, 20, 30, and 40 dry tons per hectare. Certified *Solanum tuberosum* ‘Laura’ seeds were planted at 2000 kg/ha under drip irrigation. Key agronomic parameters (plant height, leaf count, collar diameter, and yield) and soil properties (pH, electrical conductivity (EC), organic matter, and nutrient content) were assessed at 30-day intervals, with soil samples analysed post-harvest. Data analysis utilised XLSTAT (version 2024, Lumivero, USA) and Python 3.11.

Results indicated substantial benefits of digestate application. High digestate rates significantly improved soil fertility, reducing pH from 7.9 to 7.61 (at 40 t/ha), increasing organic matter from 5.42 % to 6.64 % (at 20 t/ha), and enhancing nutrient availability (N: +650 %, P: +64 %, K: 794 mg/kg at 40 t/ha). Elevated application rates also increased soil salinity (EC: 0.882 dS/m at 40 t/ha versus 0.407 dS/m control). Potato growth significantly improved with digestate; plants under the highest digestate rate reached heights of 74.12 cm and yielded 10.72 t/ha, surpassing conventional NPK fertilisation by 50 %.

In conclusion, digestate application notably enhances potato yields and soil health, supporting circular agricultural practices and sustainable agroecosystem management in semi-arid regions like Morocco.

Keywords: Circular agroecosystems, digestate, sustainable-potato-farming

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