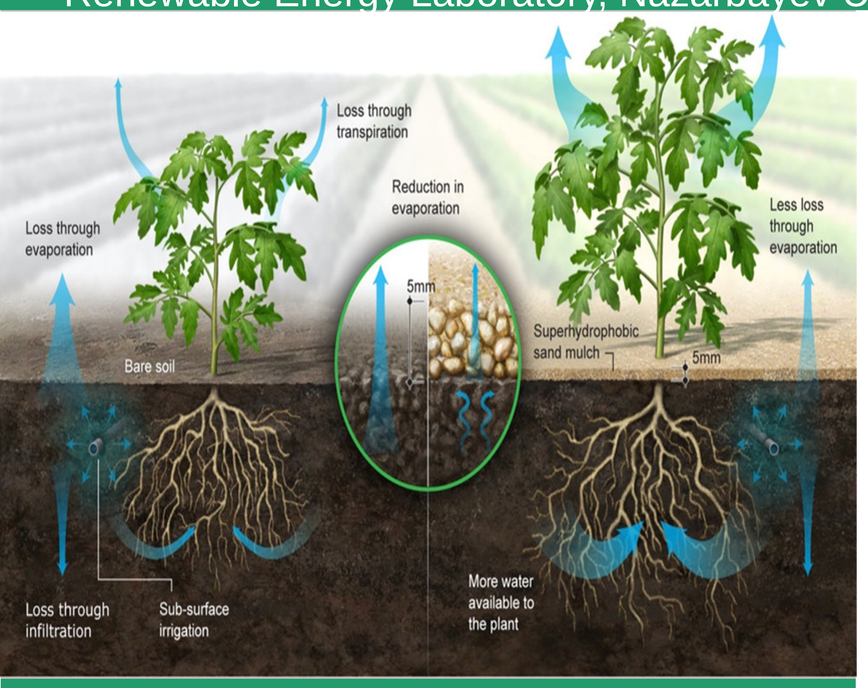
4th International Symposium on Emerging Materials and Devices

STEARIC ACID-COATED SAND (SACS): A SUPERHYDROPHOBIC MATERIAL FOR SUSTAINABLE WATER MANAGEMENT IN AGRICULTURE

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INTRODUCTION

Agriculture, consuming 70–90% of global freshwater, faces significant water losses from evaporation and runoff, particularly in arid regions. Traditional irrigation methods, with their low 50–60% efficiency, exacerbate this issue. In contrast, advanced systems achieve 90–95% efficiency, underscoring the need for innovation. SACS, a low-cost superhydrophobic (SH) material, addresses this by reducing evaporation and enhancing soil moisture retention, offering a scalable solution for sustainable water management in agriculture.

METHODS

SYNTHESIS OF SACS

- Silica sand particles were coated with stearic acid in an ethanol-based solution.
- Controlled drying at 80°C for 3 days stabilized the hydrophobic layer.

CHARACTERIZATION TECHNIQUES

- **SEM**: Surface morphology and coating uniformity.
- **EDS**: Elemental distribution (C, O, Si).
- **FTIR/Raman/XRD**: Chemical composition and crystallinity.
- **Water Contact Angle (WCA) Measurements**: Water contact angle (WCA >150°).

EXPERIMENTAL SETUP

- Tested SACS-treated soil vs. untreated soil for moisture retention.
- Evaluated hydrophobicity under wetting/drying cycles (Figure A).

DATA ANALYSIS

SUPERHYDROPHOBIC PROPERTIES (SHP)

- SEM images showed uniform stearic acid clusters (4–10 µm diameter) forming hierarchical roughness (Figure D).
- WCA measurements confirmed superhydrophobicity (WCA >150°) (Figure B and C).

EDS RESULTS

- Uniform carbon (C) distribution confirmed successful coating.
- No structural degradation of silica sand after coating.

FTIR/RAMAN/XRD

- FTIR detected C–H, C=O, and O–H bonds from stearic acid (Figure E).
- Raman spectra confirmed long alkyl chains and carboxylate groups.
- XRD showed preserved crystallinity of silica substrate (Figure F).

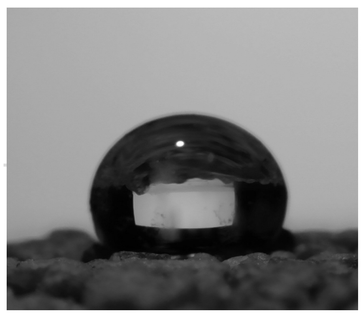
A FABRICATION OF SACS



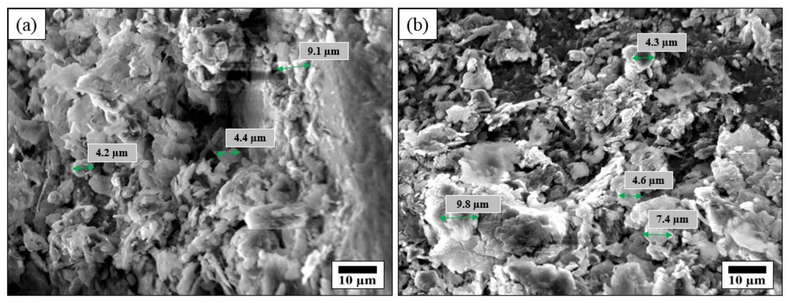
B SHP OF SACS



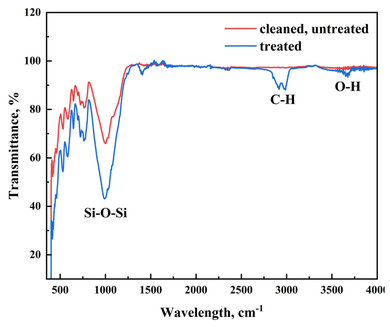
C WCA



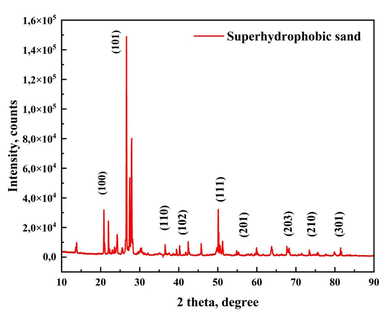
D SEM OF SACS WITH STEARIC ACID CLUSTERS



E FTIR SPECTRA

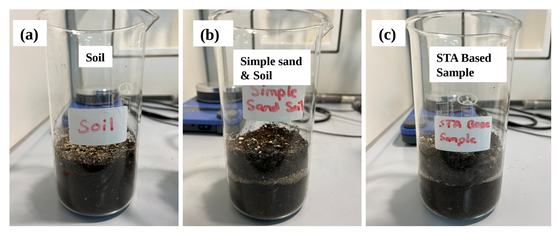


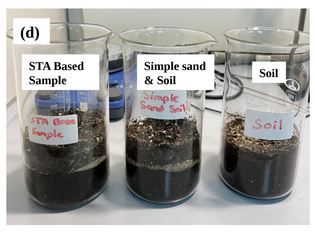
F XRD SPECTRUM



RESULTS

The results showed that SACS-treated soil retained moisture for 10 days, 4 days longer than untreated soil, and reduced water evaporation by 30% under controlled conditions. Initial trials also demonstrated a 10–20% increase in plant biomass yield in SACS-treated soil.





However, hydrophobicity decreased by 10–15% after five wetting/drying cycles, indicating moderate long-term stability. These findings highlight SACS's potential as a sustainable solution for enhancing water efficiency and crop productivity in agriculture.

CONCLUSION

- SACS effectively reduces water loss and enhances soil moisture retention, offering a sustainable solution for water management in agriculture.
- Potential challenges include degradation under acidic/organic conditions, requiring further research.
- SACS addressing water scarcity and supporting sustainable farming practices.

Sustainable Development Goals



Reference to Funder:

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