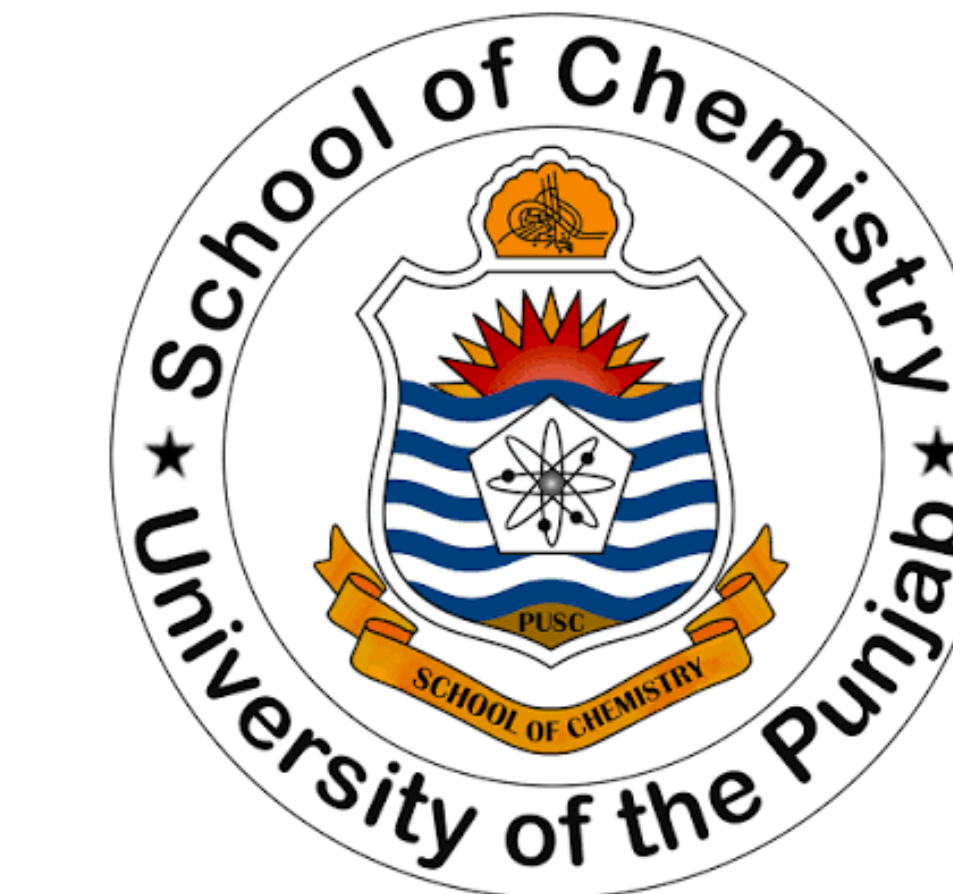




Citric Acid-Modified Fe-MOF for Efficient Iron Delivery and Growth Promotion of *Pennisetum Glaucum* in Calcareous Soil



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Abstract

A porous iron-based metal-organic framework (Fe-MOF) was functionalized with citric acid and applied to *Pennisetum glaucum* plants in calcareous soil. The effects of these substances on plant growth rate, chlorophyll content, and iron content were observed. Iron analysis revealed a concentration of 343 ppm in treated plants, demonstrating effective iron enrichment, while chlorophyll content was 5.87 mg/g.

Introduction

This study investigates the application of Fe-MOF-CA as a foliar nano-fertilizer to enhance iron accumulation, growth, and physiological performance in millet, thereby contributing to sustainable crop biofortification.

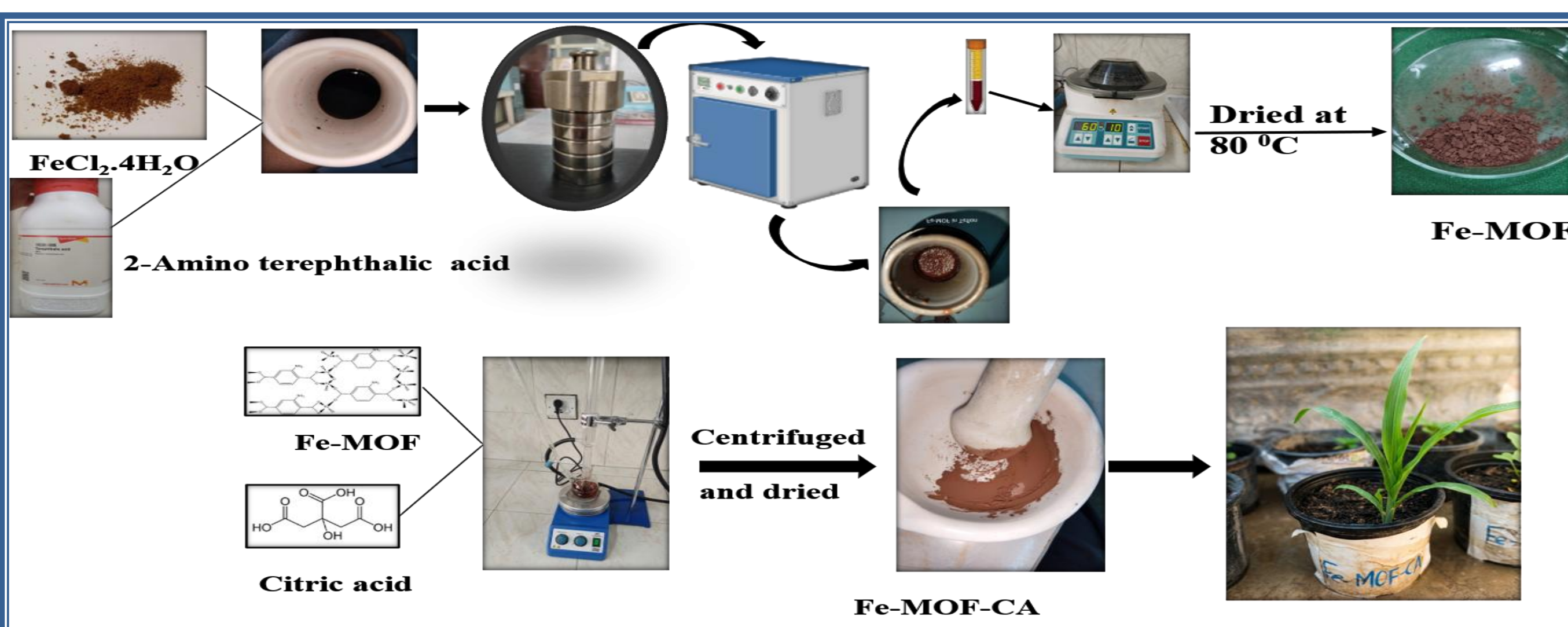


Figure 1: Graphical abstract

Material

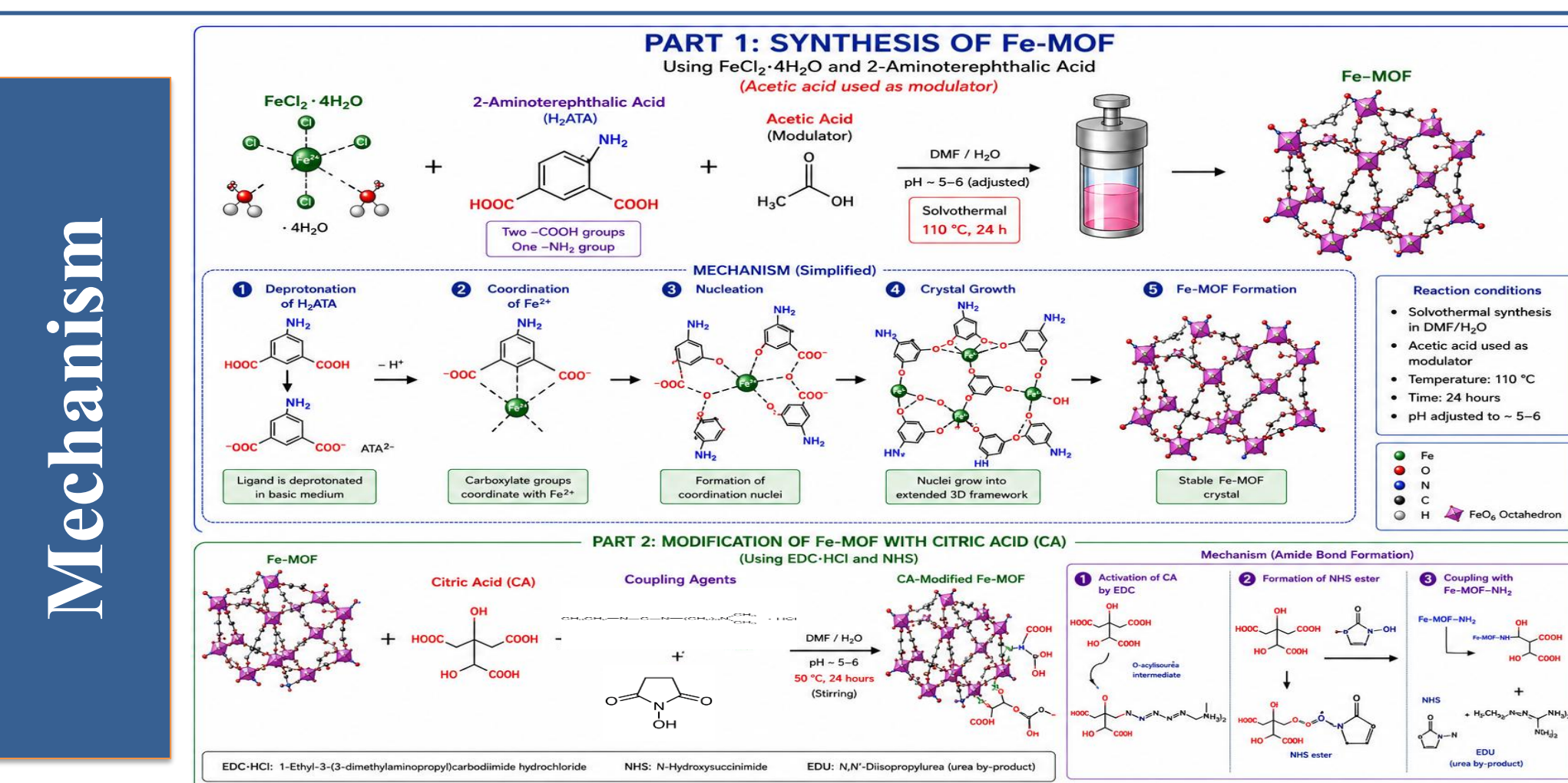
$\text{FeCl}_2 \cdot 4\text{H}_2\text{O}$, 2-Amino Terephthalic acid, Citric acid, DMF, N-Hydroxy succinimide, EDC.HCl.

Conclusion

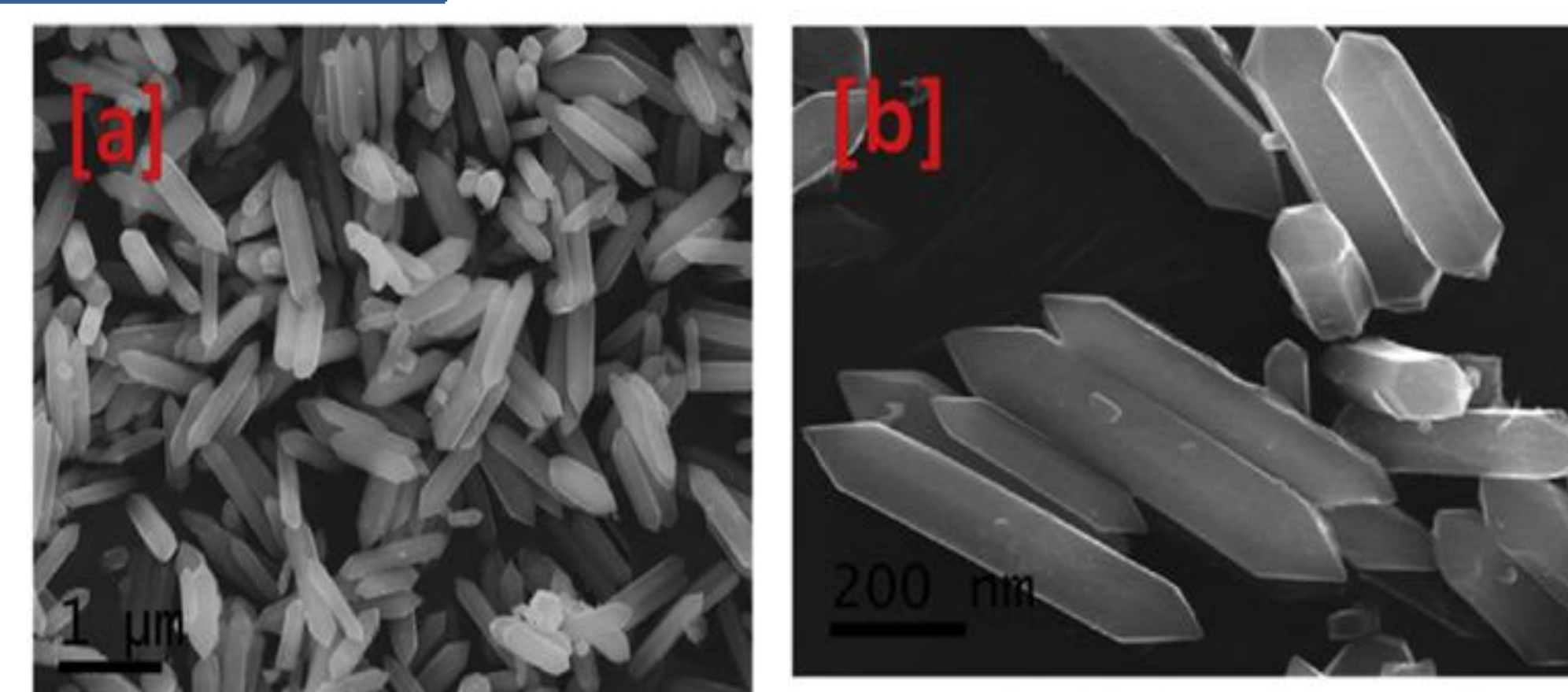
The citric acid-functionalized Fe-MOF (Fe-MOF-CA) was successfully synthesized and characterized as a sustainable nanomaterial for agricultural applications. Functionalization enhanced the stability and surface properties of the Fe-MOF, thereby improving iron availability and uptake by plants. Application of Fe-MOF-CA promoted plant growth and biomass production, demonstrating its potential as an efficient and eco-friendly iron delivery system. These findings highlight the promise of Fe-MOF-CA as a sustainable strategy to improve crop nutrition and support environmentally responsible agriculture.

Methodology

- ❑ An iron-based metal-organic framework was synthesized using the solvothermal method by the reaction of $\text{FeCl}_2 \cdot 4\text{H}_2\text{O}$ and 2-aminoterephthalic acid in a Teflon-lined autoclave at 110°C for 24 hours
- ❑ Prepared Carbamide-activated system using citric acid, EDC.HCl and NHS.
- ❑ Fe-MOF-CA was synthesized using Fe-MOF and an activated citric acid system using a reflux condenser and 50°C for 24 hours



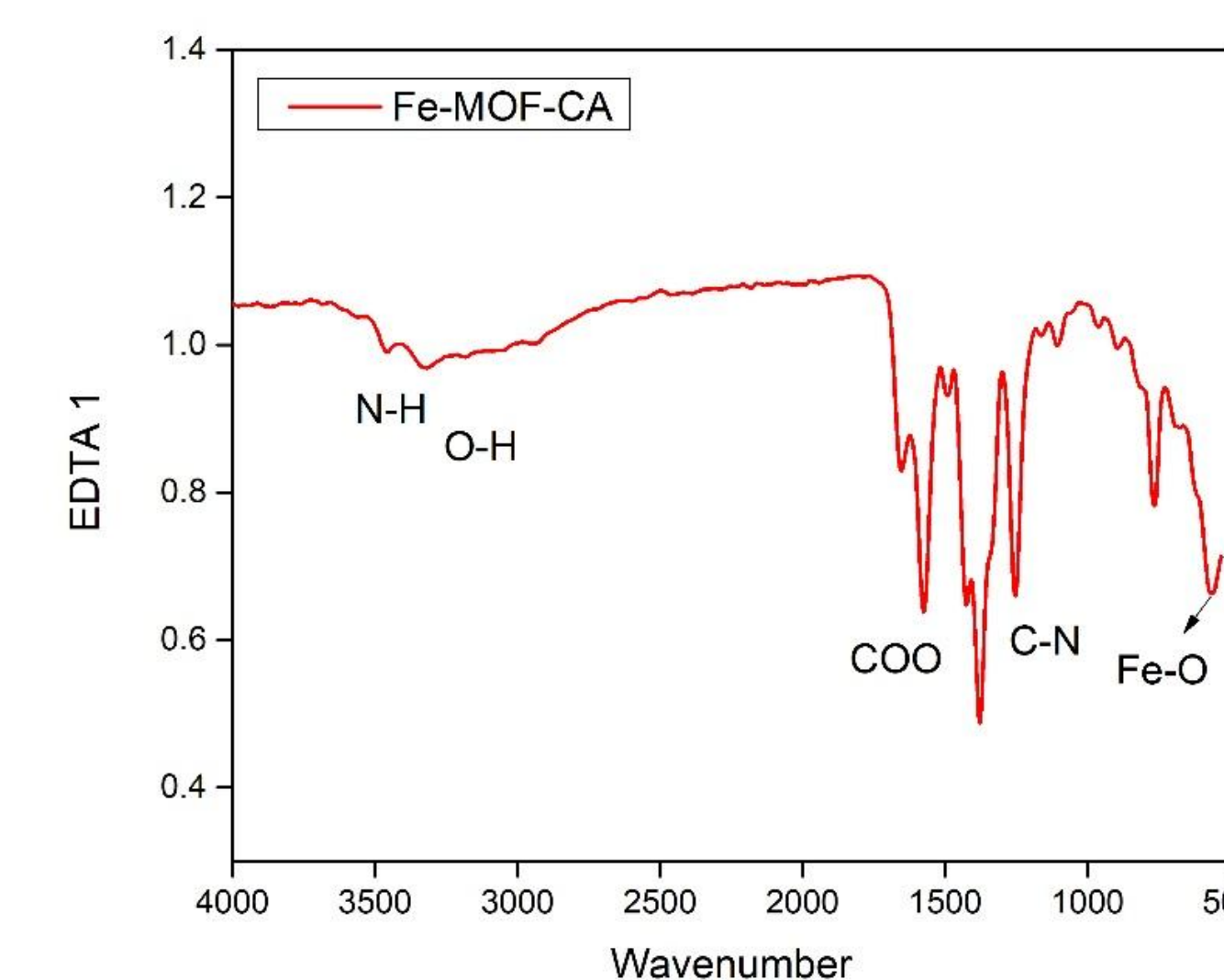
SEM analysis



[a] Fe-MOF

[b] Fe-MOF-CA

FTIR analysis



Results

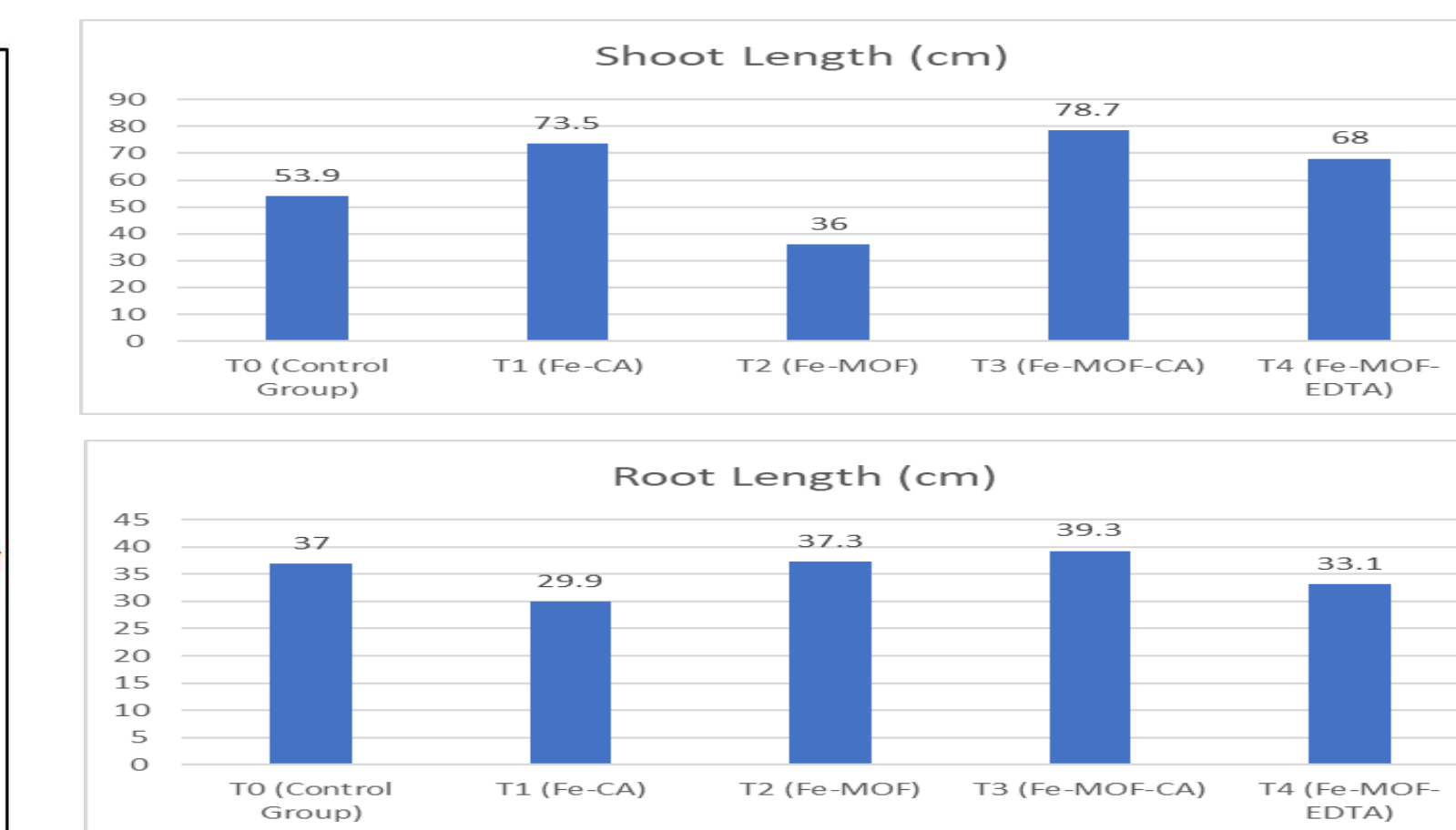


Figure 2: Shoot length and Root length

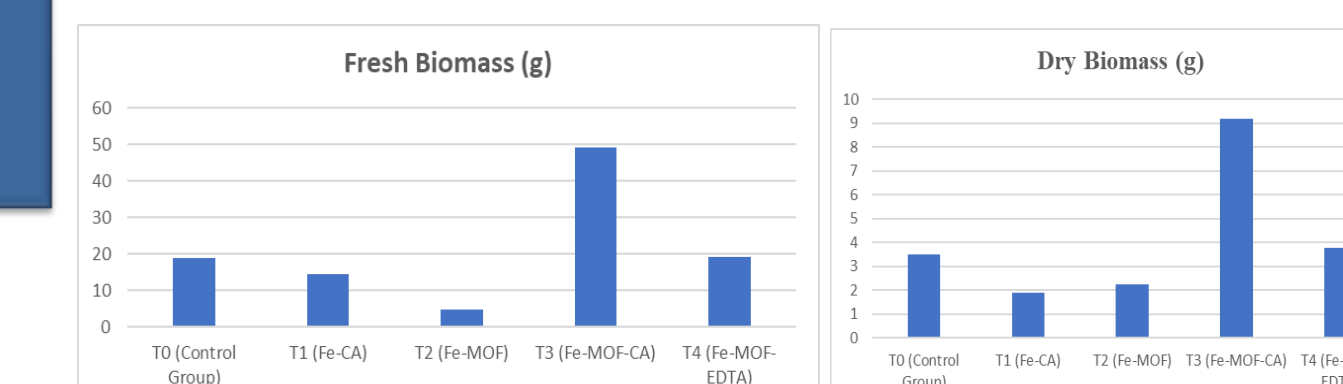


Figure 3: Fresh Biomass, Dry Biomass, and % Water Content

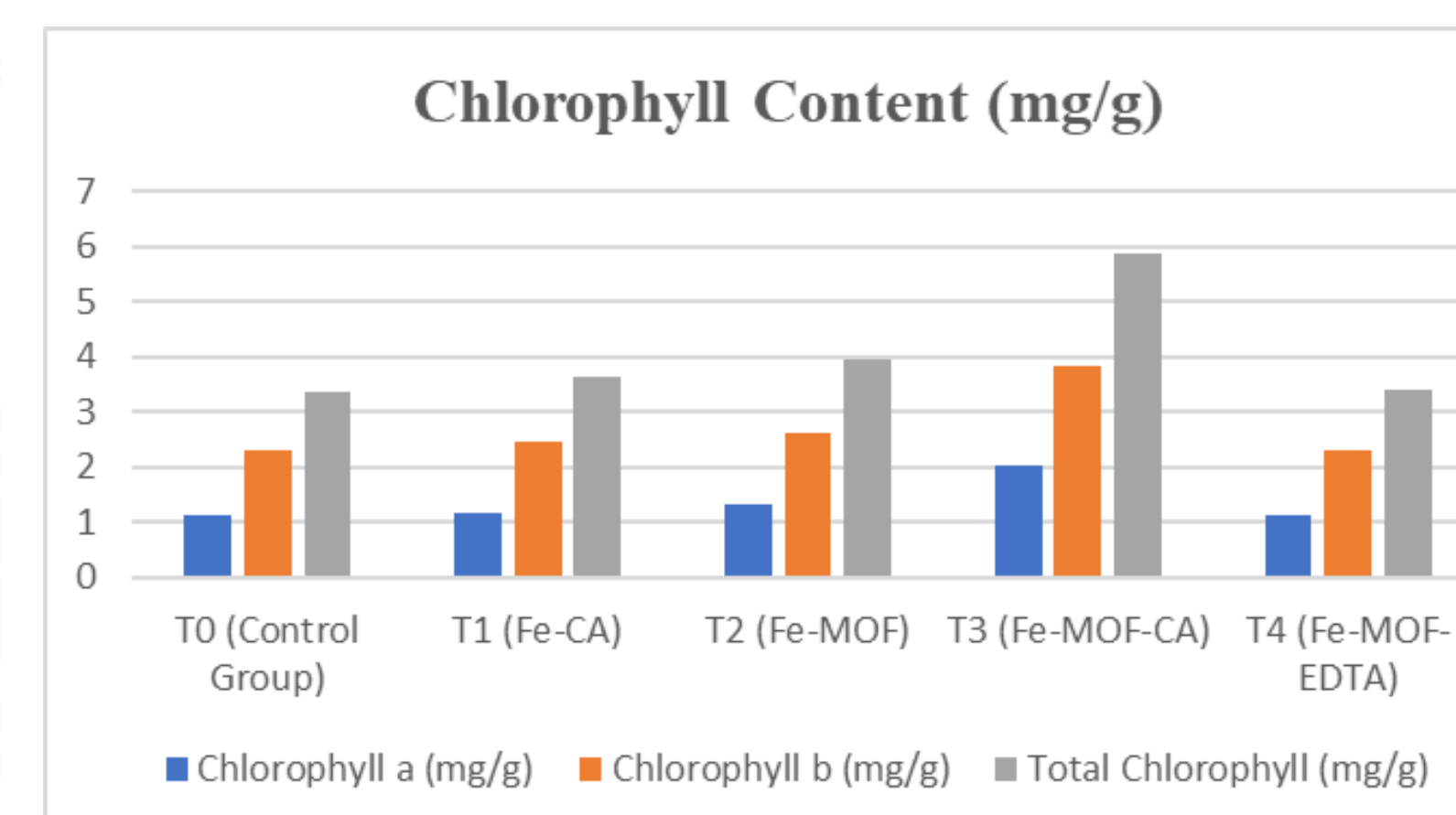
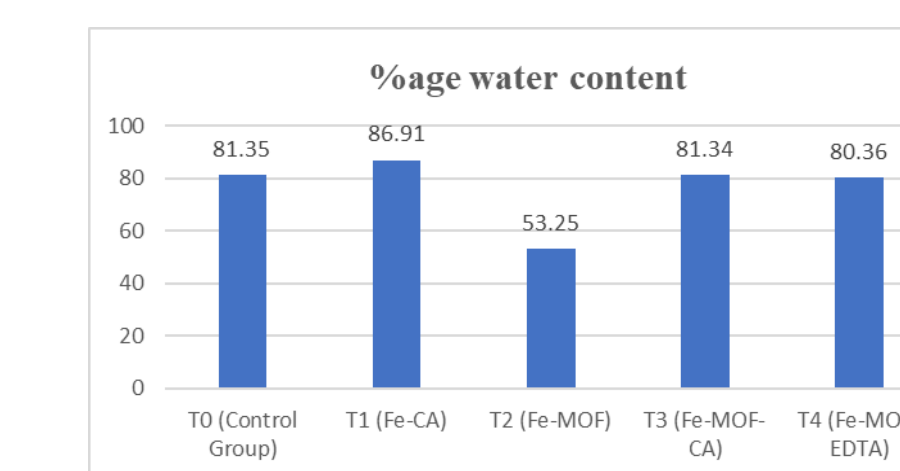


Figure 4: Chlorophyll Content

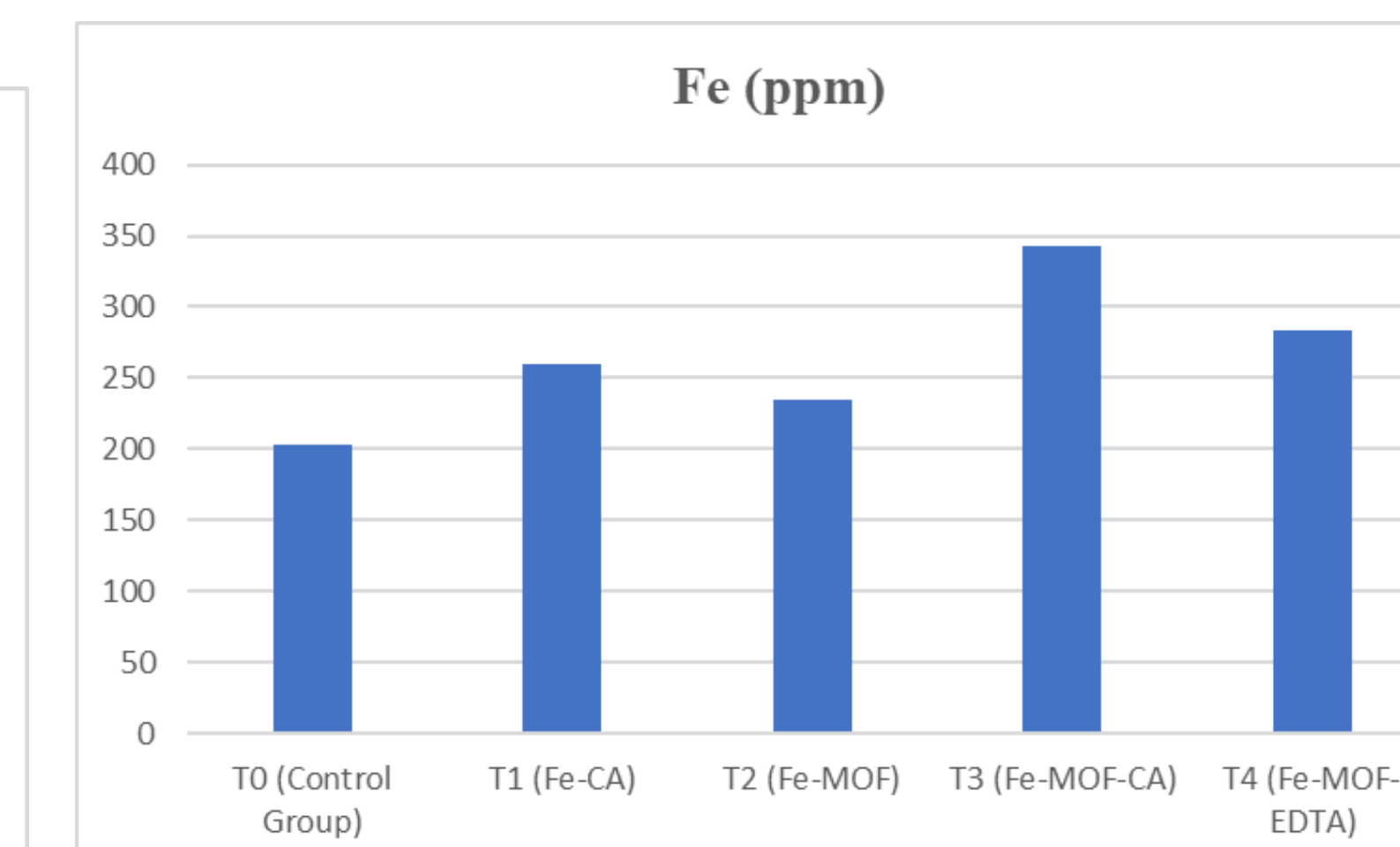


Figure 5: Iron Content in Pearl Millet Plants

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