ISETC2025

UNIVERSITI TEKNOLOGI MARA

ISETC2025

2 ND INTERNATIONAL SCIENCE, ENGINEERING AND TECHNOLOGY COLLOQUIUM

THE POWER OF SCIENTIFIC INNOVATION

INTELLIGENT SOLUTIONS FOR A SUSTAINABLE WORLD

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EDITORS

Dr. Emi Norzehan Mohamad Mahbob
Dr. Saiyidah Nafisah Hashim
Ms. Lili Widarti Zainuddin
Ms. Nurul Nazwa Mohammad
Ms. Rozaina Saleh

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PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob
Dr. Saiyidah Nafisah Hashim
Ms. Lili Widarti Zainuddin
Ms. Nurul Nazwa Mohammad
Ms. Rozaina Saleh

ISETC 2025 Proceedings Editors

EFFECT OF GROWTH MEDIUM AND PRIMING WITH NANOCOPPER MIXTURE ON GERMINATION OF SPINACH, BOK CHOY AND OKRA

Nurul Izza Taib[1], Muhammad Firassul Zulkiflee[1], Luqman Nurhakim Mohamad Rozali[1], Munirah Onn[2], Saiyidah Nafisah Hashim[1*]

[1]*Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, 35400 Tapah Road, Perak, Malaysia*
[2]*Faculty of Applied Sciences, Universiti Teknologi MARA, UiTM Johor Branch, Pasir Gudang Campus, 81750 Masai, Johor, Malaysia*

**Corresponding author: saiyidah394@uitm.edu.my*

Abstract: Nanotechnology offers innovative solutions to enhance crop establishment and productivity, yet the application of copper-based nanomaterials in seed priming remains underexplored. This study evaluates the effects of copper nanomixtures on seed germination and early seedling growth of hydroponic vegetables: bok choy, okra and spinach. First, copper nanoparticles were synthesized then physically mixed with either methyl jasmonate or yeast extract to produce two nanocomplexes: Cu-MeJA and Cu-Yeast. These were prepared in three concentrations (0.25, 0.5, and 1.0 mg/mL), along with controls, forming a total of 10 different treatments. Next, seed germination and viability test was carried out by soaking the seeds in each treatment solution for 24 hours. Treated seeds then were inoculated on two different growth mediums (peat moss and cocopeat). This followed by monitoring the germination rate and seed viability after 7 days. Then FTIR analysis was conducted on the nanomixtures. Results showed that seeds treated with Cu-MeJA and Cu-Yeast demonstrated improved germination performance and early root development compared to untreated controls. The FTIR spectra confirmed successful formation of copper complexes with organic ligands. These findings suggest that copper-based nanomaterials, particularly when combined with biological elicitors, may serve as promising nanostimulants in hydroponic agriculture.

Keywords**:** *Copper nanoparticle, methyl jasmonate, yeast extract, seed priming, germination, FTIR, nanostimulant*

INTRODUCTION

In agriculture, nanotechnology provides new tools, particularly for seed care. By enhancing nutrient uptake and metabolism, nanoparticles can improve germination and seedling vigor (Mahra et al., 2025; Su et al., 2024). The effect of copper methyl, copper yeast, and methyl jasmonate on hydroponic crops are the main topics of this investigation Wang et al., 2024).

LITERATURE REVIEW

According to earlier research, methyl jasmonate increases chlorophyll content and stress tolerance (Wang et al., 2024), whereas copper oxide nanoparticle enhances root and shoot growth (Feigl, 2023; Azam et al., 2012). Additionally, nano priming improves antioxidant activity and water absorption (Mahra et al., 2025). Nevertheless, nothing is known about integrating these nanoparticles into hydroponic systems.

MATERIALS AND METHODS

Chemical reduction was used in the synthesis of copper nanoparticle. Copper was combined with either yeast extract or methyl jasmonate to create copper methyl and copper yeast. Tap water was used as control. For priming, a whole day seeds were immersed in different treatment solutions included of nanoparticles mixture at different concentrations (0.25, 0.5, and 1.0 mg/mL). The nanoparticle size of mixtures had been tested previously using XRD, HRTEM and EDX physical analyses (data not shown). Both peat moss and coco peat media were used to assess plant survivability.

The survivability percentage was measured using the formula below:

Seed Survivability (%) = (Total number of germinated seeds / Number of surviving seedlings) ×100

The results were recorded in the first and second week. FTIR analysis was also performed to identify functional groups and confirm interactions between copper and the organic compounds. Dried samples were mixed with KBr, pressed into pellets, and scanned over 4000–400 cm^{-1}.

RESULTS

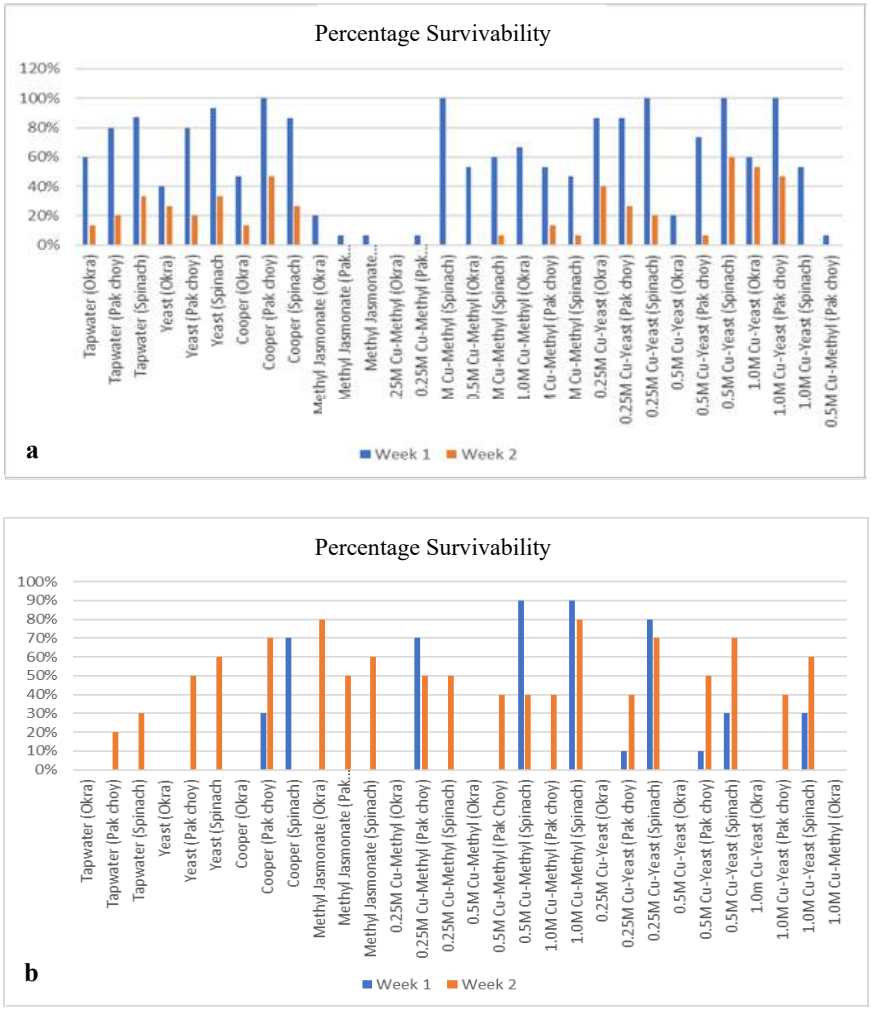

Figure 1. Seed percentage survivability after prime with different mixture treatments and sown in two different medium a) Peat moss b) Coco peat

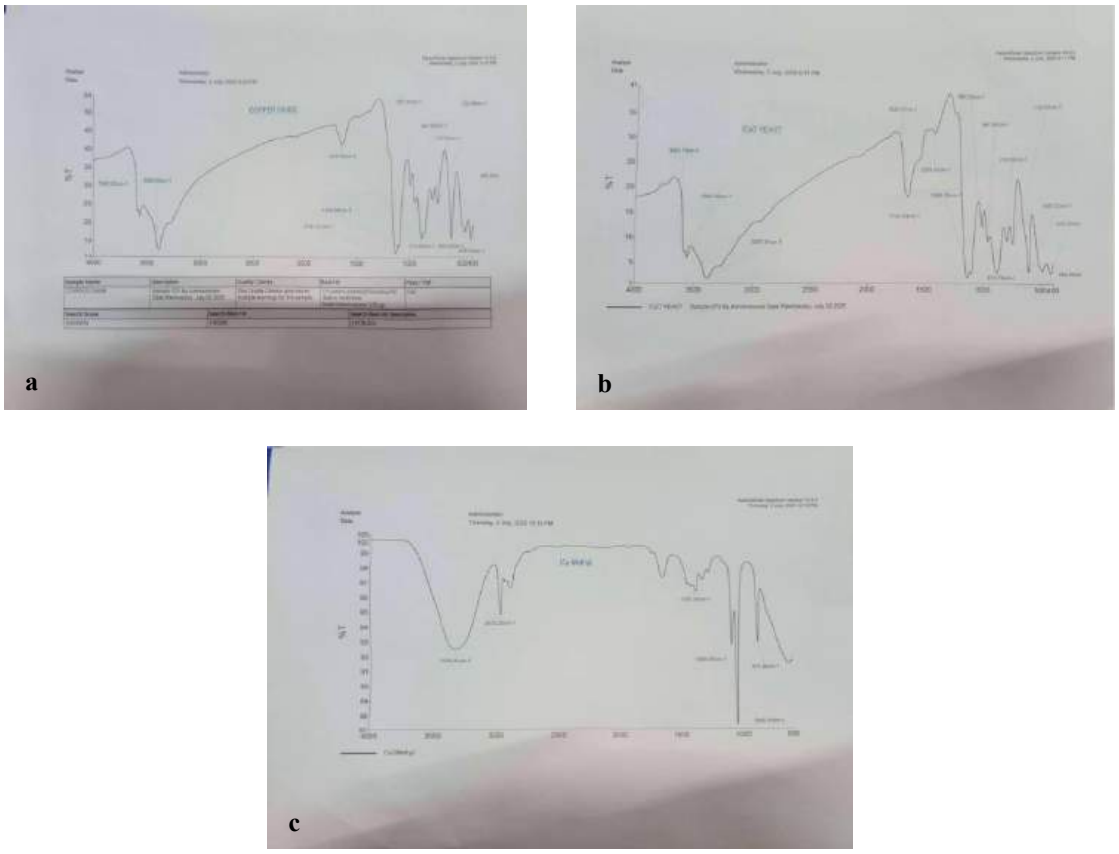

Figure 2. Peaks of Spectroscopy a) CuO b) Cu-Yeast c) Cu-Methyl

DISCUSSION/ANALYSIS

In peat moss, survivability was generally higher in the first week than the second (Figure 1a). For example, treatments with tap water, yeast, and copper showed up to 100% survivability for okra and spinach initially but declined by week two. This drop may be due to peat moss's limited nutrient retention once initial reserves are used up (Bewley et al., 2013).

In coco peat (Figure 1b), survivability appeared more stable or improved over time, especially for treatments with methyl jasmonate, Cu-Methyl, or Cu-Yeast complexes. For instance, bok choy survivability under 0.25 M Cu-Methyl increased in week two. This can be explained by coco peat's better aeration and moisture retention, which support root growth and water availability (Thae et al., 2019).

However, okra seeds did not germinate in coco peat because different seeds were used, and poor seed quality likely reduced viability. Aging and poor storage can lower germination rates, especially in inert substrates like coco peat (Bewley et al., 2013).

Overall, peat moss supported higher germination than coco peat. For bok choy, copper and 1.0 M Cu-Yeast treatments gave 100% germination, suggesting copper and yeast can boost seed vigor. In contrast, methyl jasmonate and low-concentration Cu-Methyl treatments resulted in poor germination, likely due to suboptimal dosages.

For spinach, 0.25 M Cu-Methyl and 0.25 M Cu-Yeast in peat moss gave the best results (100% germination), confirming that moderate copper levels enhance seed metabolism and seedling growth. In coco peat, germination was lower but improved under higher copper concentrations. For example, spinach reached 90% with 1.0 M Cu-Methyl

and 80% with tap water, suggesting that suitable copper levels can partly offset coco peat's limitations.

According to Figure 2, FTIR analysis confirmed functional groups in the copper oxide. Pure CuO showed broad O–H stretching at ~3563 and 3389 cm^{-1} (adsorbed moisture), H–O–H bending at 1625 cm^{-1}, and clear Cu–O stretching at ~600 and 416 cm^{-1} (Azam et al., 2012). The CuO-yeast composite showed similar O–H and N–H peaks (~3584 and 3368 cm^{-1}) and an amide I band at 1632 cm^{-1}, indicating protein binding. The retained Cu–O peaks confirm the copper oxide remained intact during bioconjugation. FTIR was suitable for this study because it quickly identifies functional groups and interactions with biological materials.

These bio-organic functional groups can act as natural stabilizers and nutrient sources, as supplying amino acids and growth factors that stimulate seed metabolism. This dual action micronutrient copper plus bioactive yeast compounds likely explains why Cu-Yeast treatments improved germination and seedling vigor more than CuO alone. In summary, the presence of bioactive functional groups in Cu-Yeast (proteins) and Cu-Methyl (plant hormone) enhances the base benefit of copper ions by supplying extra biochemical signals and nutrients. This synergy likely makes Cu-Yeast and Cu-Methyl more effective than pure CuO for boosting seed germination and early growth.

CONCLUSIONS

Peat moss supported higher initial germination, while coco peat offered more stable survivability over time due to better aeration and moisture retention. Copper treatments combined with bioactive compounds like yeast and methyl jasmonate (Cu-Yeast, Cu-Methyl) improved germination and seedling vigor more effectively than pure CuO. FTIR analysis confirmed functional groups that enhance nutrient delivery and biochemical signaling. Overall, combining copper with biological elicitors offers a promising approach to boost seed performance across different substrates.

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Sekian, terima kasih.

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SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

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