

Evaluating the bio stimulant potential of brown seaweed extracts on tomato(*Solanum lycopersicum*) germination and early growth for sustainable crop production

**Chaima BOUKHAROUAA^{1*}; Oukacha AMRI¹; Khadija EL MEHRACH¹; Ilham ZERBET¹ ; Fadma FAHMI¹
and Saida TAHROUCH¹**

¹Plant Biotechnology Laboratory, Faculty of Sciences of Agadir, Ibn Zohr University, Agadir, Morocco

INTRODUCTION & AIM

Facing the dual crisis of food security and environmental impact, conventional agriculture's limits drive the need for sustainable alternatives like plant biostimulants. Brown algae extracts are powerful biostimulants rich in polysaccharides, phytohormones, and antioxidants that boost plant defense and stress tolerance, especially in vulnerable crops like tomatoes



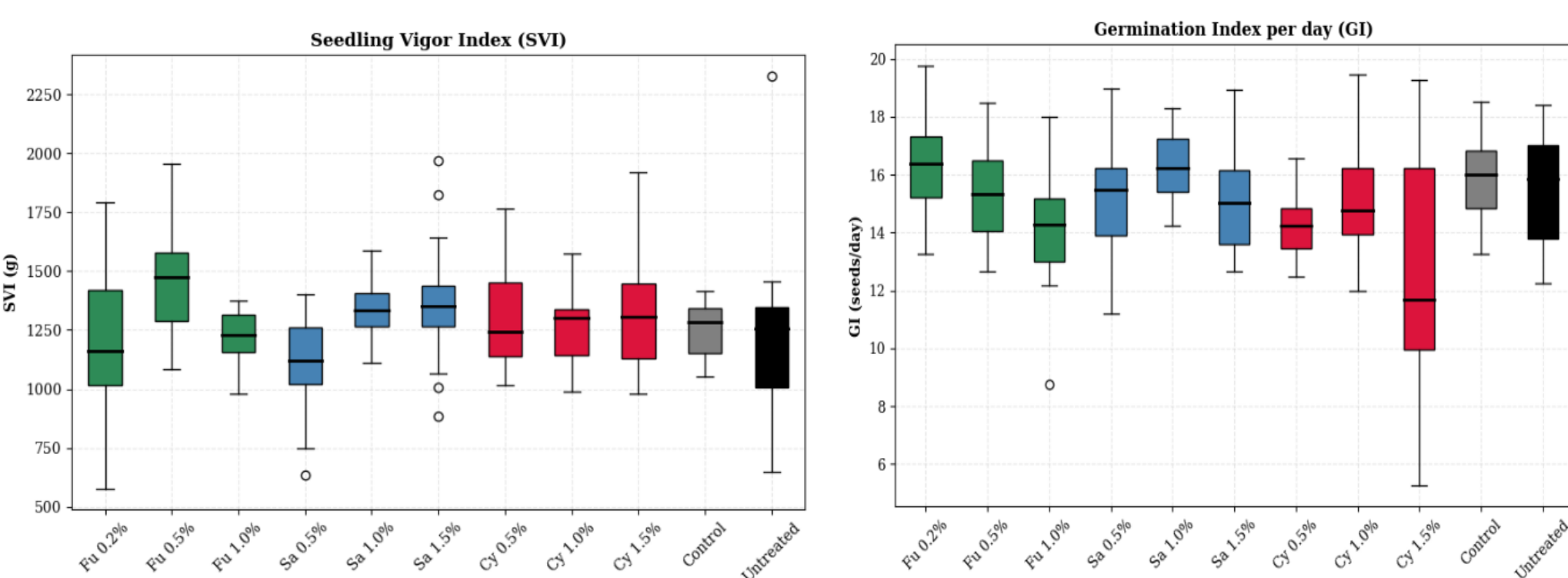
The aim is to compare the biostimulant efficacy of aqueous extracts derived from three brown seaweed species : *Fucus spiralis*, *Cystoseira tamariscifolia*, and *Sargassum trichocarpum*, on tomato (*Solanum lycopersicum* L.) during early development by assessing differences in seed germination rate, seedling growth metrics,

METHOD

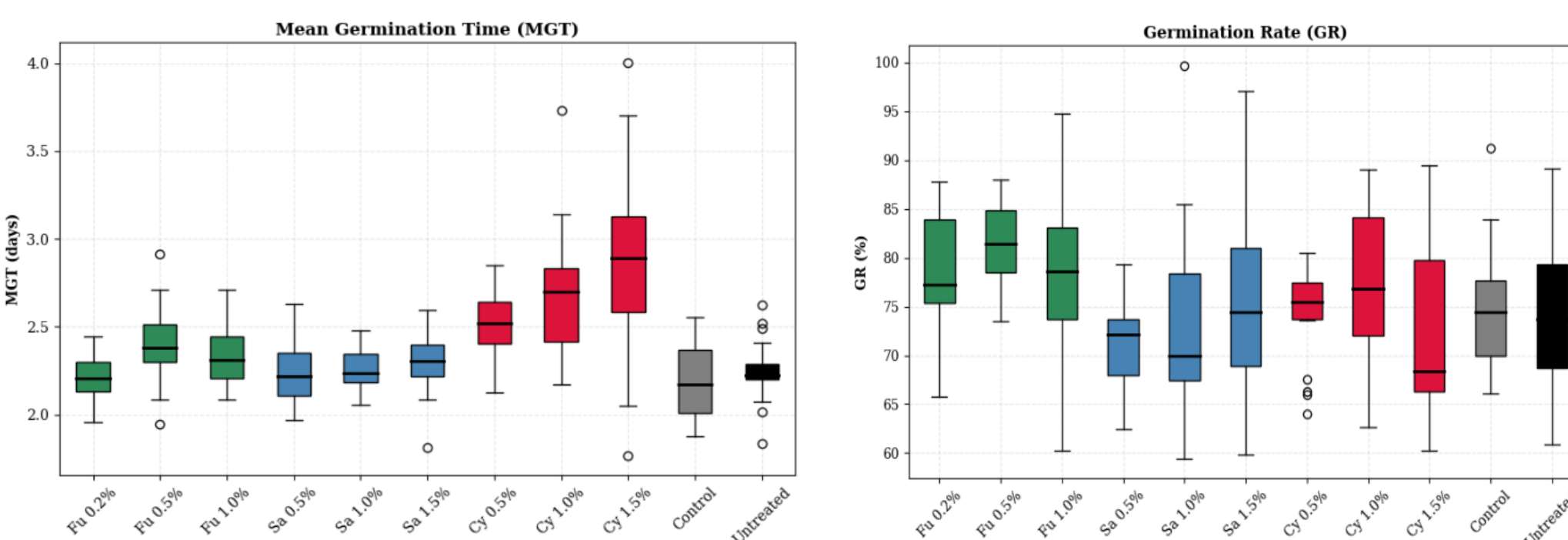


- **Plant model:** (*Solanum lycopersicum* L.) seeds, variety "Campbell 33."
- **Experimental design:** Completely Randomized Design (CRD).
- **Replications:** n=10 Petri dishes per treatment/40 seeds per petri dish.
- **Negative control:** Distilled Water / **Positive control:** 0.2% Potassium nitrate
- **Algae Treatments:** 3species*3concentrations = 9 treatments in total
- **Germination Parameters:** Germination Rate (GR) ; Mean Germination Time (MGT)and Germination Index (GI)
- **Growth/Vigor Parameters:** Radicle Length (RL); Hypocotyl Length (HL); Total Seedling Length (TSL) and Vigor Index (VS)

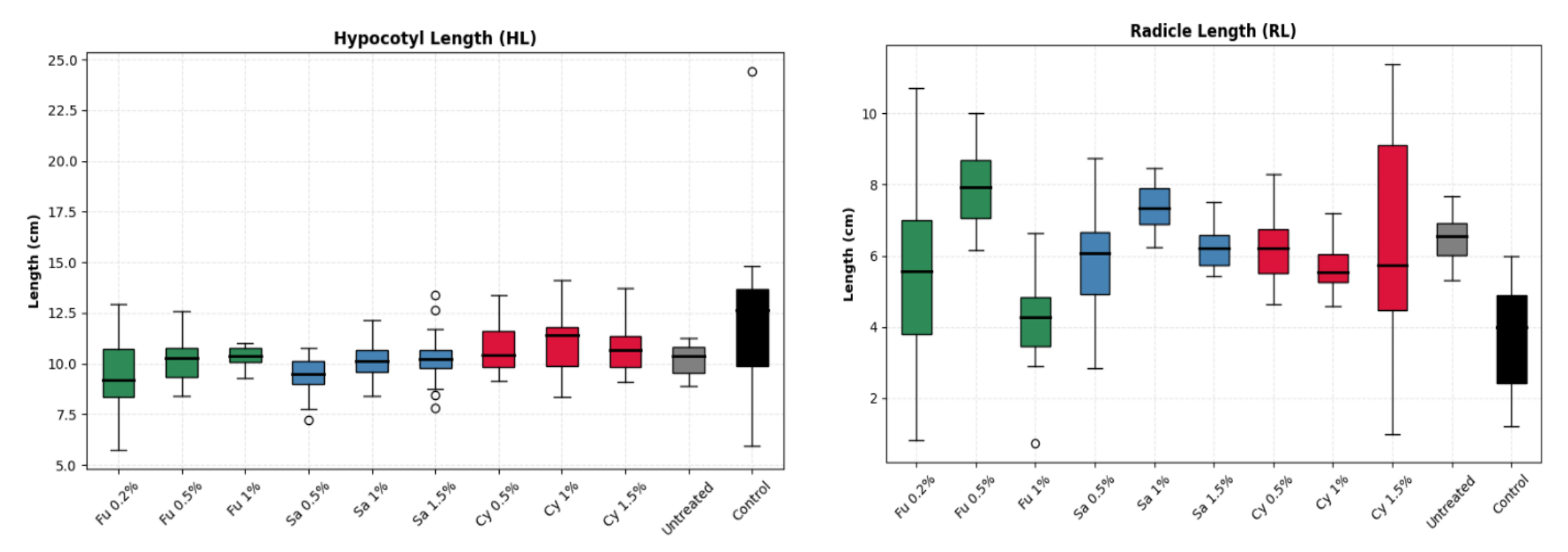
RESULTS & DISCUSSION



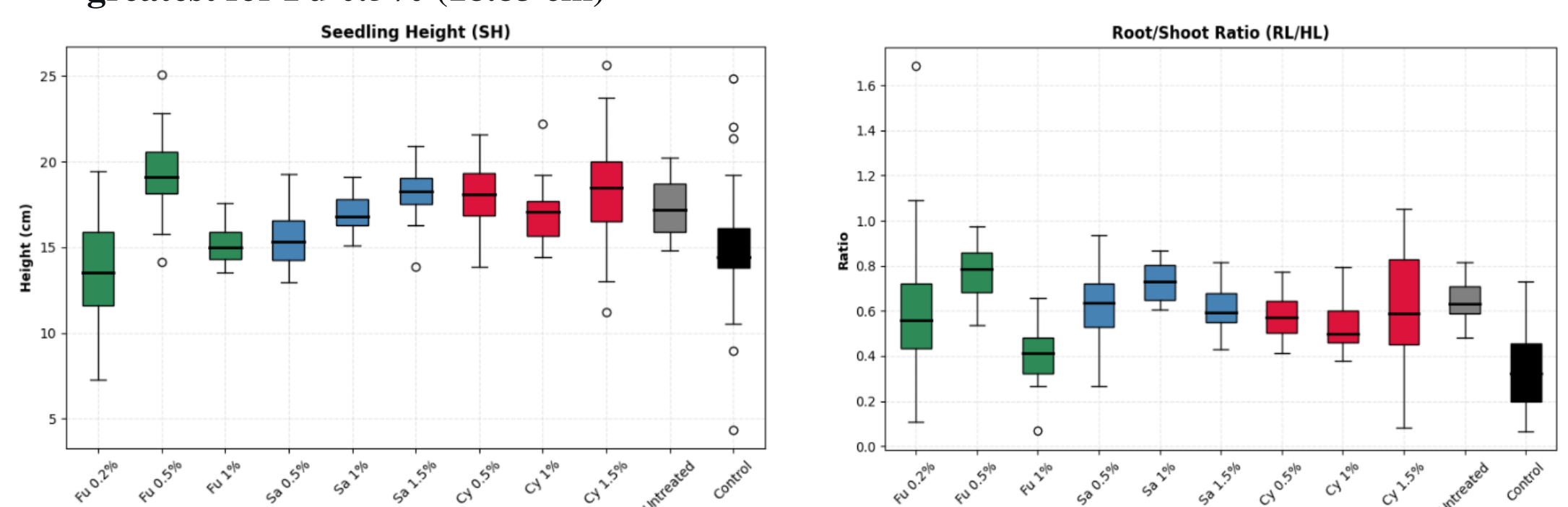
***Fucus* sp. extract at 0.5% was optimal, increasing the Seedling Vigor Index by ~40% versus the untreated control. The effect was species- and dose-dependent, while *Fucus* was most effective at 0.5%, *Sargassum* sp. showed a moderate effect at higher concentrations (1-1.5%). However *Cystoseira* sp. extract did not improve SVI and showed slight inhibition at 1.5%**



Final germination rates (71-81%) were minimally affected across treatments. However, Cystoseira (Cy) extract at 1.5% significantly delayed germination, indicated by increased MGT and decreased GI. This retardation suggests the presence of phytotoxic compounds or ABA-like effects. Fucus (Fu) and Sargassum (Sa) extracts did not alter germination speed.



Hypocotyl growth showed a limited response (9.44–11.0 cm). *Cystoseira* at 1% produced the longest hypocotyls (11.0 cm), indicating a shoot-specific effect. In contrast, radicle growth was more variable and strongly treatment-dependent. *Fucus* at 0.5% yielded the longest radicles (7.77 cm) significantly higher than the control (3.59 cm), highlighting a targeted root stimulation. Consequently, total seedling length was greatest for Fu 0.5% (18.83 cm)



Each algal species exhibited a distinct optimal concentration. *F. spiralis* at 0.5% was ideal for overall growth. *S. trichocarpum* showed a moderate effect, best at 1.5%.

C. tamarsicifolia favored hypocotyl over radicle growth, reducing its root-to-shoot benefit. The most effective algal extracts, particularly *Fucus* at 0.5%, outperformed both control groups, demonstrating strong biostimulant potential.

CONCLUSION & FUTURE WORK

This study demonstrates the strong biostimulant potential of brown seaweed extracts, notably *Fucus spiralis*, for enhancing tomato seedling vigor and root architecture in a species- and dose-dependent manner, supporting their use in sustainable agriculture.

To advance toward practical application, future work should focus on elucidating the molecular mechanisms, testing efficacy under abiotic stress, and chemically characterizing the active extracts to ensure consistency and enable product development.

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