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Exploring frass deriving from *Hermetia illucens* as a new sustainable tool for inducing biostimulant and antifungal activities in wheat and tomato against *Fusarium* spp.

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INTRODUCTION & AIM

Hermetia illucens (Diptera: Stratiomyidae), named black soldier fly (BSF) is commonly used to bioconvert organic wastes into larval biomass fostering the circularity of the agri-food sector. The residual material of the bioconversion process by BSF larvae, composed of uneaten feedstock, larval exuviae and excrements, is known as frass. It is rich of macro- and micro-nutrients and, for this reason, it can be considered useful as a sustainable alternative to chemical fertilizers. In addition, frass, similarly to compost and vermicompost, can have suppressive effects against some phytopathogenic fungi.

The aim of the current study was to assess frass derived from *H. illucens* larvae reared on Gainesville diet under standard conditions for its biostimulant and antifungal properties through *in vitro* and *in vivo* studies.

METHOD

Bioconversion by *H. illucens*

Frass recovery and heat treatment to comply EU regulations

70° C
1 h

Nutrient rich material with suppressive properties

Ten grams of frass were added to 100 mL of sterile physiological saline solution (0.5% NaCl) under agitation for 1 h at 27°C; frass aqueous extract (FAE) was obtained by ultracentrifugation followed by filtration with sterile gauze.

A possible phytotoxicity was tested on garden cress (*Lepidium sativum L.*) using FAE as such (100%), and diluted at 50%, 25%, 12% and 6%.

Dual culture overlay test was performed in order to assess the antifungal effect of frass extract against *Fusarium* spp., in presence or not of the biological control agent *Trichoderma harzianum* T22 (T22).

FAE biostimulant effect was assessed on tomato and wheat plants with a germination assay and microscopic examination of the roots.

RESULTS & DISCUSSION

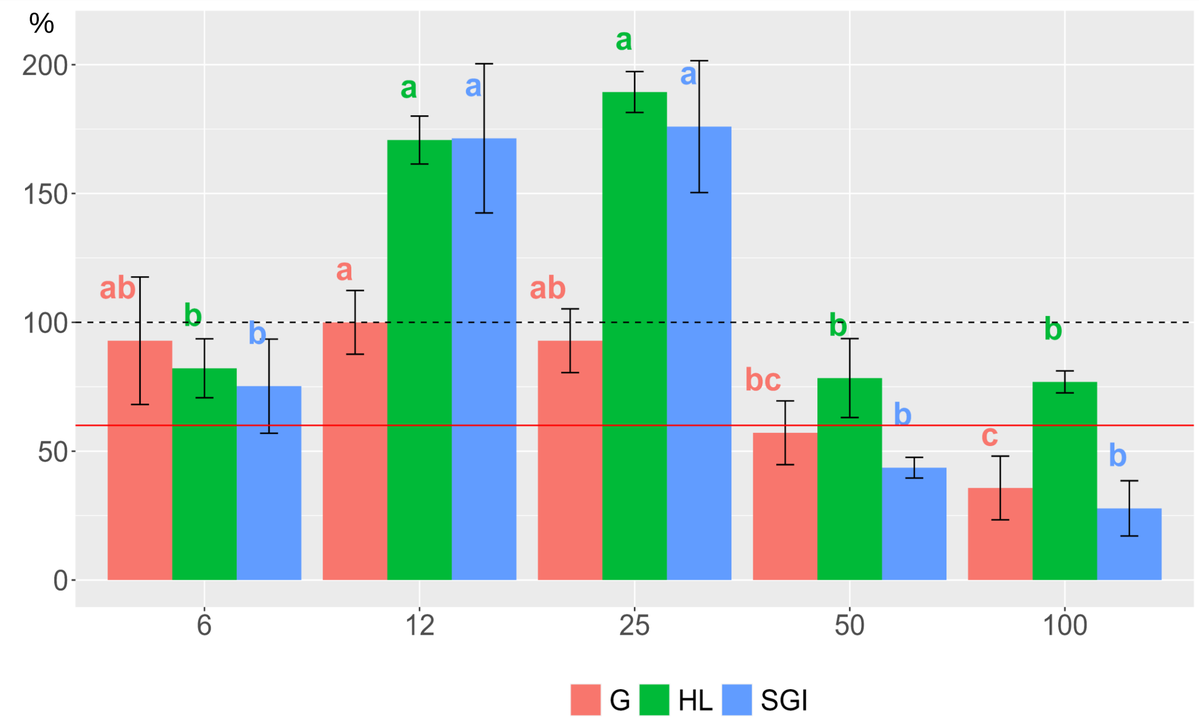


Figure 1. Phytotoxicity test on *Lepidium sativum* L. seeds. Mean values of germinated seeds (G), hypocotyl length (HL) and seed germination index (SGI) are expressed as percentages relative to the control. Bars represent SD. Different letters indicate significant differences according to One-Way ANOVA followed by Tukey post hoc test ($p < 0.05$). The black dashed line represents value of control (H_2O), while the red one represents the phytotoxicity treshold according to Zucconi *et al*., 1981.

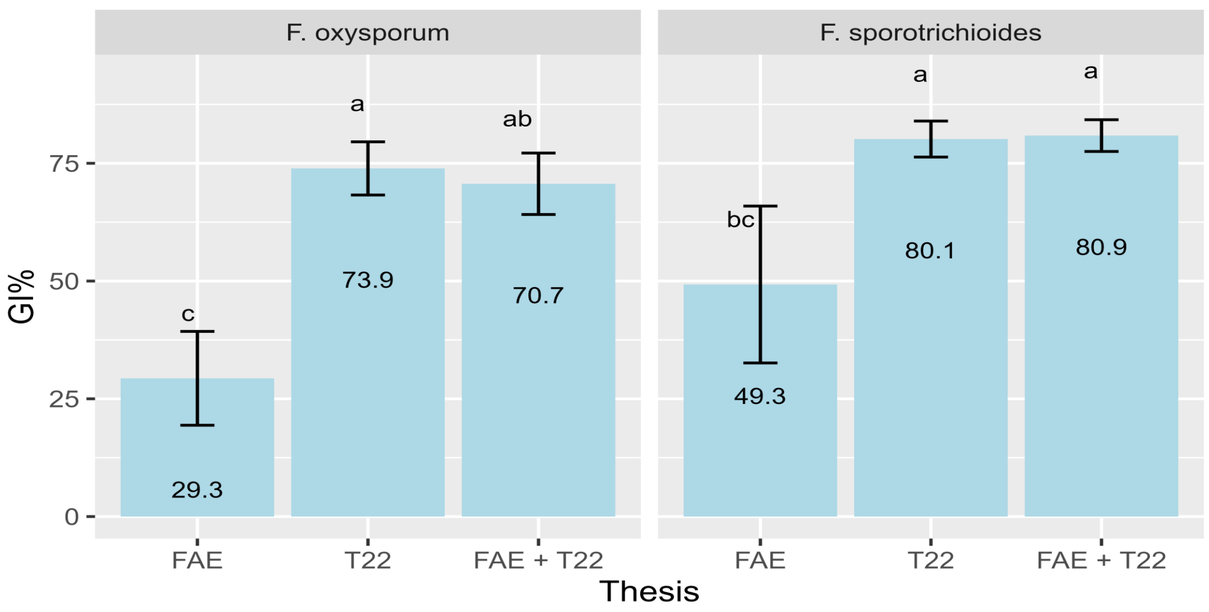


Figure 2. Mycelial growth inhibition (GI%) induced by FAE and *T. harzianum T22* (T22) against *F. oxysporum* and *F. sporotrichioides*. Different letters indicate significant differences according to Two-Way ANOVA followed by Tukey post hoc test ($p < 0.05$).

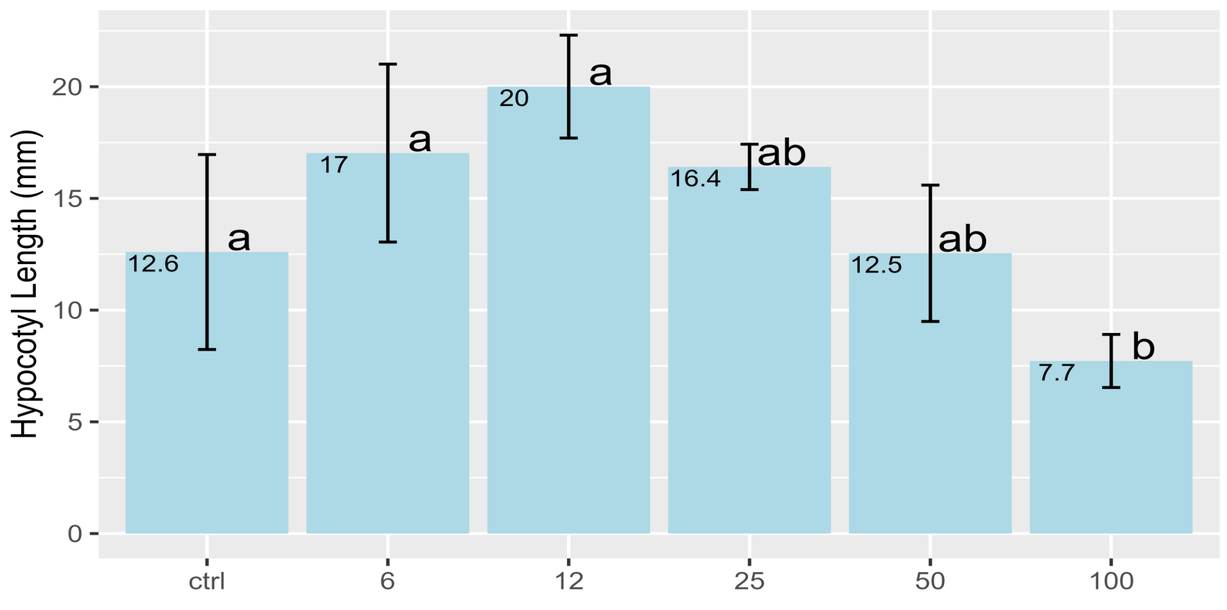
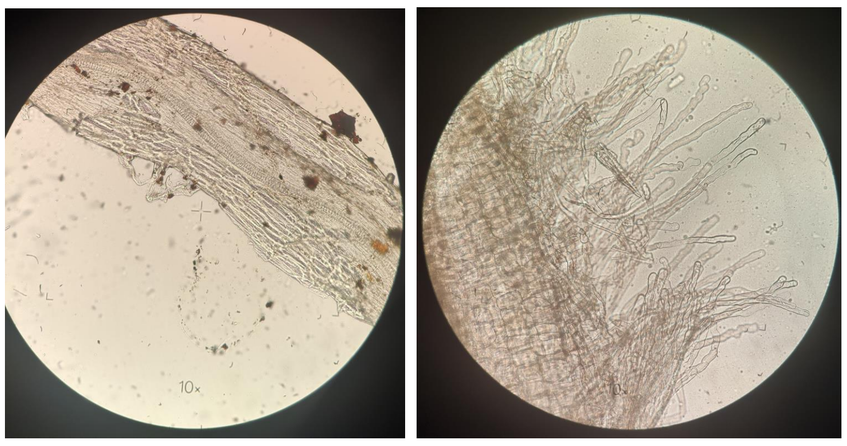


Figure 3. Hypocotyl length of tomato plants exposed to different FAE dilutions (6%, 12%, 25%, 50% and 100%). Distilled water represents the control (ctrl). Different letters indicate significant differences according to One-Way ANOVA followed by Tukey post-hoc test ($p < 0.05$).



CONTROL FAE

Figure 4. Representative images showing microscopic root hair density in tomato plants exposed to FAE.

CONCLUSION

Our results open the door for further studies on frass implementation as a green, circular economy-based and sustainable tool to be used in agriculture systems for high-quality productions.

REFERENCES

Arabzadeh *et al.*, 2022, Agronomy, 12, 1765; Zucconi *et al*., 1981, Biocycle, 22, 27-29; Commission Regulation (EU) 2021/1925 https://eur-lex.europa.eu/legal-content/EN/TXT/?toc=OJ%3AL%3A2021%3A393%3AFULL&uri=uriserv%3AOJ.L_.2021.393.01.0004.01.ENG

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