ECP 2025 Conference
The 4th International Electronic Conference on Processes
20–22 October 2025 | Online
MDPI
ipb INSTITUTO POLITÉCNICO DE BRAGANÇA
iniav Instituto Nacional de Investigação Agrária e Veterinária, I.P.

Impact of Selenium Seed Priming on Emergence Rate, Selenium Accumulation, and Phytochemical Profile of Pea Microgreens

Centro de Investigação de Montanha CIMO
SUS TEC Associate Laboratory for Sustainability and Technology in Mountain Regions

Matilde Rodrigues[1], Cátia Magalhães[1,2], José Pinela[1,3*]

[1]CIMO, LA SusTEC, Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
[2] School of Agriculture, Polytechnique Institute of Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
[3] National Institute for Agricultural and Veterinary Research, I.P. (INIAV, I.P.), Rua dos Lágidos, Lugar da Madalena, 4485-655 Vairão, Vila do Conde, Portugal

*jose.pinela@iniav.pt

INTRODUCTION

Selenium (Se) is an essential micronutrient for human health, playing a crucial role in antioxidant defense and immune regulation as a key component of enzymes and proteins [1]. Although not essential for plants, small amounts of Se can benefit some species by improving their tolerance to environmental stresses [2]. Plants cultivated in Se-deficient soils naturally exhibited low Se levels, a concern expected to intensify with climate change. By the end of the century, 66% of croplands—including significant areas in Europe—are expected to face Se depletion [3], potentially exacerbating dietary deficiencies that already affect up to 1 billion people worldwide [3]. To counteract this, the use of Se-containing fertilizers has been proposed as a possible solution. This study explored the biofortification of pea (*Pisum sativum* L.) microgreens through Se seed priming, a cost-effective and environmentally friendly technique that enhances germination uniformity and seedling vigor.

METHODS

Seeds underwent nutripriming with sodium selenate (25–100 µM Se) for 6 and 12 h, with hydroprimed (HP) and unprimed (NP) seeds serving as controls. After treatment, one batch of seeds was analyzed for electrolyte leakage, while another was sown to evaluate germination dynamics and biomass accumulation (Fig. 1). Upon harvest 25 days after sowing, the Se content was quantified using atomic absorption spectroscopy, alongside analyses of chlorophylls, soluble sugars, organic acids, total phenolics, and antioxidant activity, performed using different methodologies [4-5].

Fig. 1 Illustration of pea microgreen production and the process of extract preparation for the quantification of total phenolics and evaluation of *in vitro* antioxidant activity.

REFERENCES

[1] M. P. Rayman, *The Lancet*, 379(9822), 2012, 1256-1268.
[2] R. Feng, C. Wei, S. Tu. *Environmental and Experimental Botany*, 87, 2013, 58-68.
[3] G.D. Jones, B. Droz, P. Greve, et al., *PNAS*, 114(11), 2022, 2848-2853.
[4] M. Añibarro-Ortega, V. López, S. Núñez, et al., *Industrial Crops and Products*, 214, 2024, 118546.
[5] M. Añibarro-Ortega, J. Pinela, A. Ćirić, et al., *Food and Bioproducts Processing*, 124, 2020, 307-319.

ACKNOWLEDGEMENTS

The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support through national funds FCT/MCTES (PIDDAC): CIMO, UIDB/00690/2020 (DOI: 10.54499/UIDB/00690/2020) and UIDP/00690/2020 (DOI: 10.54499/UIDP/00690/2020); and SusTEC, LA/P/0007/2020 (DOI: 10.54499/LA/P/0007/2020). National funding by FCT through the individual research grant (2024.04986.BD) of M. Rodrigues.

RESULTS

Results showed that Se nutripriming improved membrane integrity by reducing the electrolyte leakage in pea seeds (Fig. 2). The treatment influenced the emergence and growth of microgreens. The 6-h priming treatment led to superior agronomic performance and biomass accumulation compared to the 12-h treatment, though unprimed seeds exhibited the highest emergence rate (Fig. 3) and biomass production. Nevertheless, nutripriming increased Se contents in microgreens (Fig. 3).

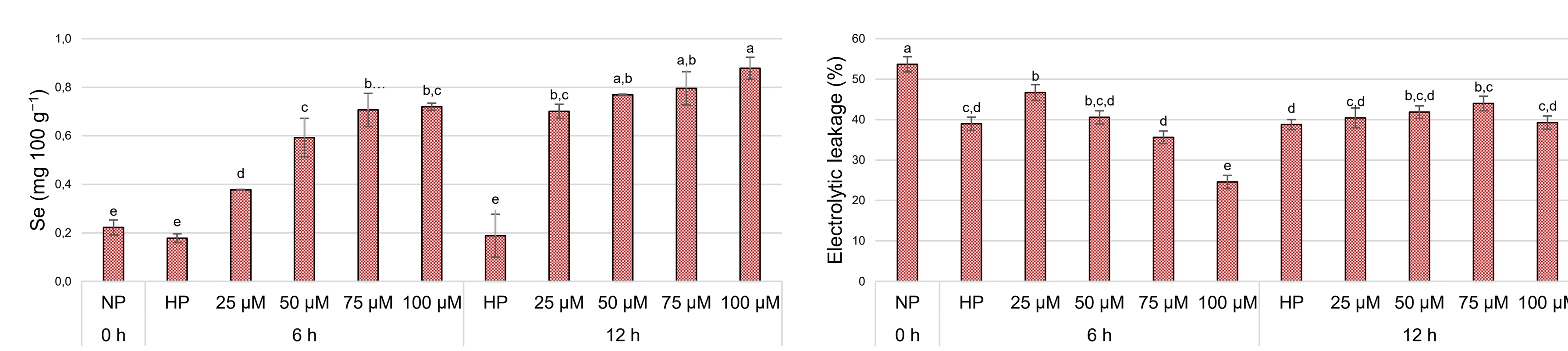

Fig. 2 Effect of Se nutripriming and hydropriming (HP) for 6 and 12 h, as well as no priming (NP), on Se contents in pea seeds and electrolyte leakage. In each graph, different letters indicate significant differences ($p < 0.05$) between treatments.

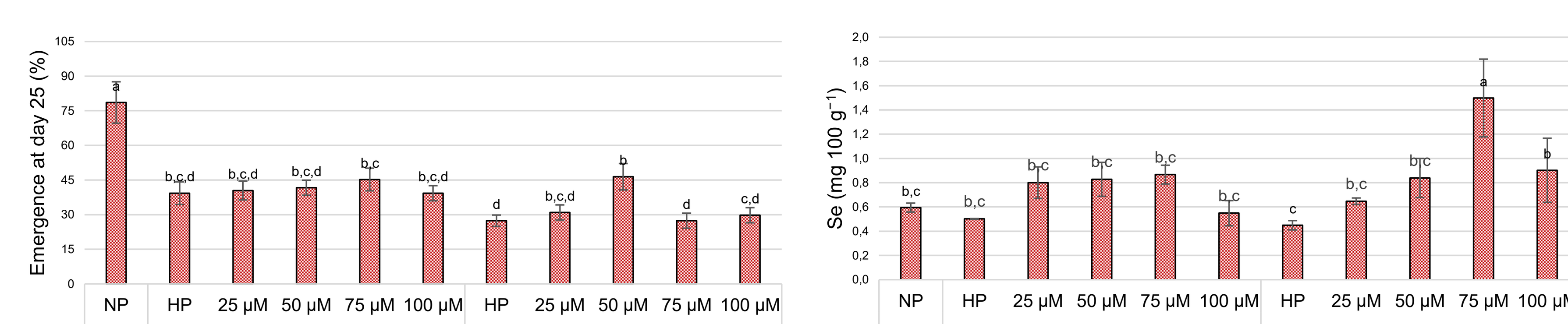

Fig. 3 Effect of Se nutripriming and hydropriming (HP) for 6 and 12 h, as well as no priming (NP), on the emergence rate and Se contents. In each graph, different letters indicate significant differences ($p < 0.05$) between treatments.

A linear discriminant analysis was conducted to evaluate the overall effects of the applied priming treatments on pea microgreens, considering biomass yield, chemical composition, and antioxidant activity. As shown in Fig. 4, the 12-h treatment exhibited a clear separation of markers, whereas those of the 6-h priming were more dispersed. Both HP treatments clustered closely and in proximity to the NP control. Variables with discriminant power included sucrose, oxalic, malic, ascorbic, and succinic acids, Ca, K, chlorophylls, biomass yield, and total phenolics.

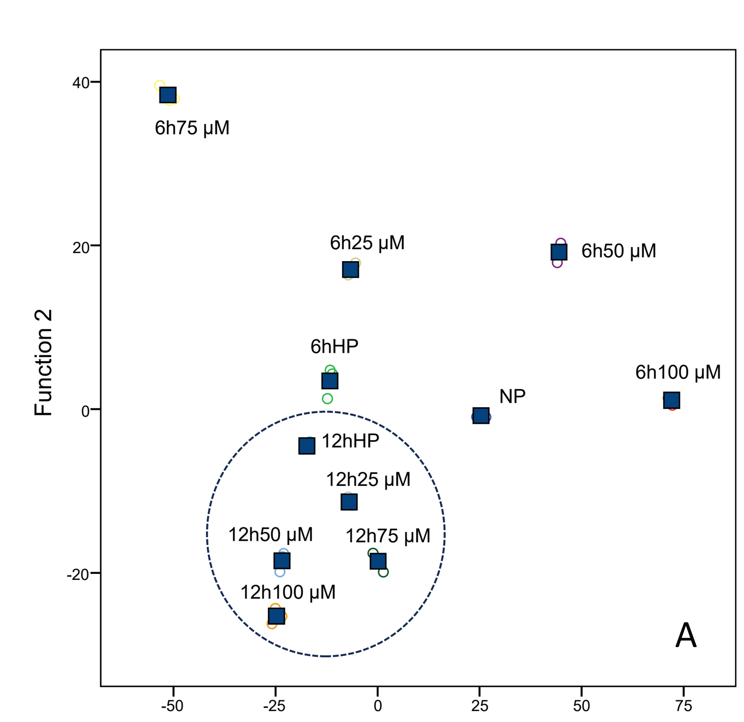

Fig. 4. Spatial distribution of markers for each treatment based on the canonical discriminant function coefficients, considering biomass yield, chemical composition, and antioxidant activity of pea microgreens.

CONCLUSION

These findings underscore the need to optimize priming protocols to enhance both seedling emergence and Se uptake, offering a sustainable strategy for developing Se-biofortified food crops to address global nutritional deficiencies in the context of climate change.