Plant Biostimulants from urban waste and crop by-product and their nutrients use efficiency

Segatelli, A. B. M.[1,2], Figueiredo, D.[3], Telmo Machado[4],Figueiredo, T.[1,2], Hernández, Z.[1,2*]

[1] Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança (IPB), Bragança, Portugal
[2] Laboratório Associado para a Sustentabilidade e Tecnologia em Regiões de Montanha (SusTEC), IPB, Portugal, *zulimar@ipb.pt
[3] MORE-Laboratorio Colaborativo, Edifício Brigantia Ecopark, Bragança, Portugal
[4]LIPOR - Associação de Municípios para Gestão Sustentável de Resíduos do Grande Porto, Rua da Morena, 805, 4435-746, Baguim do Monte, Portugal

Introduction

Plant biostimulants can be microbial or non-microbial, and their function is to improve crops nutrients use efficiency.

Objective

The aim was to evaluate the nutrients use efficiency of two **non-microbial biostimulants** from urban waste and olive mill by-product, in a vegetable (lettuce, *Lactuca sativa) and in an* aromatic (thyme, *Thymus vulgaris* L.) plant.

Material and Methods

The experiment was conducted in a **hydroponic chamber** (Fig.1), with 45 plants (23 thyme and 22 lettuce). The seeds were hydrated and transferred to the chamber after approximately 10 days, with the emergence of the first "true" leaf (Fig. 2 and 3). Three treatments were tested:

C: without biostimulant, utilizing a commercial nutrient solution (NS);

G1: combining NS + aerated biostimulant from agro-industrial residues (olive mill by-product);

B1: combining NS + aerated biostimulant from urban food waste.

In both G1 and B1 treatments, the biostimulants were diluted to a concentration of 5%. During each experiment (22 days), temperature, humidity and luminosity of the chamber were monitored, as well as pH, CE, temperature and NS consumption. At the end of the experiment, root length (RL), leaf and root dry weight (DWL; DWR), leaf and root fresh weight (FWL; FWR) and number of leaves (NL) were measured.

Figure 1- Hydroponic chamber consisting of 3 levels, light control, temperature and humidity monitoring, capacity for 45 plants and tank/pump.

Figure 2- First "True" leaf of lettuce.

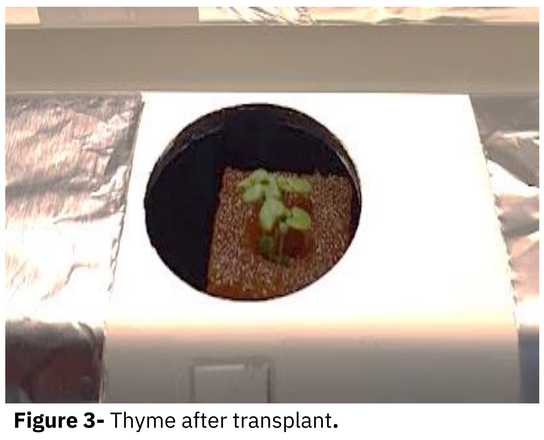


Figure 3- Thyme after transplant.

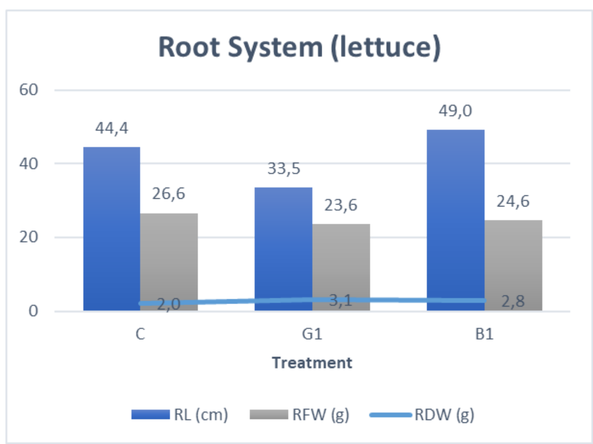
Results

As main results, biostimulants presence resulted in an inhibitory effect on lettuce, particularly in NL and FWL.

Table 1- Growth parameters in lettuce in hydroponics subjected to different treatments: with and without biostimulant.

Lettuce	RL (cm)	NL (average)	LFW (g)	LDW (g)	RFW (g)	RDW (g)
C	44,4 b	17,8 c	126,6 b	6,5 a	26,6 a	2,0 a
G1	33,5 a	15,6 b	86,2 a	6,8 a	23,6 a	3,1 b
B1	49,1 b	14,0 a	84,9 a	6,5 a	24,6 a	2,8 ab

Statistically significant differences represented by different letters (pvalue<0,05).
RL=Root length, DWL= leaf and DWR= root dry weight, FWL= leaf and FWR= root fresh weight and NL=number of leaves.



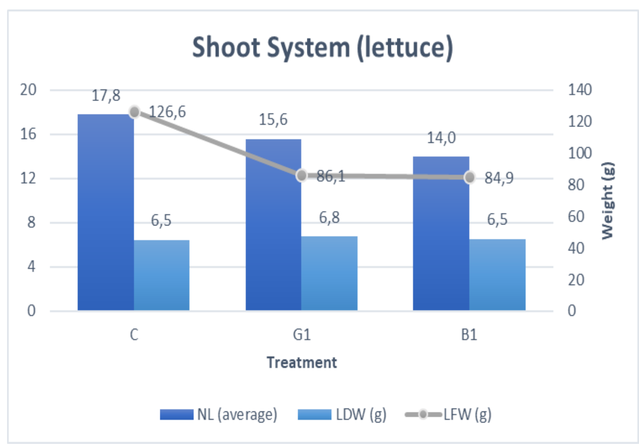


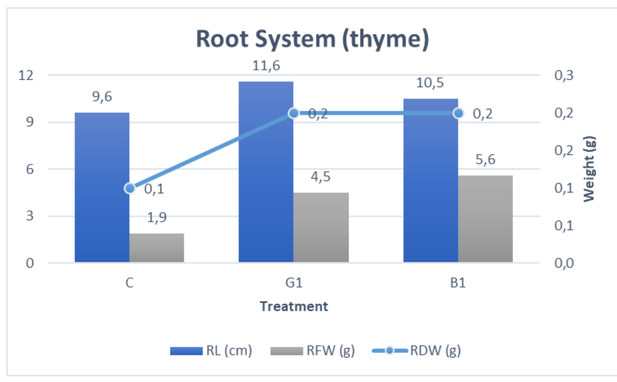
Figure 4- Lettuce root and shoot system.

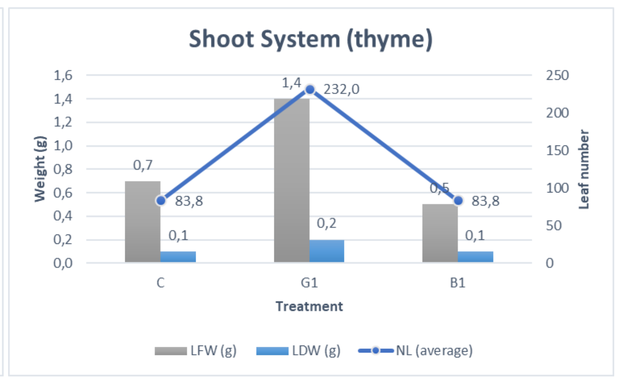
In contrast, biostimulants used in thyme, mainly G1, showed highest values of NL (~65% higher than C), FWL and DWL, and no significant differences between B1 in DWR.

Table 2- Growth parameters in thyme subjected to different treatments: with and without biostimulant.

Thyme	RL (cm)	NL (average)	LFW (g)	LDW (g)	RFW (g)	RDW (g)
C	9,6 a	83,8 a	0,7 a	0,1 a	1,9 a	0,1 a
G1	11,6 a	232,0 b	1,4 b	0,2 b	4,5 b	0,2 b
B1	10,5 a	83,8 a	0,5 a	0,1 a	5,6 c	0,2 b

Statistically significant differences represented by different letters (pvalue<0,05).
RL=Root length, DWL= leaf and DWR= root dry weight, FWL= leaf and FWR= root fresh weight and NL=number of leaves.





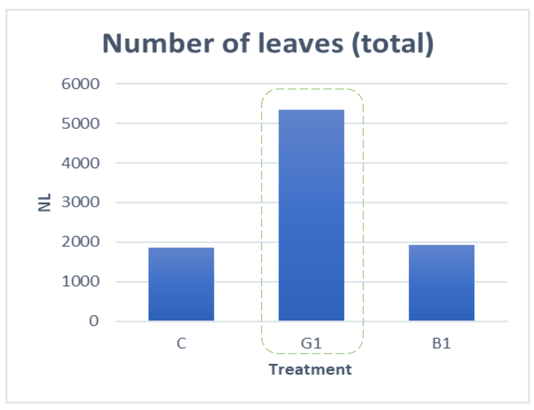


Figure 5- Thyme root and shoot system and total number of leaves.

Figure 6- Thyme: A) G1 treatment; B) C treatment.

Conclusion

In conclusion, biostimulants from urban waste and olive mill by-product are promising for advancing sustainable agricultural practices and contributing to circular economy. However, a deeper understanding of their mechanism of action is essential for development and market.

Acknowledgments - The research and divulgation has been supported by BIOMA Project (POCI-01-0247-FEDER-046112) and REACT UE project FORESTWATERUP (POCI-07-62G4-FEDER-181557). The authors thank LIPOR for producing the compost teas.