5.55 Application of Microbial Consortia as biostimulants for sustainable Lettuce and Rocket cultivation

Giulia Vitiello* [1], Mariolina Gullì [1,2], Elena Maestri [1,2], Nelson Marmiroli [2]

[1] Department of Chemistry, Life Sciences and Environmental Sustainability, University of Parma, Parco Area delle Scienze, 43124 Parma , Italy

[2] Interuniversity National Consortium for Environmental Sciences (CINSA), Parco Area delle Scienze, 43124 Parma, Italy

* Corresponding author: giulia.vitiello@unipr.it

BACKGROUND

Microbial biostimulants are a promising ecological innovation that can complement traditional agricultural approaches. Plant Growth Promoting Microorganism (PGPM) can induce molecular, biochemical, physiological and morpho-anatomical responses in plants influencing crop productivity and protecting from diseases and abiotic stress. Moreover, biochar can be used, as well as a soil improver, as a favorable substrate to microbial proliferation. Baby leaf vegetables represent a good source of minerals, vitamins and phytochemicals of considerable antioxidant potential. This research is carried out within the project 'Shelf-life, quality and safety of high-convenience fruit and vegetables' (POFACS).

MATERIALS AND METHODS

Rocket seeds (*Eruca sativa* Mill.) were germinated in normal condition (Ctr), with a microbial consortium (MC) (*Azotobacter vinelandii, Alcaligenes faecalis, Paracoccus denitrificans, Pseudomonas fluorescens, Azospirillum brasilense*, and *Trichoderma harzianum*) or functionalized using methycellulose (MTC). After a germination test, plants continued their growth in greenhouse.

Rocket (9 plants/ treatment)		
Ctr	MC	MTC

Lettuce plants (*Lactuca sativa* L.) grown in greenhouse were treated with two microbial consortia, MC_C and MC_B[1] applied in the lyophilized form, alone and in combination with mycorrhizae (AMF-MA, MycAgro, France) and biochar (Char), for a total of 12 conditions.

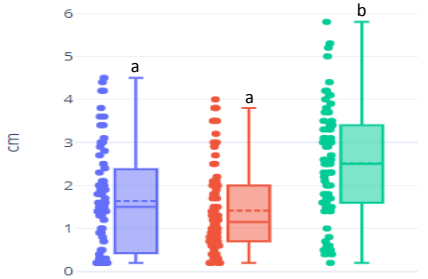
Lettuce (6 plants/ treatment)		
Ctr	MC_B	MC_C
AMF	MC_B + AMF	MC_C + AMF
Char	MC_B + Char	MC_C + Char
Char + AMF	MC_B + AMF + Char	MC_C + AMF + Char

Measurements and Analysis

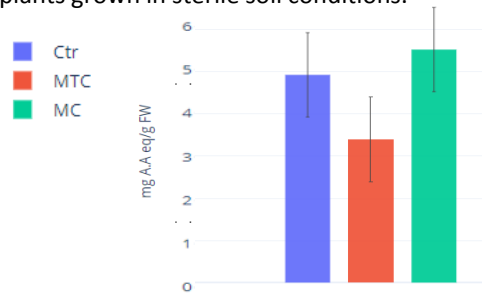
Photosynthetic activity (SPAD)
Leaf transpiration rate (AP4 Porometer)
Thermal imaging
Leaf and root biomass
Leaf and root lengths
Water content
Polyphenolic compounds content [2] (Rocket)
Carotenoids and chlorophylls content [3] (Rocket)
Antioxidant potential (DPPH assay) [2] (Rocket)

RESULTS

Rocket seeds showed a significant improvement in root length after germination test (200 seeds/condition) in MC as compared to Ctr (p= 3.574e-4) or MTC (p= 7.052e-6). Leaf extracts obtained from the MC treated plants showed a higher content of phenols and antioxidant compounds. These evidences are significant if compared to the values obtained from untreated plants grown in sterile soil conditions.



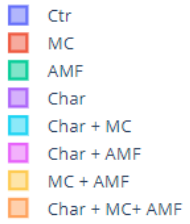
Root length germination Rocket

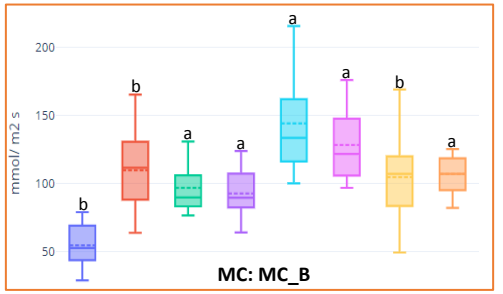


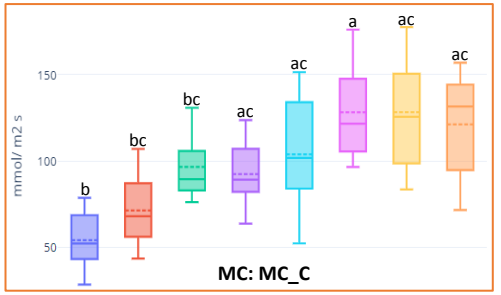
Antioxidant potential

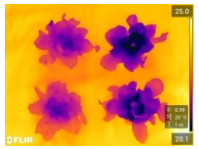
Control **Lettuce** leaf transpiration rate is significantly lower than all treatments except for both MCs and the MC_B + AMF (as shown below). The photosynthetic activity is significantly higher in MC_B than in the conditions with Char + MCs. Last, AMF treatment is associated with a significant increase in leaf biomass (17.5 ± 1.2 g) than in all other treatments (Ctr 13.1 ± 3.0 g) unless both MCs, Char + MC_B and the combinations MCs + AMF.

Leaf transpiration rate









Ctr Char +AMF

Ctr MC_C +AMF

From thermal imaging the leaves temperatures of Lettuce control are higher than those of the treatments. By way of example, the images of the comparisons Ctr vs Char + AMF and Ctr vs MC_C + AMF are shown.

SUMMARY AND PERSPECTIVES

Growth stimulation in the early stages of rocket development by MC treatment is clearly shown. In lettuce, treatments and their combinations affect the physiology of the plant, while AMF improves epigeal production. These last results will have to be interpreted considering the further analyses in progress on the metabolites content of leaf extracts and the evaluation of the fungal colonization of the roots.

REFERENCES [1] Tabacchioni et al. *Microorganism.* 2021; 9(2),426; [2] Ismail et al.. *Food Chemistry.* 2004; 87(4),581-586; [3] Lichtenthaler et al.. *Biochemical Society Transactions.* 1983; 11, 591-603.