EFFECT OF MICROBIAL BIOSTIMULANTS AND ORGANIC FERTIGATION ON NURSERY PRODUCTION OF ORGANIC LETTUCE TRANSPLANTS

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Introduction

Organic transplant must be produced by organic nurseries that use only seeds, substrates and fertilizers that have been authorized for use in organic production in accordance with the EU rules. The selection of substrate and fertilization strategy is a big challenge for organic transplant production. The supplementation of diluted organic liquid fertilizers directly at the root level (fertigation) can be a good system for supplying required nutrients as it increases nutrient uptake and reduces water and nutrient loss and allows growers to fulfill specific nutritional necessities. Organic seedling production could also take advantage of inoculating the substrate with biofertilizer microorganisms or plant growth-promoting microorganisms also known as microbial biostimulants

AIM OF THE STUDY

Test the efficacy of microbial biostimulants inoculated in the growing media to enhance the growth and quality of lettuce seedlings fertigated with increasing rates of an organic liquid fertilizer.

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Material and Methods

The nursery trial was carried out in a greenhouse situated at the Department of Agricultural, Food, and Forest Sciences (SAAF-University of Palermo, Italy) (38° 06′ 28″ N 13° 21′ 3″ E; altitude 49 m) during spring 2021.

Seeds of 'Romana bionda degli ortolani' lettuce (Vilmorin, La Ménitré, France) were sown into 36 polystyrene trays with 160 cells.

- (C) Twelve trays were filled with a commercial organic substrate (Compo Bio Terriccio per Orto e Semina, COMPO Italia Srl, Cesano Maderno, Italy)
- (M) Twelve trays were filled with the same substrate inoculated with 0.75 g L^{-1} of Flortis Micorrize (Orvital, Settimo Milanese, Italy)
- (B) Twelve trays were filled with the commercial substrate inoculated with 1.5 g L^{-1} of TNC Bactorr^{S13} (The Nutrient Company, Rochdale, UK)

Microbial biostimulants

Flortis Micorrize contains 30% of *Glomus* spp., 1.24 × 10^8 CFU g^{-1} of *Agrobacterium radiobacter*, *Bacillus subtilis*, *Streptomyces* spp. and 3 × 10^5 CFU g^{-1} of *Thricoderma* spp.

TNC Bactorr^{S13} contains plant growth-promoting bacteria (1.3 × 10^8 CFU g^{-1} of *Bacillus spp.*) as well as compounds derived from *Ascophylum nodosum*.

Two fertigation treatments were performed after 10 (plantlets with fully expanded cotyledons and the first true leaf visible) and 20 days (plantlets with three true leaves visible) from emergence by sub-fertigating the trays with four doses (0, 7, 14 and 28 ml L^{-1}) of an organic liquid fertilizer (OLF) (Organic liquid vegetable plant food, Grandiol, ASB Grünland Helmut Aurenz GmbH, Stuttgart, Germany) (NK 3-4) obtained from beet marc, contains 2.7% of organic nitrogen and 0.3% of inorganic nitrogen, 18.9% of organic C, 0.3% MgO, 0.9% Na and 0.4% S, and it is suitable for organic farming according to EC regulations.

When lettuce seedlings had a suitable size for transplanting (33 days after sowing), four replicated samples of 25 transplants randomly selected from each treatment were destructively analyzed.

The experimental design consisted of three replicates for each combination of microbial biostimulants and organic fertigation rates, randomly assigned in three blocks. The effect of microbial biostimulants and organic fertigation rates on lettuce seedlings (25 seedlings for each replicate) was evaluated by performing a two-way ANOVA. The least significant differences (LSD) test at $p \leq 5\%$ was applied to compare the mean values and to detect the significant differences among treatments and the significant interactions between factors.

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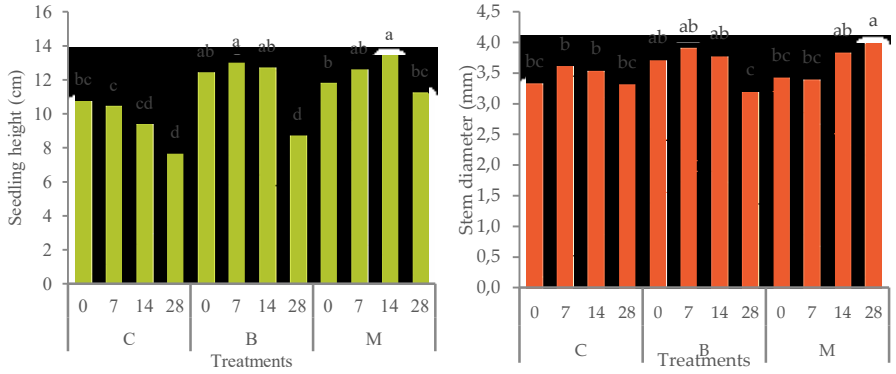
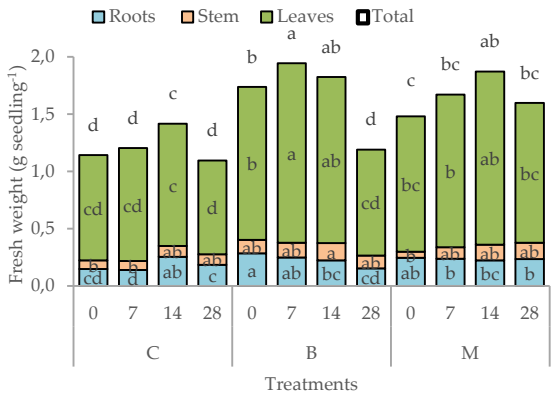
Seedling height and Stem diameter

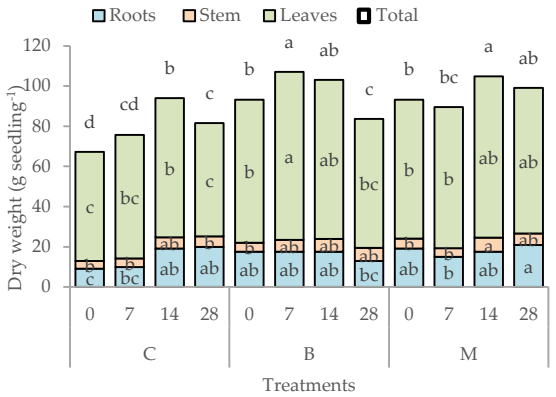


Unfertigated control seedlings (10.7 cm) were slightly shorter than those treated with microbial biostimulants. The height of control seedling decreased when increasing liquid organic fertilizer concentration down to 7.6 cm. B-treated seedling height was not significantly affected up to 14 ml L^{-1} and dropped down to 8.7 cm with 28 ml L^{-1} of organic liquid fertilizer (OLF).

M-treated seedlings increased their height when increasing organic fertigation rate up to 14 L^{-1} and maintained a significantly higher height with 28 ml L^{-1} OLF compared to the other treatments. Stem diameter recorded small variation in control seedlings (3.4 mm on average) and was higher than 3.7 mm in the seedlings inoculated with B and fertigated with 0, 7 or 14 ml L^{-1} OLF and with M and fertigated with 14 and 28 ml L^{-1} OLF

Fresh and dry biomass

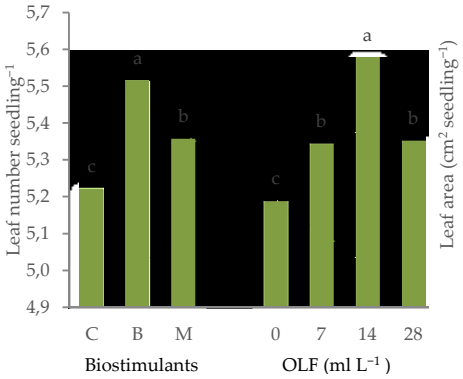


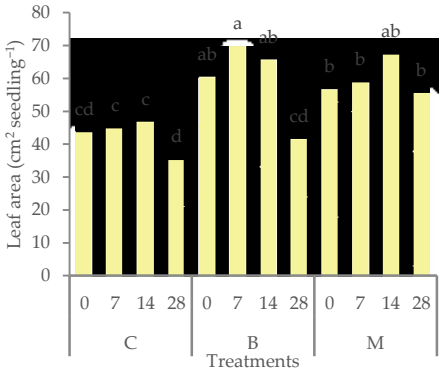


The seedlings fresh weight (FW) was influenced by the interaction between the microbial biostimulants and the organic fertigation rates showing a significant quadratic trend in the seedling inoculated with microbial biostimulants. The total fresh biomass of control seedlings increased significantly only supplementing 14 ml L^{-1} OLF. B-treated and M-treated seedlings had a significantly higher total fresh weight than control at every fertigation level except when B seedlings were fertigated with 28 ml L^{-1} OLF.

The total dry biomass (DW) of control seedling ranged from 67.3 to 93.9 mg DW for 0 and 14 ml L^{-1} OLF, respectively. The inoculation with the microbial biostimulants significantly increased the dry weight of the non-fertigated seedlings (93.2 mg DW on average). B-treated seedlings had the highest dry biomass accumulation when fertigated with 7 ml L^{-1} OLF (107.0 mg DW). M-treated seedlings showed the highest biomass accumulation with 14 ml L^{-1} OLF (104.8 mg DW).

Leaf number and leaf area

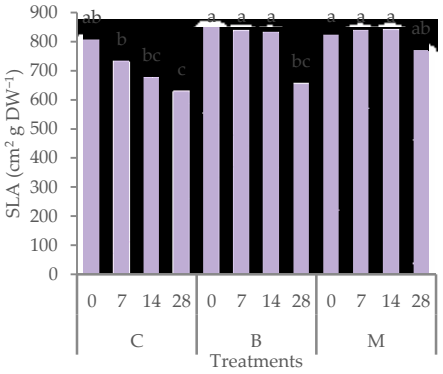




The highest leaf number of the lettuce seedlings was recorded in those inoculated with B. The seedling leafiness significantly increased when increasing OLF from 0 ml L^{-1} OLF up to 14 ml L^{-1} OLF and then decreased with 28 ml L^{-1} OLF.

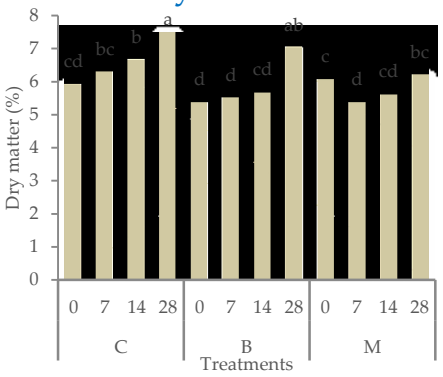
Control seedling total leaf area slightly increased by increasing OLF up to 14 ml L^{-1} but significantly reduced their leaf area with the highest OLF concentration compared to 7 and 14 ml L^{-1} OLF. The inoculation of the substrate was effective in improving the total leaf area of the seedlings grown without fertigation or even when increasing the fertigation rate up to 14 ml L^{-1} OLF for B and up to 28 ml L^{-1} OLF for M.

Specific leaf area



The effect of organic liquid fertilizer concentration on SLA followed a negative trend in control seedlings lowering from 829.9 to 626.2 cm^2 g DW^{-1}. This negative effect was not recorded in the seedling inoculated with M and was found in those inoculated with B only when fertigating with 28 ml L^{-1} OLF.

Dry matter



The dry matter percentage of the untreated seedlings increased linearly when increasing OLF concentration from 5.9% (0 ml L^{-1}) to 7.5% (28 ml L^{-1}). The seedlings treated with microbial biostimulants maintained lower values of dry matter percentages even when increasing OLF rate except when B seedlings were fertigated with 28 ml L^{-1} OLF.

Conclusions

- The results showed that the organic liquid fertilizer levels supplied to lettuce seedlings can influence their growth and vigor.
- Organic fertigation, especially with 14 ml L^{-1} of OFL, improved WUE, dry matter percentage and biomass accumulation of the control seedlings, but negatively affected their height with the highest fertigation rate.
- The use of the microbial biostimulants modified seedling growth and its response to organic liquid fertilizer levels.
- Microbial biostimulants had a growth-promoting effect on the unfertilized seedlings and modified the response of lettuce seedlings to organic fertigation but to different extents for TNC Bactorr[S13] and Flortis Micorizze.

Water Use Efficiency

The water use efficiency of the unfertigated seedlings was 2.4 g DW L^{-1} H_2O in the untreated seedlings and was significantly higher in the seedlings inoculated with M. The highest WUE was recorded in control seedlings fertigated with 14 ml L^{-1} OLF. Compared to control, B seedlings increased WUE with 7 ml L^{-1} OLF and had a lower WUE with 28 ml L^{-1} OLF.

Nitrogen Use Efficiency

The nitrogen use efficiency was significantly increased by the microbial biostimulant only when the seedlings were not fertigated.

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