The Alleviation of Water Deficit via Biostimulant Application in Greenhouse Grown Lettuce Plants - Abstract

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Summary

Water shortage is considered one of the most important limiting factors for cropping under arid and semi-arid conditions. This problem is expected to worsen in the following years within the scenario of the ongoing climate crisis as the result of the uneven distribution of rainfalls throughout the year and the increasing periods of drought. Vegetable production is among the most critical sectors of the primary production and water availability is essential for high yields and high quality of produce. Therefore, water management through modern agronomic practices is pivotal to ensure high yields and food security. The aim of the present study was to evaluate the effect of deficit irrigation and biostimulant application on lettuce plants grown directly in soil under protected environment. Two cultivars were selected (one Romaine and one Batavia type), while young seedlings were transplanted directly in soil 7 weeks after sowing in seed trays. Three irrigation treatments were applied based on the water field capacity (FC) of soil, namely Control (100% FC), I1 (66% FC) and I2 (46 of field capacity). Moreover, six biostimulant treatments were applied, namely Control (no biostimulants added), AG109 (seaweed and plant extracts and mcrominerals), AGR100 (humic and fulvic acids), AGR111+112 (Si and Ca mobilization agent, Ca and Zn) AGR113 (Si) and AGR114 (mixture of 20 L amino acids). The experimental layout was designed according to split-plot design, using the irrigation treatment as the main plot and the biostimulant treatments as the subplot for each of the tested cultivars. Irrigation was scheduled based on the readings of Delta-T PR2/4 profile probe (Delta-T Devices Ltd., Burwell, UK) and according to the target soil moisture content. Biostimulants were applied manually with foliar (AGR109, AGR111+111 and AGR113) or soil application (AGR110 and AGR114) three times throughout the growing period, while all seedlings were immersed in the respective biostimulant solution before transplantation. Chlorophyll content (SPAD index) and plant height were recorded at three sampling dates (one week after each biostimulant application), while yield and growth parameters (leaves number, leaves fresh and dry weight, Leaf Area Index (LAI) and Specific Leaf Area (SLA)) were recorded at harvesting. Our results showed a varied effect of the tested factors on chlorophyll content of leaves and plant height throughout the growing season for both cultivars. Moreover, deficit irrigation at 46% FC resulted in a significant decrease of fresh biomass, regardless of the cultivar and the biostimulant product. Interestingly, the mild water shortage (irrigation 66% of field capacity) resulted in similar or higher yields compared to full irrigation, especially in the case of AGR109, AGR110 and AGR 114 in Batavia lettuce and AGR110 in Romaine lettuce. The highest yields in Batavia lettuce were recorded for AGR113 (315.4 g per plant) and AGR114 (317.9 g per plant) at 100% FC and 66% FC, respectively, while AGR111+112 resulted in the highest yield at 46% FC. On the other hand, the highest yield in Romaine lettuce was recorded for the control treatment (no biostimulants; 297.5 g per plant) and AGR109 (292.6 g per plant) at 100% FC, while the same biostimulant (AGR109) resulted in the highest yield at 66% FC. AGR113 treatment was the most productive at 465 FC irrigation. A varied response to irrigation regime and biostimulant application was also observed for the number of leaves, LAI and SLA values, although in most cases the application of biostimulants alleviated the negative effects of water stress. In conclusion, the combinatory

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application of mild water deficit and biostimulant showed promising results as an innovative agronomic tool for water management.

Keywords
Lettuce, water deficit, biostimulant, fresh yield, water stress

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