THE EFFECT OF BIOSTIMULANT APPLICATION ON LETTUCE GROWTH PARAMETERS

Spyridon A. PETROPOULOS*, Christina CHASKI

University of Thessaly, Department of Agriculture, Crop Production and Rural Environment, Fytokou Street, 38446, Volos, Greece
*Corresponding author: spetropoulos@uth.gr

INTRODUCTION

- Biostimulant application is an innovative and ecofriendly agronomic practice with increasing interest in horticultural production.
- Lettuce is an important crop as nutritive source of minerals and vitamins as it is consumed as a fresh green salad (Hanafy et al., 2000). Also, lettuce leaves are considered a rich source of antioxidants, vitamins A and C (Norman, 1992).
- Biostimulants are biologically active compounds that enhance metabolisms and promote plant development when applied in small quantities. Their constituents may be microelements, hormones, enzymes, proteins, vitamins, amino acids, and other compounds (Edmeades, 2002).
- It is an environmental friendly method of improving plant development that reduces fertilizer and pesticide consumption. The application of biostimulants might be considered as a good production strategy for obtaining high yield of nutritionally valuable vegetables (Paradikovic et al., 2011).
- The aim of the present study was to evaluate the effects of the application of biostimulants on the growth parameters of two lettuce cultivars (Romaine type: cv. Doris; Batavia type: cv. Manchester) grown in pots.

METHODOLOGY

- The experiment took place on the experimental farm of the School of Agricultural Sciences of the University of Thessaly. Plants from two varieties of lettuce (Romaine type: cv. Doris; Batavia type: cv. Manchester) were transplanted in 2 L pots filled with a mixture of peat and perlite (1:1; v/v).
- Five biostimulant products (109: Mixture of Plants and Seaweed extracts, Amino Acids and Trace elements, 110: Humic & Fulvic Acids Balanced Solution, 111+112: CaO and SiO_2 + Calcium Utilization, Mobilization and Translocation Factor 113: Stabilized Orthosilicic Acid, 114: Vegetal proteins and amino acids + Carboxylic Acids, including the untreated control) were tested. The biostimulants were provided by Agrology S.A., Greece. The frequency of the biostimulant application was 5 days, 15 and 25 days after transplantation.
- All treatments were applied with foliar spraying except for biostimulants containing humic-fulvic acids (e.g. 110) and those contained CaO and SiO_2 + Calcium Utilization, Mobilization and Translocation Factor (e.g. 111+112) which were applied through fertigation.
- The measurements of SPAD index and plant height took place after the application of biostimulants at 15 and 25 days after the transplantation as well as before the harvest. After harvest, the following measurements were recorded: plant height; plant fresh weight; number of leaves; fresh and dry weight of leaves; leaf area; specific leaf area.

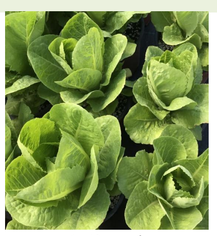

Image 1. Romaine type: cv. Doris

Image 2. Batavia type: cv. Manchester

RESULTS AND DISCUSSION

Table 1. Height and chlorophyll of Romaine lettuces after the application of biostimulants at 15, 25 days and before harvesting.

TYPE	Control		109		110		111+112		113		114	
A/A	Height (cm)	SPAD	Height (cm)	SPAD	Height (cm)	SPAD	Height (cm)	SPAD	Height (cm)	SPAD	Height (cm)	SPAD
15 DAYS	9.5±0.9cD	24.2±3.3aD	9.7±1.0cC	26.2±5.8aB	7.5±0.8cF	25.1±2.5aC	8.0±0.8cE	28.0±2.4aA	10.7±0.9cA	25.5±3.5aC	10.3±1.5cB	28.9±5.1aA
25 DAYS	17.3±0.9bE	13.9±3.6bD	20.0±3.6bA	17.0±2.5bA	18.6±2.8bC	15.4±5.0cB	17.9±1.3bD	13.9±3.0cD	19.2±2.6bB	14.8±3.0bC	19.7±1.6bA	15.3±2.9bB
HARVEST	21.7±2.4aC	13.2±3.1bE	27.6±5.3aA	16.2±4.1bB	27.1±2.2aA	17.4±4.2bA	20.6±3.0aD	15.6±3.5bC	24.7±4.2aB	14.2±2.6bD	21.5±4.7aC	11.1±3.3cF

*Different small size and capital Latin letters indicate differences between the means of the same column and the same row for plant height and SPAD index, respectively (p=0.05).

Table 2. Height and chlorophyll of Batavia lettuces after the application of biostimulants at 15, 25 days and before harvesting.

TYPE	Control		109		110		111+112		113		114	
A/A	Height (cm)	SPAD	Height (cm)	SPAD	Height (cm)	SPAD	Height (cm)	SPAD	Height (cm)	SPAD	Height (cm)	SPAD
15 DAYS	8.7±1.3cA	12.7±2.9aC	6.9±1.0cE	13.3±3.0aB	8.2±1.1cB	14.1±2.2aA	7.6±1.0cD	12.5±0.9aC	8.1±0.8cB	12.7±1.0aC	7.9±1.0cC	11.7±2.1aD
25 DAYS	15.4±1.6bD	9.4±2.0bB	16.3±2.2bC	9.1±0.8bB	17.4±2.6bB	8.2±1.0cC	17.0±1.4bB	10.3±1.0bA	18.5±1.8bA	7.8±1.9bD	16.0±2.1bC	7.4±0.7cE
HARVEST	18.2±2.1aE	9.3±1.8bB	18.9±2.5aD	8.0±2.2cC	21.1±1.8cB	9.5±2.0bB	20.0±3.1aC	10.7±2.3bA	23.5±3.4aA	7.1±1.7bD	21.1±3.5aB	8.3±1.9bC

*Different small size and capital Latin letters indicate differences between the means of the same column and the same row for plant height and SPAD index, respectively (p=0.05).

- A varied effect of biostimulant treatment was observed on SPAD index and plant height in the case of Romaine lettuce, where the formulations 111+112 and 109, 110 increased SPAD index and plant height, respectively. Moreover, plants treated with 110 formulation recorded leaves of better visual quality at harvesting date compared to the rest of the treatments, as indicated by the SPAD index values (**Table 1**).
- On the other hand, Romaine lettuce presented the higher plant height at harvest when treated with formulation 116, while the SPAD index values where the highest at 15 days after transplantation, especially in the case of plants treated with 110 formulation (**Table 2**).

Table 3. Growth parameters of Romaine lettuces.

Biostimulant	Weight (g)	Number of leaves	Fresh weight of leaves (g)	Leaf area index (cm^2)	Dry weight of leaves (%)
Control	196.2±80.8e	34.0±3.8d	152.5±64.6d	3273.3±1183.2d	6.2±0.2c
109	288.3±124.8a	37.6±3.6b	220.5±101.3a	4277.8±1504.6a	5.2±0.4e
110	255.9±122.9b	40.4±5.2a	197.0±97.2b	3953.8±1603.9b	5.9±0.6d
111+112	226.0±82.1d	38.0±3.5b	168.5±66.1c	3507.7±1054.3c	6.8±0.8a
113	238.4±90.0c	35.6±4.3c	177.9±70.84c	3598.6±1261.5c	4.9±0.3f
114	200.8±75.5	41.6±7.1	166.6±78.3	3539.7±1306.2	6.4±0.1c

*Different small size Latin letters indicate differences between the means of the same column (p=0.05).

Table 4. Growth parameters of Batavia lettuces.

Biostimulant	Weight (g)	Number of leaves	Fresh weight of leaves (g)	Leaf area index (cm^2)	Dry weight of leaves (%)
Control	184.6±36.0c	25.6±2.4d	163.3±29.8c	3365.4±491.9c	6.1±0.9a
109	111.9±28.0e	23.0±2.1e	97.7±28.3e	2204.2±542.3e	6.7±0.8d
110	167.4±37.9d	26.8±3.8c	149.1±31.3d	2932.7±511.3d	6.1±0.5b
111+112	240.9±59.5a	30.8±2.9a	215.5±55.0a	4149.0±844.7a	3.7±0.1c
113	220.9±49.5b	27.2±3.2bc	188.6±45.1b	3906.8±1112.5b	4.8±0.3b
114	220.4±91.2b	27.6±3.4b	193.1±73.5b	4098.7±1436.2a	4.8±0.4b

*Different small size Latin letters indicate differences between the means of the same column (p=0.05).

- For Romaine lettuce, seaweed extract (formulation 109) had a beneficial effect on total plant weight, weight of fresh leaves, leaf area and the dry matter, while humic and fulvic acids (formulation 110) increased the number of leaves.
- All biostimulants showed better results in the case of the Romaine lettuce for all the tested growth parameters compared to control except for the dry weight where formulation 113 (CaO and SiO_2) resulted to the lowest dry weight of leaves.
- In the case of Batavia, the application of 111+112 formulation (CaO and SiO_2) had the most beneficial effect on the tested growth parameters, whereas the lowest dry weight was also recorded for the same treatment.
- Another interesting result observed was the contrasting effect of formulation 109 on growth parameters of both varieties, indicating a genotype dependent response to biostimulant application.
- Similar results were presented by Vernieri et al. (2002) who showed that the application of a biostimulant with a complex of plant extracts, polysaccharides, amino-acids, betaines and enriched in vitamins and micronutrients, had a positive effect on plant growth in lettuce.
- Similarly, the two varieties of lettuces were affected either positively or negatively from the application of the different biostimulants in regards to their morphological features.

CONCLUSIONS

- Our results indicate positive effects of biostimulants on lettuce plant growth. However, a varied response was observed depending on the biostimulant product, especially in the case of Romaine lettuce. On the other hand, the combination of 111+112 consistently improved most of the growth parameters in Batavia type.
- Different effects of the same biostimulant formulation were observed on growth parameters in the two lettuce species, indicating a genotype dependent response.
- The application of biostimulants needs further in depth research to allow the producers can to produce vegetable products of better quality without compromising yield and without burdening the environment with agrochemical inputs.
- Biostimulants can also increase the sustainability of agricultural and horticultural production systems as well as improve the quality and quantity of food for the ever-growing world's population.
- Although there are several cases where biostimulant application resulted to beneficial effects on plant growth and yield, more studies are needed to fine-tune application practices, since it seems there are product and crop specificities to be addressed and negative or no effects have been reported in the literature.

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