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Integrated Use of Biostimulants and Organic Fertilizers Enhances Biomass and Yield Traits in Melon: A Case Study from Adıyaman, Türkiye

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ABSTRACT

This study aimed to evaluate the effects of various biostimulants, both alone and in combination with organic fertilizers, on biomass accumulation and yield components of *Cucumis melo* L. Galia C8 and Kırkağaç 637 under the ecological conditions of Adıyaman, Turkey. Plants were grown in 8-liter pots and uprooted on the 30th and 60th days after planting to assess various morphological and physiological parameters in 2011. For yield parameter, experiments were carried out in open field conditions in the spring growing years of 2011 and 2013.Treatments consisted of different biostimulants *Bacillus subtilis* (OSU 142), *Bacillus megaterium* (M3), *Azospirillum* spp. (SP245), Bioplin, Phosfert, EM1, Bio-one, Endoroots, Sim-derma, and *Spirulina* sp. applied either alone or in combination with organic fertilizers (OF) (Çamlıbesi Bioactive Compost, Liquid Organic Fertilizer, and K-Humate), along with conventional fertilization (DAP + urea) and an untreated control as reference treatments. The results demonstrated significant improvements in morphological parameters, vegetative growth, and biomass production with combined applications of biostimulants and organic fertilizers. Among all treatments, Spirulina + OG and Sim-derma + OG led to the most pronounced improvements in stem diameter (up to 46%), stem length (25%), internode number (42%), root length (up to 44%), and total biomass (up to 188%) relative to the control. Biomass accumulation was assessed through two destructive harvests, revealing statistically significant differences among treatments in root, stem, leaf, and total fresh and dry weights. While no substantial difference was observed between the cultivars for some traits, interactions between cultivar and treatment were found to be statistically significant for several biomass-related traits. Total yield was calculated as 2359.16 kg/da for Galia C8 and 2283.97 kg/da for Kırkağaç 637. The average yield increased from 1441 kg/da in the first year to 3201 kg/da in the second year. Compared to the control treatments, the total yield showed an increase of 91.94% for Galia C8 and 26.75% for Kırkağaç 637. These findings suggest that integrating biostimulants with organic fertilizers can enhance melon growth, yield components, and biomass partitioning, providing a sustainable alternative to conventional fertilization practices, particularly under semi-arid conditions.

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Introduction

Melon (*Cucumis melo* L.) is an important summer fruit widely cultivated worldwide. Turkey is located within the center of origin of melon, with Anatolia, Iran, and Afghanistan representing its natural distribution areas. The Eastern Anatolia Region is considered one of the micro-centers of diversity for this species (Sarı et al., 2000). In Turkey, melon cultivation is mostly carried out in open fields, and large-fruited varieties belonging to *C. melo* var. inodorus are generally preferred (Sarı et al., 1992).

In recent years, sustainable agricultural systems that support plant growth, minimize environmental impacts, and preserve soil health have gained importance. Particularly, the use of organic and microbial fertilizers offers an environmentally friendly alternative to chemical fertilizers. Organic fertilizers, obtained through natural processes, improve soil structure and increase the content of plant nutrients, thereby enhancing product quality and maintaining soil fertility sustainably (Akgün, 2011; Anonymous, 2013El-Sayed, 2006). Numerous studies have demonstrated the positive effects of organic fertilizers on plant growth (Bitew and Alemayehu, 2017; Chatzistathis et al., 2025), stress tolerance (Geng et al., 2025; Rahim et al., 2025), yield (Nkolisa et al., 2025; Yu et al., 2025) and quality parameters (Qi et al., 2025) in crop production.

Microbial fertilizers or biofertilizers contain bacterial and fungal microorganisms that directly or indirectly stimulate plant growth. These microorganisms support plant development through mechanisms such as atmospheric nitrogen fixation, phosphate solubilization, and phytohormone production (Arcak and Güven, 2004; Glick, 2012). Particularly, Plant Growth-Promoting Rhizobacteria (PGPR) also exhibit biological control effects against soil-borne pathogens, thereby protecting both yield and soil health (Benaissa; Mena & Olalde, 2007).

Recent studies have revealed that microbial fertilizers positively affect biomass increase, fruit quality, nutrient uptake, and stress tolerance in various vegetable and fruit crops (Ünlü & Padem, 2013; Gholami et al., 2009; Pırlak & Köse, 2009, Sabir et al., 2021). The terms biostimulant and biofertilizer are often used interchangeably, particularly in the context of microbial agents such as *Bacillus* spp. and *Azospirillum* spp. However, these two terms refer to distinct functional categories. Biofertilizers are defined as living microorganisms that primarily enhance the availability or fixation of nutrients (e.g., nitrogen fixation, phosphate solubilization), whereas biostimulants encompass a broader group of substances and microorganisms that stimulate plant growth through non-nutritional mechanisms, such as enhancing plant metabolism or improving stress tolerance (Chiaiese et al., 2018; Renuka et al., 2018). Moreover, in the context of microalgae, they are increasingly recognized as potential dual-function agents, acting both as biofertilizers—through organic matter and nutrient contributions—and as biostimulants—owing to bioactive compounds such as proteins, pigments, vitamins, and phytohormones (Rouphael & Colla, 2020; Kapoore et al., 2021). Additionally, microalgae, as novel biofertilizer sources, have attracted attention due to their high content of proteins, vitamins, and pigments, and their potential effects on plant growth are being investigated (Chiaiese et al., 2018).

Adıyaman, with its favorable climatic conditions and unpolluted soils, is suitable for organic and microbial agricultural practices. In recent years, regional agricultural statistics indicate a decline in tobacco cultivation, coinciding with a diversification toward alternative and sustainable production systems (TÜİK, 2023; Adıyaman Provincial Directorate of Agriculture and Forestry, 2023). This trend may contribute to an increased interest in the use of these fertilizers.

The aim of this study is to determine the effects of different organic and microbial fertilizer applications on plant growth and yield of melon (*Cucumis melo* L.). Evaluations conducted in this study aim to reveal the applicability of alternative fertilization methods for sustainable melon cultivation.

Materials and Methods

This study was conducted in 2011 and 2013 under open field conditions at the experimental field of Adıyaman University Agricultural and Field Management Research Centre, located in Hasancık, Adıyaman, Türkiye (37° 46' 39.11" N, 38° 25' 39.69" E). The soil at the experimental site had a loamy texture, and no pesticides were applied during the trial period. Two different melon cultivars were used as plant material: 'Galia C8' (*Cucumis melo* var. *cantalupensis*) representing summer melon, and 'Kırkağaç 637' (*Cucumis melo* var. *inodorus*) representing winter melon.

Experimental Design and Plant Cultivation

Seedlings were transplanted into the field on May 5 in both 2011 and 2013. The experimental layout followed a randomized complete block design (RCBD) with four replications. Each replicate consisted of 10 melon plants planted in rows with a spacing of 1.8 m between rows and 0.5 m within rows. In addition to the field plots, four seedlings from each subplot were simultaneously planted into 8-liter pots filled with field soil to evaluate plant biomass. Accordingly, a total of 14 plants per treatment (10 in field + 4 in pots) were assessed. With 23 treatments, 4 replications, and 2 cultivars, a total of 2576 plants were evaluated over the two experimental years. While the field experiment was irrigated using a drip irrigation system, the potted plants were watered manually.

Biostimulants and Application Methods

Biostimulant treatments were applied following either manufacturer instructions or research-based protocols. Isolates of *Bacillus subtilis* (OSU 142), *Bacillus megaterium* (M3), and *Azospirillum* spp. (SP 245) were cultured in solid media and transferred to liquid media to reach a concentration of 10^9 cells/mL. Seedling roots were immersed in these preparations for 20 minutes before transplanting into field and pot conditions.

Bioplin (commercial product containing *Azotobacter vinelandii* × *A. chroococcum*) and Phosfert (containing *A. vinelandii* × *A. chroococcum* × *B. polymyxa*) were also applied once by immersing the roots in a 100 mL/7 L solution for 20 minutes before transplanting. EM1 (containing *Saccharomyces cerevisiae*, lactic acid, and local bacteria) was diluted to a 1/1000 ratio, mixed with 45 L of water, and applied biweekly at 200 cc per plant to the soil surface.

Bio-one (comprising *A. vinelandii* × *Clostridium pasteurianum*) was prepared by mixing 21.6 cc of the product with 1.3 L of water and combined with a sugar solution (154 g sugar in 7.2 L of water). The final mixture was applied once at 21.6 cc per plant. Endoroots Soluble, a cocktail of arbuscular mycorrhizal fungi (*Glomus* spp.), was applied once at 2.25 g per 9 m² of planting area. Sim-Derma (commercial *Trichoderma harzianum* KUEN1585) was prepared by dissolving 5 g of the product in 5 L of water. Seedling roots were soaked in this mixture for 30 minutes before planting. Additionally, Spirulina algae was applied by preparing a solution of 45 g/L and delivering 200 cc directly to the root zone of each plant.

Organic and Conventional Fertilizer Applications

Among organic fertilizers, Çamlı Bioactive Organic Fertilizer was applied as a solid form at 1,600 g per 9 m² in field plots and 160 g per pot. Biofarm Liquid Organic Fertilizer and K-Humat were prepared at a concentration of 100 g/100 L and applied foliar three times per week throughout the experiment in both field and pot-grown plants. For conventional fertilization, DAP (di-ammonium phosphate) was applied at 160 g/9 m² and urea at 40 g/9 m² directly to the soil. No biostimulants or fertilizers were applied in the control plots.

Plant Protection Practices

Plant protection measures were implemented as needed during both years of the study. In 2011, pest management involved the application of 1 L Neemazal. Weeds were removed manually from the plots, and infected plants or fruits were discarded. Cultural practices such as hilling, hoeing, and fruit covering were performed in a timely and careful manner. Damage from melon fruit fly (*Myopardalis pardalina*) was observed particularly in the 'Kırkağaç 637' and 'Galia C8' cultivars.

In 2013, two foliar applications of elemental sulfur were made. To control melon fruit fly, two yellow sticky traps were placed per plot, and Neemix was applied in three doses at 10-day intervals. Weeds were again manually removed, and hoeing was conducted twice by hand and once by tractor.

Biomass Measurements and Observations

For all treatments, four plants grown in pots were sampled on the 30^{th} and 60^{th} days after planting to evaluate morphological and physiological characteristics. The main stem diameter of each plant was measured just below the first branching point using a caliper, and the average diameter was calculated. The length of the main stem was measured from the collar region to the apex using a tape measure. The number of nodes on the main stem was counted, starting from the cotyledons. Root length was determined by measuring the cleaned roots with a tape after carefully removing the plants from the soil and washing them with tap water. Following this, the fresh weight of the roots was measured using a precision scale immediately after washing, while dry weight was obtained after placing the roots in paper bags and drying them at 65°C in an oven until a constant weight was reached. The stems, after being separated from the leaves and roots, were washed, surface-dried, and weighed for their fresh weights, followed by oven-drying at 65°C for dry weight measurements. Similarly, the fresh weights of the leaves were recorded after washing and drying the surface water, and then the dry weights were determined by drying them at 65°C. The total dry weight of each plant was calculated as the sum of the dry weights of the roots, stems, and leaves, and the averages were used for further analysis. All values obtained at each harvest date were summed to determine the total biomass yield.

Yield

Total yield was determined by summing the yields from each harvest period.

Statistical Analyzes

Statistical analyses were performed in the JMP 5.1 program and the LSD test was used to compare the means and group them. Applications in the same group are indicated with the same letter. The D value is calculated by multiplying the t-value by the square root of the result obtained from dividing twice the mean square error (MSE) by the number of observations (n). This formula is typically used in Least Significant Difference (LSD) tests for comparing treatment means. The formula used to calculate the D value is shown below.

$$D = t \times \sqrt{\frac{2 \times MSE}{n}}$$

Results and Discussion

The effects of various biostimulant and fertilization treatments on the vegetative growth and yield of two melon cultivars, Galia C8 and Kırkağaç 637, were evaluated at 30 and 60 days after transplanting, with results summarized in Tables 1 through 4, and yield data over two years in Table 5.

As shown in Table 1, stem diameter significantly increased from 30 to 60 days in both cultivars, following typical vegetative growth patterns. Spirulina combined with organic fertilizer (Spirulina + OF) consistently resulted in the largest stem diameters at both measurement points (mean 8.11 mm at 30 days; 8.90 mm at 60 days), significantly outperforming other treatments. DAP + Urea also yielded the greatest diameter for Galia C8 at 60 days (11.52 mm). These results suggest that Spirulina-based biostimulants, rich in nutrients and growth-promoting substances, enhance stem thickening synergistically with organic fertilizer by improving nutrient availability and stimulating physiological growth processes (Calvo et al., 2014; Hayat et al., 2010). These results suggest that Spirulina-based biostimulants, rich in nutrients and growth-promoting substances, may enhance stem thickening synergistically with organic fertilizer by improving nutrient availability and stimulating physiological growth processes. Similar effects have also been reported in previous studies (Calvo et al., 2014; Hayat et al., 2010). Galia C8 generally exhibited larger stem diameters than Kırkağaç 637, indicating genetic differences influencing stem development. Stem length data (Table 1a, b) reflected similar trends, with Spirulina + OF and DAP + Urea treatments producing the longest stems early on, and M3 + OF promoting the longest stem length in Kırkağaç 637 by 60 days, highlighting cultivar-specific growth dynamics and treatment interactions.

Node counts, indicative of branching potential, increased significantly over time (Table 1). Fertilization influenced early development, while cultivar effects were more pronounced later ($p < 0.05$). At 30 days, treatments such as Sim-derma + OF, SP 245 + OF, and OSU 142 + OF led to higher node numbers, while at 60 days, the organic fertilizer (OF) treatment alone produced the highest node count, especially in Kırkağaç 637. Kırkağaç 637 also generally exhibited more nodes than Galia C8. Statistical analysis confirmed significant treatment effects at 30 days and significant cultivar effects at 60 days, implying that fertilization mostly affects early node formation, whereas genetic factors dominate later development.

Significant cultivar-treatment interactions ($p < 0.05$) were observed early. Root length and fresh weight (Table 2a, b) were positively influenced by certain biostimulant and organic fertilizer combinations. Phosphert + OF and Endoroots + OF treatments produced the longest roots (>34 cm at 30 days; ~47 cm at 60 days) and higher root biomass. The early sensitivity of root growth to treatment-cultivar interactions was statistically significant at 30 days. These findings align with Mena-Violente and Olalde (2007), who demonstrated that *Bacillus subtilis* inoculation enhanced tomato root length and biomass, underscoring the role of biostimulants in promoting root system development essential for water and nutrient uptake.

Table 1a. Main Stem Diameter (mm), Main Stem Length (cm) and Number of Nodes of Galia C8 and Kırkağaç 637 Cultivars Measured on the 30th and 60th Days After Transplanting in Pot-Grown Plants

Stem diameter (mm)	30th		Mean	60th		Mean
Applications	G	K		G	K	
1	6.58 D-J	5.37 Q-U	5.97 e-h	7.81 E-K	7.61 F-K	7.71 d-g
2	6.38 F-L	5.46 P-T	5.92 e-j	7.50 H-K	7.76 E-K	7.63 efg
3	6.12 H-P	5.43 P-T	5.77 f-k	9.70 BCD	6.43 K	8.06 c-g
4	5.78 K-R	5.06 STU	5.42 jk	7.65 F-K	8.29 C-J	7.80 c-g
5	6.36 F-M	4.96 T-U	5.65 k	8.10 D-K	8.33 C-J	8.22 b-g
6	5.93 İ-R	4.70 U	5.31 g-k	7.47 İJK	7.34 İJK	7.40 fg
7	5.50 O-T	5.40 Q-U	5.44 ijk	7.56 G-K	6.69 JK	7.13 g
8	6.67 C-H	5.62 N-T	6.14 c-g	8.39 C-J	8.14 D-K	8.27 b-g
9	6.19 G-O	5.29 R-U	5.74 f-k	7.84 E-K	7.56 G-K	7.70 d-g
10	8.54 A	6.30 F-N	7.42 b	10.0 ABC	8.76 B-İ	9.38 ab
11	6.60 C-İ	5.61 N-T	6.11 c-g	9.09 B-İ	8.14 D-K	8.17 a-f
12	6.85 C-G	5.78 K-R	6.32 cde	8.34 C-J	8.32 C-J	8.33 b-g
13	7.29 BC	5.48 P-T	6.38 cde	8.12 D-K	8.90 B-İ	8.51 a-f
14	7.71 B	5.49 O-T	6.60 cd	10.21 AB	7.41İJK	8.81 a-e
15	6.54 E-J	5.80 K-R	6.17 c-f	8.08 D-K	8.29 C-J	8.19 b-g
16	7.01 B-F	5.68 L-S	6.34 cde	8.96 B-İ	7.92 E-K	8.44 a-f
17	7.19 B-E	6.02 H-Q	6.61 c	8.87 B-İ	9.47 B-E	9.17 abc
18	6.34 F-M	5.53 O-T	5.93 e-i	9.28 B-G	8.22 D-J	8.75 a-e
19	5.88 J-R	6.44 F-K	6.16 c-g	7.73 E-K	8.92 B-İ	8.33 b-g
20	7.18 B-E	5.65 M-T	6.41 cde	9.36 B-F	8.05 D-K	8.70 a-e
21	8.96 A	7.27 BCD	8.11 a	9.26 B-H	8.55 B-İ	8.90 a-d
22	5.33 Q-U	6.87 C-G	6.10 d-g	11.52 A	7.76 E-K	9.64 a
23	5.75 K-S	5.40 Q-U	5.57 h-k	8.65 B-İ	8.08 D-K	8.36 b-g
Mean	6.63 a	5.67 b		8.67 a	8.04 b	
30th [D % 1 (Application)= 0.50 D % 1 (Cultivar)= 0.15 D % 1 (Application x Cultivar)= 0.71]						
60th [D % 1 (Application)= 1.25 D % 1 (Cultivar)= 0.37 D % 1 (Application x Cultivar)= 1.77]						

Main Stem length (cm)	30th		Mean	60th		Mean
Applications	G	K		G	K	
1	15.6 E-L	15.4 F-L	15.5 e-j	52.8 F-M	98.1 BC	75.4 a-c
2	12.7 MN	15.5 F-L	14.1 jk	48.2 F-M	79.5 C-G	63.8 a-e
3	16.7 C-İ	20.2 A	18.4 ab	54.5 E-M	89.3 BCD	71.9 a-d
4	15.4 F-L	15.9 D-L	15.6 c-j	33.1 LM	42.6 İ-M	37.8 f
5	13.8 K-M	14.7 İ-M	14.2 i-k	34.1 LM	66.3 C-L	50.2 def
6	14.3 J-M	14.7 İ-M	14.5 h-k	41.5 İ-M	54.1 F-M	47.7 ef
7	11.8 N	15.1 G-L	13.5 k	50.0 F-M	47.8 G-M	49.2 def
8	16.1 D-K	14.1 K-N	15.1 g-j	45.0 H-M	74.4 C-İ	59.7 b-f
9	16.8 C-İ	13.7 LMN	15.2 g-j	39.1 J-M	76.4 C-H	57.8 b-f
10	18.0 A-D	16.5 C-J	17.2 bc	48.3 F-M	72.0 C-J	60.1 b-f
11	15.0 H-L	17.9 A-E	16.4 c-g	34.2 LM	63.9 D-L	49.1 def
12	15.6 E-L	17.4 B-G	16.5 c-g	43.3 H-M	87.6 B-E	65.4 a-e
13	14.6 İ-M	14.8 H-M	14.7 h-k	34.0 LM	133.6 A	83.8 a
14	17.9 A-E	15.9 D-L	16.9 b-f	57.0 D-M	49.9 F-M	53.5 c-f
15	16.5 C-J	17.4 B-G	17.0 b-e	63.6 D-L	62.3 D-M	63.0 a-e
16	14.9 H-M	16.8 C-İ	15.8 c-i	54.4 F-M	29.9 M	42.1 ef
17	17.0 C-H	15.0 H-L	16.0 c-h	38.1 KLM	117.3 AB	77.8 ab
18	14.1 KLM	16.5 D-J	15.3 f-j	57.3 D-M	44.3 H-M	50.8 def
19	17.4 B-G	15.4 F-L	16.4 c-g	49.3 F-M	72.8 C-İ	61.0 a-f
20	15.9 D-L	17.5 B-F	16.7 c-g	67.6 C-K	76.4 C-H	72.0 a-d
21	19.6 AB	19.4 AB	19.5 a	81.0 C-F	42.1 İ-M	62.0 a-e
22	18.8 ABC	15.5 F-L	17.1 bcd	81.2 C-F	43.0 İ-M	62.1 a-
23	15.4 F-L	15.8 D-L	15.6 d-j	74.4 C-İ	46.9 G-M	60.6 a-f
Mean	15.8	16.1		51.4	68.3	
30th [D % 1 (Application)= 1.6 D % 1 (Cultivar)= NS D % 1 (Application x Cultivar)= 2.3]						
60th [D % 1 (Application)= 0.7 D % 1 (Cultivar)= 6.93 D % 1 (Application x Cultivar)= 1.05]						

Table 1b. Main Stem Diameter (mm), Main Stem Length (cm) and Number of Nodes of Galia C8 and Kırkağaç 637 Cultivars Measured on the 30th and 60th Days After Transplanting in Pot-Grown Plants

Number of nodes	30th		Mean	60th		Mean
Applications	G	K		G	K	
1	2.3 G-M	2.0 İ-N	2.1 e-k	14.30	27.10	20.70
2	2.1 H-M	2.0 İ-N	2.1 f-k	13.00	20.60	16.80
3	2.3 G-M	1.6 LMN	1.9 h-k	22.10	22.00	22.10
4	1.0 M	1.9 J-N	1.4 k	16.50	18.90	17.70
5	1.8 K-N	1.9 J-N	1.8 ijk	17.30	13.60	15.40
6	1.6 LMN	4.0 AB	2.8 b-f	12.30	21.40	16.80
7	2.3 G-M	2.5 E-L	2.4 d-j	19.30	10.90	15.10
8	2.1 H-M	3.0 B-İ	2.6 d-i	20.80	20.30	20.60
9	1.4 MN	2.8 D-K	2.1 f-k	14.60	22.10	18.40
10	3.5 A-E	3.3 A-G	3.4 abc	18.30	19.90	19.10
11	2.6 D-L	2.9 C-J	2.8 c-g	21.10	34.50	27.80
12	3.4 A-F	3.7 A-D	3.5 ab	20.50	21.30	20.90
13	2.6 D-L	2.6 D-L	2.6 d-h	17.90	27.10	22.50
14	3.9 ABC	2.3 G-M	3.1 a-d	16.70	21.30	19.00
15	2.3 G-M	1.8 K-N	2.0 g-k	13.60	17.10	15.40
16	1.6 LMN	2.3 G-M	1.9 h-k	19.80	19.10	19.40
17	3.0 B-İ	3.9 ABC	3.4 abc	12.60	24.30	18.40
18	1.8 K-N	1.6 LMN	1.7 jk	16.10	18.80	17.40
19	2.6 D-L	3.5 A-E	3.1 a-d	17.60	23.10	20.40
20	4.1 A	3.3 A-G	3.7 a	22.10	22.90	22.50
21	3.5 A-E	3.4 A-F	3.4 abc	16.00	22.80	19.40
22	2.6 D-L	3.1 A-H	2.9 b-e	23.20	17.10	20.20
23	2.4 F-M	2.8 D-K	2.6 d-i	19.90	21.00	20.50
Mean	2.5 b	2.7 a		17.6 b	21.2 a	

30th [D % 1 (Application)= 0.76 D % 5 (cultivar)= 0.2 D % 1 (Applcation x Cultivar)= 1.1]
60th [D % 1 (Application)= NS D % 5 (cultivar)= 2.14 D % 1 (Applcation x Cultivar)=NS]

1:OSU 142 2:M3 3:SP 245 4:Bioplin 5:Phosphert 6: EM1 7:Bio-one 8:Endoroots 9:Sim-derma 10:Spirulina 11:Organic Fertilizer 12:OSU 142+OF 13:M3+OF 14:SP 245+OF 15:Bioplin+OF 16:Phosphert+OF 17:EM1+OF 18:Bio-one+OF 19:Endoroots+OF 20:Sim-derma+OF 21:Spirulina+OF 22:DAP+Urea 23:Control G:Galia C8 K: Kırkağaç 637 "They were applied separately and in combination with the organic fertilizer formulation."

Table 2a. Root length (cm), Total Fresh Weight (g) and Total Dry Weight (g) of Galia C8 and Kırkağaç 637 Cultivars Measured on the 30th and 60th Days After Transplanting in Pot-Grown Plants

Root Length (cm)	30th		Mean	60th		Mean
Applications	G	K		G	K	
1	33.0 A-G	28.4 F-L	30.7 a-f	36.50	44.00	40.2 abc
2	32.9 B-G	32.8 B-G	32.8 ab	30.60	34.60	32.6 c-g
3	30.7 C-İ	34.9 ABC	32.8 ab	46.00	48.70	47.3 a
4	32.9 B-G	30.2 C-İ	31.5 abc	34.10	31.30	32.7 c-g
5	31.8 C-H	29.6 D-J	30.7 a-f	35.20	39.60	37.4 b-f
6	33.4 A-F	30.0 C-J	31.7 abc	29.00	35.90	32.5 d-g
7	34.8 A-D	29.7 C-J	32.0 abc	33.50	34.20	33.9 b-g
8	29.6 D-J	30.1 C-J	29.8 b-f	29.30	33.30	31.3 efg
9	29.7 D-K	29.6 D-J	29.6 b-f	29.50	38.80	34.2 b-g
10	27.2 H-M	29.6 D-K	28.4 c-g	31.40	28.40	29.8 fg
11	32.7 B-G	30.6 C-İ	31.7 abc	29.40	40.80	35.1 b-g
12	33.7 A-E	21.8 N	27.8 d-g	27.00	31.10	29.1 g
13	28.1 G-L	26.2 İ-N	27.2 fgh	33.90	34.70	34.3 b-g
14	26.5 İ-N	33.4 A-F	29.9 b-f	29.40	32.30	30.8 fg
15	24.9 J-N	26.4 İ-N	25.7 gh	34.50	45.40	39.9 a-d
16	38.2 A	30.6 C-İ	34.4 a	41.10	37.10	39.1 bcd
17	32.3 C-H	29.5 D-K	30.9 a-e	25.40	39.30	32.3 d-g
18	33.9 A-E	25.9 İ-N	29.9 b-f	32.50	39.00	35.8 b-g
19	37.8 AB	30.2 C-İ	34.0 a	28.80	31.30	30.0 fg
20	30.8 C-İ	31.9 C-H	31.3 a-d	39.70	37.90	38.8 b-e
21	30.4 C-İ	28.7 E-K	29.5 b-f	28.00	32.20	30.1 fg
22	32.5 C-G	22.2 MN	27.4 e-h	29.40	33.00	31.2 efg
23	23.3 LMN	24.4 K-N	23.8 h	48.60	32.50	40.6 ab
Mean	31.3 a	28.9 b		33.2 b	36.3 a	

30th [D % 1 (Application)= 3.7 D % 1 (Cultivar)= 1.1D % 1 (Application x Cultivar)= 5.2]
60th [D % 1 (Application)= 7.7 D % 1 (Cultivar)= 2.3 D % 1 (Application x Cultivar)= NS]

Table 2b. Root length (cm), Total Fresh Weight (g) and Total Dry Weight (g) of Galia C8 and Kırkağaç 637 Cultivars Measured on the 30th and 60th Days After Transplanting in Pot-Grown Plants

Total Fresh Weight(g)	30th		Mean	60th		Mean
Applications	G	K		G	K	
1	26.3H-M	17.3 M-S	21.8 def	51.2 HİJ	176.8 B-F	114.0bcd
2	22.1 İ-P	19.1 K-R	20.6 def	34.2 J	183.3 B-E	108.8 bcd
3	17.8 P-T	14.2OPQ	16.0 f	82.5 E-J	151.8 B-İ	117.2bcd
4	9.85 ST	25.2 İ-O	17.5 ef	32.20 J	100.7 C-J	66.5 cd
5	19.3 K-R	18.3 L-S	18.8 def	78.3 E-J	216.75 B	147.5 abc
6	10.8 RST	5.97 T	8.36 g	36.4 J	111.6B-J	74.0 cd
7	25.5 İ-N	21.5 İ-P	23.5 cde	62.7 F-J	51.4HİJ	57.0 d
8	11.9 Q-T	27.4 G-L	19.7def	55.4 HIJ	207.1 BC	131.2 bcd
9	24.8 İ-O	16.3 O-S	20.5 def	27.41 J	128.5B-J	78.0 bcd
10	49.9AB	44.1 BCD	47.0 a	87.3D-J	111.3 B-J	99.3 bcd
11	16.3 N-S	28.1 F-K	22.36 c-f	33.7 J	157.7 B-İ	95.7 bcd
12	23.8 İ-O	46.5 AB	35.16 b	50.1HİJ	164.3B-H	107.2 bcd
13	23.1 İ-P	20.6 J-Q	21.80 def	75.0 E-J	357.7 A	216.3 a
14	30.4 E-İ	20.0 J-Q	25.2 cd	171.6 B-G	93.9 C-J	132.7 bcd
15	18.7 L-S	29.1E-J	23.9cde	76.1 E-J	137.7 B-J	106.9 bcd
16	22.2 İ-P	18.6 L-S	20.4 def	76.5E-J	46.02İJ	61.3 d
17	27.1 G-L	30.3 E-İ	28.7 c	45.3 İJ	386.67 A	216.0 a
18	17.4 M-S	23.8 İ-O	20.6 def	121.7 B-J	46.19 İJ	84.0 bcd
19	27.9 F-K	45.3 BC	36.6 b	117.9 B-J	199.2 BCD	158.6 ab
20	55.4 A	41.8 BCD	48.7a	199.4 BCD	43.73 İJ	121.6 bcd
21	36.6 C-F	37.3CDE	36.9 b	132.4 B-J	95.8 C-J	114.1 bcd
22	35.2 D-H	35.4 D-G	35.3 b	201.BCD	61.9 G-J	131.5 bcd
23	20.3 J-Q	24.38 İ-O	22.3 c-f	176.1 B-G	29.49 J	102.8 bcd
Mean	24.54	24.89		88.03	141.72	

30th [D % 1 (Application)= 6.47 D % 1 (Cultivar)= NS D % 1 (Application x Cultivar)= 9.14]
60th [D % 1 (Application)= 81.12 D % 1 (Cultivar)= 16.92 D % 1 (Application x Cultivar)= 115.11]

Total Dry Weight(g)	30th		Mean	60th		Mean
Applications	G	K		G	K	
1	4.52 İ-N	3.58 LMN	4.05 hij	15.0 KL	66.6 B-İ	40.8 c-g
2	4.48 İ-N	3.32 MN	3.90 j	49.5D-L	68.7 B-H	59.1 a-d
3	6.20 D-İ	4.88 H-N	5.54 e-h	18.26 KL	37.3 E-L	27.8 d-g
4	3.85 K-N	4.23 İ-N	4.04 ij	16.89 KL	20.1JKL	18.5 g
5	3.35 MN	4.23 İ-N	3.90 j	24.7 H-L	56.9 B-K	40.8 c-g
6	3.28 MN	2.87 N	3.80 j	11.73 L	48.4 D-L	30.1 d-g
7	3.21 MN	4.98 H-M	4.10 hij	24.3 K-L	26.8 G-L	25.6 efg
8	3.95 J-N	4.44 İ-N	4.20 g-j	73.2 B-F	96.9AC	85.0 a
9	3.13 MN	5.08 G-M	4.11 g-j	8.34 L	45.9 D-L	27.1 d-g
10	8.96 AB	5.78 F-K	7.37 bcd	44.1 D-L	26.2 G-L	35.1 c-g
11	6.75 C-H	7.27 B-F	7.01 b-e	43.6 D-L	46.6 D-L	45.1 b-g
12	5.77 F-K	5.98 E-J	5.88 ef	25.2 H-L	66.5 B-İ	45.8 b-g
13	5.77 F-K	6.23 D-İ	6.00 def	28.1 F-L	101.8 AB	35.0 abc
14	7.90 B-E	5.00 H-M	6.45 c-f	51.6C-L	40.5 E-L	46.0 b-g
15	6.21 D-İ	5.84 E-K	6.03 def	43.0 D-L	71.5 B-G	57.2 a-f
16	4.94 H-N	5.96 E-J	5.45 f-i	31.8 F-L	17.8 KL	24.8 fg
17	7.19 B-G	8.42 ABC	7.80 abc	33.3 F-L	122.3 A	77.8 ab
18	3.82 K-N	8.14 A-D	5.98 def	64.6 B-J	32.2 F-L	48.4 b-g
19	8.18 A-D	6.87 B-H	7.52 bc	50.2 D-L	65.1 B-J	57.7 a-e
20	8.84 ABC	7.55 B-F	8.19 ab	125.6 A	22.12 İ-L	73.8 ab
21	8.40 ABC	10.13 A	9.27 a	44.8 D-L	27.9 F-L	36.4 c-g
22	5.61 F-L	5.58 F-L	5.59 efg	80.1 A-E	27.8 F-L	54.0 a-f
23	3.40 MN	3.05 MN	3.22 j	87.2 A-D	14.3 KL	50.7 b-g
Mean	5.55	5.63		68.97	79.76	

30th [D % 1 (Application)= 1.49 D % 1 (Cultivar)= NS D % 1 (Application x Cultivar)= 2.11]
60th [D % 1 (Application)= 32.74 D % 1 (Cultivar)= 10.92 D % 1 (Application x Cultivar)= 46.31]

1:OSU 142 2:M3 3:SP 245 4:Bioplin 5:Phosphert 6: EM1 7:Bio-one 8:Endoroots 9:Sim-derma 10:Spirulina 11:Organic Fertilizer 12:OSU 142+OF 13:M3+OF 14:SP 245+OF 15:Bioplin+OF 16:Phosphert+OF 17:EM1+OF 18:Bio-one+OF 19:Endoroots+OF 20:Sim-derma+OF 21:Spirulina+OF 22:DAP+Urea 23:Control G:Galia C8 K: Kırkağaç 637; "They were applied separately and in combination with the organic fertilizer formulation."

Fernando et al. (2018) demonstrated that *Trichoderma saturnisporum* isolates significantly enhance melon seedling vigor, root development, and overall crop productivity without compromising fruit quality. Their findings align with our results, highlighting the potential of specific microbial biostimulants to improve both early growth stages and yield parameters in melon cultivation. This reinforces the role of *Trichoderma* species as effective biostimulants that can be integrated into sustainable horticultural practices to boost productivity while maintaining crop quality.

Fresh weights of roots and stems (Table 3a,b) followed similar patterns, with Spirulina + OF, Sim-derma + OF, and EM1 + OF treatments markedly increasing biomass relative to controls. Enhanced biomass reflects improved nutrient uptake and hormonal stimulation, consistent with findings from Ghosh and Mohiuddin (2000) and Arıkan et al. (2013).

Yield data summarized in Table 4a,b showed no statistically significant differences among treatments or cultivars, but the second year exhibited a significantly higher average yield (3.202 tonnes/da) compared to the first year (1.441 tonnes/da), emphasizing environmental impacts. No statistically significant differences were detected among treatments or cultivars ($p > 0.05$). Spirulina + OF, EM1, and BIOPLIN treatments achieved the highest yields (above 2.500 tonnes/da), while control plots had the lowest (1.704 tonnes/da), highlighting the productivity benefits of combined biostimulant and organic fertilizer applications. Galia C8 tended to outperform Kırkağaç 637 in yield, though both cultivars showed similar trends. These outcomes corroborate previous studies reporting yield increases with biostimulants and microbial inoculants (Pırlak & Köse, 2009; Vazquez-Hernandez et al., 2011, Bayu et al. 2025). The study by De Queirogo et al. (2020) demonstrated that the dose and timing of biostimulant application significantly affect melon yield and quality parameters. Specifically, biostimulant doses between 0.9 and 1.5 L/ha increased fruit number, fruit weight, and total production, while applications 15 days before harvest positively influenced soluble solids content. These findings align with our results, highlighting the critical role of optimizing biostimulant dosage and timing for improving yield and quality.

Across all parameters measured stem diameter and length (Table 1), node number (Table 1), root length and fresh weight (Table 3), stem fresh weight (Table 3), and yield (Table 5)—the integration of Spirulina, microbial inoculants, and organic fertilizers consistently enhanced vegetative growth and biomass accumulation in both melon cultivars compared to controls. Genetic differences between Galia C8 and Kırkağaç 637 influenced growth dynamics and response to treatments, underlining the importance of cultivar-specific nutrient management strategies to optimize melon production. These findings support and extend prior literature on the synergistic benefits of combining organic fertilization with biostimulants for sustainable crop improvement.

Table 3a. Root Fresh Weight (g), Stem Fresh Weight (g) and Leaf Fresh Weight (g) of Galia C8 and Kırkağaç 637 Cultivars Measured on the 30th and 60th Days After Transplanting in Pot-Grown Plants

Root Fresh Weight (g)	30th		Mean	60th		Mean
Applications	G	K		G	K	
1	9.13 F-O	5.18 J-P	7.16 fgh	10.7 D-M	8.41 G-O	9.55 d-h
2	7.16 F-P	7.04 F-P	7.10 f-i	6.05 L-P	13.8 A-H	9.94 c-g
3	5.91 H-P	4.63 K-P	5.27 hi	11.9 D-L	9.04 G-O	10.35 c-g
4	2.79 M-P	13.1 C-H	7.93 e-h	2.35 P	15.3 A-E	8.82 e-h
5	5.27 İ-P	8.98 F-O	7.14 fgh	6.45 J-P	18.7 AB	12.57 a-f
6	2.13 NOP	1.28 P	1.70 i	5.94 L-P	4.97 M-P	5.45 hi
7	14.1 CF	10.1 E-M	12.1 d-g	4.39 NOP	15.1 A-F	9.76 d-g
8	2.08 OP	11.5 D-K	6.80 ghi	6.5 J-P	7.57 İ-P	7.0 ghi
9	8.59 F-P	7.17 F-P	7.88 e-h	2.38 P	6.43 K-P	4.4 i
10	18.6 CD	18.7 CD	18.69 bc	9.45 E-N	4.61 NOP	7.02 ghi
11	5.33 İ-P	9.73 E-N	7.53 fgh	3.10 OP	18.5 AB	10.8 b-g
12	5.95 G-P	19.9 BC	12.94 de	7.80 İ-P	13.3 B-İ	10.54 c-g
13	6.30 G-P	6.75 F-P	6.53 hi	7.94 H-P	6.95 J-P	7.44 ghi
14	6.48 F-P	6.31 G-P	6.40 hi	11.4 D-L	8.96 G-O	10.19 c-g
15	5.50 H-P	12.90 C-İ	9.20 e-h	10.0 E-N	18.2 ABC	14.1 abc
16	4.96 K-P	6.47 F-P	5.71 hi	13.1 B-İ	13.9 A-H	13.5 a-d
17	6.20 G-P	10.2 E-M	8.21 e-h	4.80 M-P	5.88 L-P	5.34 hi
18	3.83 L-P	12.3 D-K	8.05 e-h	13.6 B-İ	12.5 C-J	13.0 a-e
19	12.8 C-J	17.2CDE	15.01 cd	4.63 NOP	4.34 NOP	4.48 i
20	27.0 B	19.0CD	22.97 ab	14.2 A-G	16.4 A-D	15.25 a
21	45.3 A	7 .8 F-P	26.53 a	10.1 E-N	19.64 A	14.84 ab
22	13.6 C-G	11.4 D-L	12.47 def	12.1 D-K	6.00 L-P	9.03 e-h
23	6.21 G-P	7.68 F-P	6.95 ghi	9.15 F-N	8.10 H-P	8.62 f-i
Mean	9,79	10,22		8.16 b	11.15 a	

30th [D % 1 (Application)= 5.4 D % 1 (Cultivar)= NS D % 1 (Application x Cultivar)= 7.4]
60th [D % 1 (Application)= 4.26 D % 1 (Cultivar)= 1.26 D % 1 (Application x Cultivar)= 6.03

Table 3a. Root Fresh Weight (g), Stem Fresh Weight (g) and Leaf Fresh Weight (g) of Galia C8 and Kırkağaç 637 Cultivars Measured on the 30th and 60th Days After Transplanting in Pot-Grown Plants

Stem Fresh Weight (g)	30th		Mean	60th		Mean
Applications	G	K		G	K	
1	6.38 F-K	5.44 G-M	5.91 fgh	14.26 Hİ	59.23 C-İ	36.7 b-e
2	6.15 G-L	4.79 H-M	5.47 fgh	11.90 Hİ	68.10 C-İ	40.0b-e
3	4.18 İ-M	4.25 H-M	4.21 ghi	22.64 E-İ	57.14 C-İ	39.8 b-e
4	2.61 LM	4.61 H-M	3.61 hi	12.93 Hİ	21.74 F-İ	17.3 de
5	5.12 H-M	3.40 KLM	4.26 ghi	26.06 E-İ	73.6 C-G	49.8 b-e
6	3.44 KLM	1.69 M	2.56 i	12.30 Hİ	45.22 C-İ	28.7 cde
7	4.12 İ-M	4.27 H-M	4.20 ghi	10.32 İ	17.9 GHİ	14.1 e
8	3.52 J-M	5.84 G-L	4.68 ghi	20.5 GHİ	81.2 CDE	50.9 b-e
9	6.38 F-K	11.5 ABC	8.91 bcd	11.12 Hİ	58.63 C-İ	34.9 b-e
10	12.76 AB	9.04 B-G	10.90 ab	27.10 E-İ	51.3 C-İ	39.2 b-e
11	5.00 H-M	7.73 C-İ	6.36 d-g	14.06 Hİ	102.5 BC	58.3 bcd
12	5.40 A-F	10.0 G-M	7.71 c-f	11.17 Hİ	55.84 C-İ	33.5 c-e
13	6.82 E-K	5.80 G-L	6.61 d-g	11.67 Hİ	140.0 AB	75.8 ab
14	12.42 AB	4.89 H-M	8.66 b-e	15.3 GHİ	41.99 D-İ	28.7 cde
15	4.35 H-M	6.64 E-K	5.49 fgh	12.31 Hİ	69.7 C-H	41.0 b-e
16	5.04 H-M	4.93 H-M	4.99 ghi	14.24 Hİ	13.60 H-İ	13.9 e
17	7.64 D-İ	7.97 C-H	7.80 c-f	19.7 GHİ	187.6 A	103.7 a
18	5.03 H-M	3.60 J-M	4.32 ghi	11.77 Hİ	14.0 H-İ	12.9 e
19	7.02 E-K	10.3A-E	8.64 b-e	11.24 Hİ	62.9 C-İ	37.0 b-e
20	11.3 A-D	9.08 B-G	10.2 abc	79.7 C-F	13.2 H-İ	46.4 b-e
21	13.3 A	11.2 A-D	12.26 a	55.80 C-İ	30.8 D-İ	43.3 b-e
22	7.25 E-J	9.93 A-F	8.59 b-e	92.2 BCD	28.4 E-İ	60.3 bc
23	5.35 G-M	6.68 E-K	6.01 e-h	64.38 C-İ	10.7 İ	37.5 b-e
Mean	6.54	6.68		25.33 b	56.76 a	

30th [D % 1 (Application)= 2.62 D % 1 (Cultivar)= NS D % 1 (Application x Cultivar)= 3.61]
60th [D % 1 (Application)= 41.44 D % 1 (Cultivar)= 12.22 D % 1 (Application x Cultivar)= 58.61]

Leaf Fresh Weight (g)	30th		Mean	60th		Mean
Applications	G	K		G	K	
1	10.8 F-L	6.66 L-Q	8.71 fg	9.66 HİJ	97.6 B-F	58.6 bc
2	8.81 J-O	7.29 L-P	8.05 fg	16.3 HİJ	101.4 B-E	58.8 bc
3	7.69 K-P	5.27 OPQ	6.48 fgh	43.7 F-J	85.7 B-G	64.7 bc
4	4.46 PQ	7.53 K-P	5.99 gh	16.9 HİJ	38.6 G-J	27.7 cde
5	8.93 İ-O	6.77 L-Q	7.85 fg	45.7 F-J	118.6 B	82.14 ab
6	5.40 N-Q	2.97Q	4.19 h	18.1 HİJ	60.8 C-J	39.4 cde
7	7.40 K-P	7.15 L-Q	7.28 fg	12.05 İJ	18.3 HİJ	15.2 e
8	6.33 M-Q	10.0 H-M	8.17 fg	11.60 İJ	117.1 B	64.3 bc
9	9.86 H-M	4.89 OPQ	7.38 fg	13.9 HİJ	63.7 B-J	38.78 cde
10	18.45 A	16.5A-D	17.5 ab	27.6 HİJ	55.31 C-J	41.45 cde
11	6.00 M-Q	10.8 F-L	8.39 fg	16.6 HİJ	46.9 E-J	31.7 cde
12	11.6 E-K	16.6 ABC	12.1 cd	20.7 HİJ	95.2 B-F	57.7 bcd
13	9.97 H-M	7.97 J-P	8.97 efg	15.8 HİJ	210.6 A	113.2 a
14	15.0 A-F	8.82 J-O	11.9 de	23.1 HİJ	42.9F-J	33.0 cde
15	8.10 J-P	9.56 H-N	8.83 fg	15.6 HİJ	49.8 D-J	32.73cde
16	10.6 G-L	7.19 L-Q	8.91 efg	19.7 HİJ	18.5 HİJ	19.10 de
17	13.2 C-İ	12.2 D-J	12.68 cd	20.8 HİJ	193.2 A	107.0 a
18	8.50 J-P	7.96 J-P	8.23 fg	39.3 G-J	19.7 HİJ	29.5 cde
19	8.05 J-P	17.77 AB	12.9 cd	61.4 C-J	68.2 B-H	64.8 bc
20	17.2ABC	13.8 B-H	15.5 abc	108.1 BC	14.2HİJ	61.7 bc
21	17.6 AB	18.3 A	17.9 a	66.5B-İ	45.4 F-J	55.9bcd
22	14.4 A-G	15.1 A-E	14.8 bcd	97.0B-F	36.3 G-J	66.6 bc
23	8.74 J-P	10.0 H-M	9.38 ef	102.6 BCD	10.70 J	56.6bcd
Mean	10.31	10.04		36.17 b	69.94 a	

30th [D % 1 (Application)= 3.03 D % 1 (Cultivar)= NS D % 1 (Application x Cultivar)= 4.30]
60th [D % 1 (Application)= 39.28 D % 1 (Cultivar)= 11.58 D % 1 (Application x Cultivar)= 55.55]

1:OSU 142 2:M3 3:SP 245 4:Bioplin 5:Phosphert 6: EM1 7:Bio-one 8:Endoroots 9:Sim-derma 10:Spirulina 11:Organic Fertilizer 12:OSU 142+OF 13:M3+OF 14:SP 245+OF 15:Bioplin+OF 16:Phosphert+OF 17:EM1+OF 18:Bio-one+OF 19:Endoroots+OF 20:Sim-derma+OF 21:Spirulina+OF 22:DAP+Urea 23:Control G:Galia C8 K: Kırkağaç 637; "They were applied separately and in combination with the organic fertilizer formulation."

Table 4a. Root Dry Weight (g), Stem Dry Weight (g) and Leaf Dry Weight (g) of Galia C8 and Kırkağaç 637 Cultivars Measured on the 30th and 60th Days After Transplanting in Pot-Grown Plants

Root Dry Weight (g)	30th		Mean	60th		Mean
Applications	G	K		G	K	
1	1.35 J-O	1.15 K-O	1.24 ghi	3.05 İ-L	4.60 F-K	3.82 g-k
2	0.88 O	1.13 L-O	1.01 i	15.8 B	8.74 CDE	12.24 b
3	2.93 E-J	2.27 G-O	2.60 c-f	4.28 F-L	2.50 KL	3.39 h-k
4	1.67 İ-O	2.36 F-O	2.01 f-i	1.85 KL	4.37 F-L	3.11 h-k
5	2.53 F-M	2.55 F-M	2.54 c-f	1.83 KL	6.54 E-H	4.18 f-k
6	0.89 NO	1.05 MNO	0.97 i	2.68 İ-L	1.85 KL	2.26 jk
7	1.42 J-O	2.88 E-J	2.15 e-h	2.62 İ-L	8.04 CDE	5.33 e-h
8	0.82 O	1.71 İ-O	1.26 ghi	4.66 F-K	8.19 CDE	6.42 def
9	0.80 O	3.66 B-G	2.23 d-g	1.07 L	2.92 İ-L	2.00 k
10	4.65 A-D	2.66 F-L	3.65 abc	4.52 F-K	2.02 KL	3.27 h-k
11	3.24 D-İ	3.93 A-F	3.58 abc	1.50 KL	6.92 D-F	4.21 f-k
12	2.11 G-O	2.02 H-O	2.07 f-i	6.83 EH	8.40 CDE	7.61 cde
13	2.04 H-O	2.51 F-N	2.27 d-g	4.46 F-K	2.11 KL	3.28 h-k
14	2.66 F-L	2.13 G-O	2.39 d-f	4.68 F-K	4.39 F-L	4.53 f-j
15	2.87 E-J	2.88 E-J	2.87 b-f	10.2 CD	8.75 CDE	9.49 c
16	1.13 L-O	3.05 E-İ	2.09 f-i	8.76 CDE	7.62 C-F	8.19 cd
17	2.72 F-K	4.90 ABC	3.81 ab	2.55 JKL	2.97 İ-L	2.76 ıjk
18	1.08 L-O	5.43 A	3.25 b-e	3.53 H-L	8.83 CDE	6.18 d-g
19	4.35 A-E	3.45 C-H	3.90 ab	4.60 F-K	2.01 KL	3.30 h-k
20	5.06 AB	4.31 A-E	4.68 a	21.15 A	10.43 C	15.79 a
21	2.67 F-L	3.94 A-F	3.30 bcd	5.94 E-İ	10.85 C	8.40 cd
22	2.33 G-O	1.38 J-O	1.85 f-i	6.58 EH	2.20 KL	4.39 f-j
23	0.94 N-O	1.23 K-O	1.08 hi	5.87 E-J	3.80 G-L	4.84 f-i
Mean	2.22 b	2.72 a		5.61	5.61	

30th [D % 1 (Application)= 1.12 D % 1 (Cultivar)= 0.33 D % 1 (Application x Cultivar)= 1.58]
60th [D % 1 (Application)= 2.37 D % 1 (Cultivar)= NS D % 1 (Application x Cultivar)= 3.36

Stem Dry Weight (g)	30th		Mean	60th		Mean
Applications	G	K		G	K	
1	1.16 C-İ	0.90 D-İ	1.03 cde	3.33 Hİ	16.38 B-İ	9.86 c-g
2	1.00 D-İ	0.67 GHİ	0.84 de	15.52 B-İ	18.13 B-İ	16.83 a-f
3	1.12 C-İ	0.89 D-İ	1.01 cde	4.28 GHİ	11.78 D-İ	8.03 efg
4	0.63 Hİ	0.63 Hİ	0.63 e	4.46 F-İ	3.27 Hİ	3.86 g
5	2.21 GHİ	2.11 ABC	1.40 bcd	7.83 F-İ	15.56 B-İ	11.7 b-g
6	0.78 F-İ	0.51 İ	0.64 e	2.68 Hİ	8.42 E-İ	5.55 fg
7	1.28 C-İ	0.68 GHİ	0.98 cde	6.39 F-İ	7.68 F-İ	7.03 efg
8	0.93 D-İ	0.82 E-İ	0.88 cde	24.4 A-E	30.1 ABC	27.3 a
9	0.75 F-İ	0.76 F-İ	0.76 de	2.44 İ	18.16 B-İ	10.3 b-g
10	1.72 B-F	0.96 D-İ	1.34 b-e	13.32 D-İ	15.42 B-İ	14.4 b-g
11	1.47 C-İ	1.67 B-G	1.57 bc	14.8 B-İ	20.9 B-F	17.8 a-e
12	0.97 D-İ	1.31 C-İ	1.14 b-e	7.09 F-İ	14.09 C-İ	10.6 c-g
13	1.16 C-İ	1.34 C-İ	1.25 b-e	6.41 F-İ	38.82 A	22.6 ab
14	1.83 A-D	0.93 D-İ	1.38 bcd	8.77 E-İ	10.95 D-İ	9.86 c-g
15	1.04 D-İ	1.34 C-İ	1.19 b-e	11.7 D-İ	30.76 AB	21.2 abc
16	1.68 B-G	1.01 D-İ	1.34 b-e	6.920 F-İ	4.24 GHİ	5.58 fg
17	2.59 AB	1.07 D-İ	1.83 b	4.08 GHİ	40.87 A	22.4 ab
18	0.78 F-İ	0.76 F-İ	0.77 de	13.95 C-İ	9.81 E-İ	11.9 b-g
19	1.53 C-H	1.05 D-İ	1.29 b-e	15.53 B-İ	20.0 B-G	17.8 a-e
20	1.50 C-İ	1.03 D-İ	1.26 b-e	37.68 A	4.39 A	21.0 a-d
21	2.80 A	2.75 A	2.78 a	13.15 D-İ	5.49 F-İ	9.32 d-g
22	0.82 E-İ	1.82 A-E	1.32 b-e	19.3 B-H	4.52 F-İ	11.9 b-g
23	2.09 ABC	0.81 F-İ	1.45 bcd	26.7 A-D	3.80 GHİ	15.2 b-g
Mean	1.32	1.12		11.77 b	15.27 a	

30th [D % 1 (Application)= 0.71 D % 1 (Cultivar)= NS D % 1 (Application x Cultivar)= 1.01]
60th [D % 1 (Application)= 11.74 D % 1 (Cultivar)= 3.46 D % 1 (Application x Cultivar)= 16.64]

Table 4b. Root Dry Weight (g), Stem Dry Weight (g) and Leaf Dry Weight (g) of Galia C8 and Kırkağaç 637 Cultivars Measured on the 30th and 60th Days After Transplanting in Pot-Grown Plants

Leaf Dry Weight (g)	30th		Mean	60th		Mean
Applications	G	K		G	K	
1	2.01	1.53	1.77	6.81 L	45.7 A-H	26.2 b-e
2	1.97	1.53	1.78	18.3 G-L	41.9 B-J	30.0a-e
3	2.15	1.88	2.01	9.70 JKL	52.8 A-F	31.2 a-e
4	1.56	1.24	1.40	10.59 İ-L	9.74 JKL	10.17 e
5	1.55	1.04	1.29	15.0 H-L	34.4 B-L	24.71 b-e
6	1.62	1.33	1.48	6.37 L	23.3 E-L	14.9 cde
7	1.45	1.42	1.43	15.3 H-L	11.1 İ-L	13.20 de
8	1.87	1.91	1.89	44.06 B-İ	58.6A-D	51.3 a
9	1.58	1.43	1.50	4.82 L	24.8 E-L	14.8 cde
10	2.59	2.16	2.38	28.7 C-L	9.62 JKL	19.18 b-e
11	2.05	1.67	1.86	8.45 JKL	18.8 G-L	13.6 cde
12	2.71	2.65	2.68	11.2 İ-L	41.1 B-K	26.21 b-e
13	2.68	2.39	2.53	17.2 H-L	60.9 ABC	39.06 ab
14	2.44	1.95	2.19	38.1 B-L	25.2 D-L	31.64 a-e
15	2.30	1.63	1.96	21.0 F-L	32.0 C-L	26.51 b-e
16	2.14	1.90	2.02	16.1 H-L	8.08 KL	12.10 e
17	1.88	2.45	2.16	26.6 D-L	78.48 A	52.56 a
18	1.95	1.95	1.95	24.7 E-L	13.6 H-L	19.13 b-e
19	2.30	2.41	2.35	30.1 C-L	32.1 C-L	31.11 a-e
20	2.31	2.19	2.25	66.72 AB	7.30 L	37.0 abc
21	2.94	3.44	3.19	25.7 D-L	11.6 İ-L	18.6 b-e
22	2.46	**2.39**	2.43	51.8 A-G	21.1 F-L	36.4 a-d
23	1.36	6.20	3.78	54.7 A-E	6.64	30.7 a-e
Mean	2.08	2.12		24.01	29.08	

30th [D % 1 (Application)= NS D % 1 (Cultivar)= NS D % 1 (Application x Cultivar)= NS]
60th [D % 1 (Application)= 23.74 D % 1 (Cultivar)= NS D % 1 (Application x Cultivar)= 33.58]

1:OSU 142 2:M3 3:SP 245 4:Bioplin 5:Phosphert 6: EM1 7:Bio-one 8:Endoroots 9:Sim-derma 10:Spirulina 11:Organic Fertilizer 12:OSU 142+OF 13:M3+OF 14:SP 245+OF 15:Bioplin+OF 16:Phosphert+OF 17:EM1+OF 18:Bio-one+OF 19:Endoroots+OF 20:Sim-derma+OF 21:Spirulina+OF 22:DAP+Urea 23:Control G:Galia C8 K: Kırkağaç 637; "They were applied separately and in combination with the organic fertilizer formulation."

Table 5. Yield(tonnes/da) of Galia C8 and Kırkağaç 637

Yield (tonnes/da)	30th		**60th**		Mean
Applications	G	K	G	K	
1	2230,00	3085,00		2712,00	2322,00
2	1461,00	2868,00	1263,00	3498,00	2318,00
3	1872,00	3104,00	1442,00	3215,00	2312,00
4	1275,00	3695,00	1057,00	3698,00	2525,00
5	2014,00	3528,00	1434,00	3173,00	2479,00
6	1382,00	4009,00	1199,00	3195,00	2562,00
7	1795,00	2996,00	1661,00	2483,00	2177,00
8	1592,00	3312,00	1433,00	3183,00	2398,00
9	1300,00	2964,00	1506,00	3194,00	2296,00
10	1050,00	3765,00	1725,00	3559,00	2317,00
11	1539,00	2856,00	0.892	3277,00	2402,00
12	1272,00	3664,00	1937,00	2944,00	2276,00
13	1540,00	2861,00	1223,00	2946,00	2197,00
14	1170,00	2976,00	1440,00	3526,00	2281,00
15	1379,00	2711,00	1451,00	3408,00	2368,00
16	1370,00	2673,00	1973,00	2971,00	2096,00
17	1512,00	3412,00	1344,00	3594,00	2541,00
18	1317,00	2932,00	1645,00	2924,00	2151,00
19	1822,00	3638,00	1430,00	3059,00	2389,00
20	1607,00	3347,00	1038,00	2676,00	2232,00
21	1373,00	4219,00	1298,00	3437,00	2572,00
22	1449,00	3526,00	1259,00	3828,00	24,84
23	1229,00	1802,00	1131,00	2841,00	1704,00
Mean	2359,00	2284,00	1.441 b	3.201 a	

D % 5 (Application)= NS; D % 5 (Year)= 19.70D % 5 (CultivarxYear)= NS; D % 5 (App. x Cult. x Year)= NS D % 1 (Cultivar)= NS; D % 5(Application x Year)= NS; D % 5 (Application x Cultivar)= NS

1:OSU 142 2:M3 3:SP 245 4:Bioplin 5:Phosphert 6: EM1 7:Bio-one 8:Endoroots 9:Sim-derma 10:Spirulina 11:Organic Fertilizer 12:OSU 142+OF 13:M3+OF 14:SP 245+OF 15:Bioplin+OF 16:Phosphert+OF 17:EM1+OF 18:Bio-one+OF 19:Endoroots+OF 20:Sim-derma+OF 21:Spirulina+OF 22:DAP+Urea 23:Control G:Galia C8 K: Kırkağaç 637; "They were applied separately and in combination with the organic fertilizer formulation."

This supports similar mechanisms of action reported by Gabriel-Ortega et al. (2024) and highlights the importance of selectively using specific types of biostimulants to optimize plant growth. The lack of significant differences observed in other parameters indicates that the effects of biostimulants may be variable and dependent on application conditions.

Conclusion

The integration of biostimulants, especially Spirulina and microbial inoculants, with organic fertilizers offers a promising strategy to enhance melon growth and biomass accumulation sustainably. This combined approach not only supports healthier and more vigorous plants but also aligns with environmentally friendly agricultural practices by reducing reliance on conventional chemical fertilizers.

Cultivar-specific responses emphasize the importance of tailoring fertilization programs to maximize crop potential, especially under the semi-arid conditions prevalent in regions like Adıyaman. Although yield differences were not statistically significant within the study period, the positive trends observed suggest that these biostimulant-organic fertilizer combinations can contribute to improved productivity and resilience in melon cultivation.

Overall, this study highlights the potential of biostimulant-enhanced organic fertilization as a viable component of sustainable horticultural management, offering benefits for both crop performance and environmental sustainability. Further research and field validation will help optimize these practices for broader agricultural application.

Declarations

Author Contribution Statement

Ceren Ayşe Bayram: Data collection, investigation, formal analysis, and writing the original draft

Nebahat Sari: Supervision, conceptualization, methodology, review and editing

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Conflict of Interest

The authors declare no conflict of interest.

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