Scientific J. of Horticultural Research
https://sjhr.journals.ekb.eg
ISSN (print): 2974-4563
ISSN (online): 2974-4571 **doi: 10.21608/sjhr.2024.397392**

RESPONSE OF VEGETATIVE GROWTH OF LEMON BALM TO COMPOST AND ANTIOXIDANT TREATMENTS

M.A.H. Abdou, Ragaa A. Taha and Randa A. Mahmoud
Hort. Dept., Fac. Agric., Minia Univ., Egypt

Scientific J. of Horticultural Research, 2(3):41-54 (2024).

Received:
12/6/2024
Accepted:
1/7/2024

Corresponding author:
M.A.H. Abdou
mahmoudhassanabdouh@gmail.com

ABSTRACT: This research was undertaken in the two seasons 2021/2022 and 2022/2023 at the Nursery of Ornamental Plants, Fac. Agric., Minia Univ., Egypt to examine the response of vegetative growth of *Melissa officinalis*, L. to compost (0, 4, 8 and 12 ton /feddan) and some antioxidants such as amino acids (1 and 2 ml/l) , seaweed extract (1.5 and 3 ml/l) and vitamin E (100 and 200 ppm) treatments. Data revealed that all vegetative growth (plant height, stem diameter, number of branches, leaf area and weights either fresh or dry were significantly increased with fertilizing plants with compost relative to control through the three cuts during both seasons. Moreover, all aforementioned parameters were increased from the first cut up to the third one except the plant height took the opposite trend. All treatments used of antioxidants significantly increased all above-mentioned parameters compared to the control through the three cuts during both seasons. Vitamin E at low concentration was superior in this concern. The best interaction treatment was to supplying plants with compost at 8 or 12 ton/fed and vitamin E at 100 ppm or sea algae at high concentration (3 ml/l).

Keywords: *Melissa officinalis*, antioxidant, vitamin E, amino acids, sea algae, vegetative growth

INTRODUCTION

Lemon balm (*Melissa officinalis* L.) belongs to the Lamiaceae family. It is one of the oldest medicinal plants in several countries. Nowadays, the plants cultivated in Egypt to traditional medicinals or industrials and for exportation (Simon *et al*., 1984; Bagdat and Cosge, 2006 and Said-Al Ahl *et al*., 2009).

To produce clean products, the researchers go to fertilizing medicinal plants with organic fertilization and enhancing growth by spraying plants with antioxidants. Many authors on different plants concluded that compost fertilizer significantly increased all vegetative growth studied parameters such as Abdelaziz *et al*. (2007), Khalil *et al*. (2008), Abdou *et al*. (2015a), and Abdou *et al*. (2020a), Youssef *et al*. (2020). Also, many researchers pointed out that antioxidants substances like amino acids, sea algae and vitamin E have a vital role to enhance plant growth and development such as Ahmed (2009), Majkowska-Gadomska *et al*. (2022) and Al-Fraihat *et al*. (2023) for amino acids; Sari and Ceylan (2002), Mansori *et al*. (2019) and Jafr *et al*. (2022) concerning sea algae and Ayad *et al*. (2009) and Abdou *et al*. (2012) regarding vitamin E.

Therefore, this study aimed to examine the impact of compost and some antioxidants on *melissa officinalis* growth.

MATERIALS AND METHODS

This study was conducted during the two seasons 2021/2022 and 2022/2023 in the Floricultural Farm, Fac. Agric., Minia Univ., Egypt to evaluate the influence of compost and some antioxidants in the growth of *Melissa officinalis*, L.

Plant material:

Melissa officinalis seedlings were obtained from the Floricultural Farm, Fac. Agric., Minia Univ. and were transplanted in the field on 1st week of December as usually cultivated in the farm under the supervision of Prof. Dr. Mahmoud A.H. Abdou in both seasons. The physiochemical properties of the used soil were performed according to Jackson (1973) as listed in Table (a).

Layout of the experiment:

The study consisted of 28 distinct treatments arranged in a split plot design, featuring four main treatments (0, 4, 8 and 12 ton compost/feddan) across seven antioxidants treatments (control, amino acids at 1 and 2 ml/l, seaweed extract at 1.5 and 3 ml/l and vitamin E at 100 and 200 ppm), with three replicates for each. The dimensions of the main plot measured 8.70 meters in length and 2 meters in width, accommodating 14 rows, while each replicate covered an area of 8 meters in width and 8.7 meters in length, resulting in a total experimental area of 208.8 square meters. Each treatment unit comprised two rows (6 plants/row), totaling 12 plants. The four compost treatments were assigned to the main plots, whereas the seven antioxidant treatments were designated for the sub-plots.

Compost, which is produced from plant residues, was procured from the Egypt Company for Circulate Solid Residues situated in New El-Minia City and was utilized at the soil preparation for cultivation during both growing seasons. The outcomes of the chemical analysis of the compost, as indicated on the label, can be found in Table (b).

Amino acids (Aminogen) containing free amino acids was released from Chema Industries, Egypt. Algae star product contains sea algae extract was obtained from Shoura Chemical Company, Cairo-Alexandria Desert Road, Giza Governorate, Egypt. Alpha tocopherol (vit. E) was supplied by Sigma Chemical Company, USA. The application of all antioxidants occurred on nine separate occasions, specifically three times prior to the initial harvest on the 20th of December, the 11th of January, and the 2nd of February; three times before the second harvest on the 6th of April, the 27th of April, and the 18th of May; and three times preceding the third harvest on the 15th of July, the 7th of August, and the 28th of August. Each treatment was administered until the plants were thoroughly saturated. All other agricultural practices were conducted in accordance with standard procedures. The plants were harvested three times during each season, with the cutting taking place 3 cm above the soil level. The three harvesting dates were the 21st of March, the 1st of July, and the 11th of October for both seasons.

Data recorded (in each cut):

Plant height (cm), stem diameter (mm), number of branches/plants, leaf area (cm^2), and plant aerial parts fresh and dry weights (g/plant/cut). Moreover, total herb fresh and dry weights per plant per season (g) and per fed/season (ton) were calculated.

Table a. The physiochemical properties of the used soil in both seasons of 2021/2022 and 2022/2023.

Soil character	Values		Soil character	Values	
	2021/2022	2022/2023		2021/2022	2022/2023
Physical properties			**Nutrients**		
Sand (%)	29.39	29.78	**Total N (%)**	0.77	0.78
Silt (%)	31.37	31.95	**Available P (ppm)**	18.6	19.1
Clay (%)	39.24	38.27	**Na^+ (mg/100 g soil)**	1.33	1.37
Soil type	Clay loam	Clay loam	**K^+ (mg/100 g soil)**	0.87	0.98
Chemical properties			**DTPA-Extractable nutrients**		
pH (1:2.5)	7.85	7.89	**Fe (ppm)**	1.65	1.72
E.C. (dS/m)	1.01	1.06	**Cu (ppm)**	0.42	0.44
O.M.	1.62	1.73	**Zn (ppm)**	0.46	0.49
$CaCO_3$	3.16	3.38	**Mn (ppm)**	0.51	0.54

Table b. Chemical analysis of the used compost in both seasons of 2021/2022 and 2022/2023.

Properties	Value	Properties	Value
Organic carbon (%)	25.1	**Total P (%)**	0.5
Humidity (%)	25	**Total K (%)**	1.0
Organic matter	44	**Fe (ppm)**	1750
C/N ratio	17.5	**Zn (ppm)**	60
pH (1:2.5)	8.0	**Mn (ppm)**	125
E.C. (m. mhos/cm.)	5	**Cu (ppm)**	200
Total N (%)	1.5		

Statistical analysis:

The data collected for all traits were organized into tables and subjected to statistical analysis using MSTAT–C (1986), followed by the LSD test (at 0.05) to facilitate comparisons among the treatment means.

RESULTS AND DISCUSSION

Regardless of the effect of all treatments, data listed in Tables (1 to 8) pointed out that all vegetative growth traits (plant height, stem diameter, number of branches per plant, leaf area, aerial parts fresh and dry weights per plant per cut) were the highest in the third cut than either 2nd or 1st cut, except plant height and leaf area, which were reduced. These increases in stem diameter, number of branches per plants, aerial parts fresh and dry weights per plant in the 3rd cut may be attributed to the fact that cutting plants gave the thickness diameter, a greater number of branches, and heaviest biomass either fresh or dry (Abdou *et al*., 2024 a and b) on rosemary and marjoram. Also, the decreases in plant height and leaf area in the 3rd cut may be due to the development after the harvest did not reach the stage of height and leaf formation.

Fertilizing lemon balm with 3 levels of compost (4, 8 and 12 ton/fed) led to significant increase in vegetative growth traits via plant height, stem diameter, number of branches per plants, leaf area, aerial parts fresh and dry weights per plant per cut relative to control through the three cuts during both seasons (Tables, 1 to 6). The increase in previous parameters was increased with increasing compost level, so, the high values were obtained from 12 ton/fed. At the same time, no significant differences were observed between 8 and 12 ton compost per feddan.

It was noticed that the total herb fresh and dry weights either per plant or per feddan per season were significantly increased over the control (Tables, 7 and 8). Such increase in total herb fresh and dry weights per feddan per season reached 33.67, 70.41 and 98.93% for herb fresh weight per feddan and 37.46, 66.15 and 85.95% over the control for herb dry weight per feddan due 4, 8 and 12 ton compost per feddan in the first season. Similar trends were detected in the second season (Table, 8).

Compost includes much of the mineral nutrients (macro and microelements) required for plant growth and yield Rahimpoor and Fallah (2018). Similar results due to the effect of compost on different plants were obtained by Abdelaziz *et al*. (2007) on *Rosmarinu officinalis*, Khalil *et al.* (2008) on *Salvia officinalis*, Abdou *et al*. (2015a) on *Cuminum cyminum*, and Abdou *et al*. (2020a), Youssef *et al*. (2020) on *Foeniculum vulgare*.

Data presented in Tables (1 to 6) clarified that plant height, stem diameter, number of branches per plant, leaf area, aerial parts fresh and dry weights per plant per cut of *Melissa officinalis* were noticeably augmented due to all used six antioxidant treatments (amino acids, sea algae extract and vitamin E, each at 2 concentrations) relative to the check treatment through the three cuts during both seasons. Also, the calculation of herbage fresh and dry weight either per plant or per feddan per season took the same line. Where vitamin E at 100 ppm followed by vitamin E at 200 ppm then sea algae extract at 3 ml/l were the best treatments augmented by the highest values. The increase in herb fresh weight per feddan over the control measured 131.12, 108.38 and 94.57% and 90.94, 78.58 and

Table 1. Response of *Melissa officinalis* plant height (cm) to compost fertilization and some antioxidants throughout the three cuttings during both seasons (2021/2022 and 2022/2023).

Antioxidant treatments (B)	Compost fertilization level, ton/feddan (A)									
	0.0	4	8	12	Mean (B)	0.0	4	8	12	Mean (B)
	First season (2021/2022)					Second season (2022/2023)				
Cut number 1										
Control	27.0	36.3	62.0	64.5	47.5	29.8	51.0	55.5	60.0	49.1
AA (1 ml/l)	35.0	59.0	66.5	69.1	57.4	32.8	58.5	61.7	66.0	54.8
AA (2 ml/l)	40.5	64.5	71.8	74.0	62.7	43.5	66.0	68.0	69.5	61.8
SAE (1.5 ml/l)	43.7	71.5	75.6	79.6	67.6	46.4	70.3	71.2	73.6	65.4
SAE (3 ml/l)	54.1	75.0	80.6	84.7	73.6	50.2	74.5	75.6	76.7	69.3
Vit. E (100 ppm)	66.5	81.5	86.0	88.6	80.7	54.5	76.0	79.7	84.5	73.7
Vit. E (200 ppm)	60.3	79.5	85.5	87.0	78.1	52.1	75.0	76.2	82.0	71.3
Mean (A)	46.7	66.8	75.4	78.2	66.8	44.2	67.3	69.7	73.2	63.6
L.S.D. at 5 %	A: 4.5		B: 3.5		AB: 7.0	A: 4.4		B: 3.2		AB: 6.4
Cut number 2										
Control	22.0	46.5	50.5	54.5	43.4	26.0	50.4	52.3	57.0	46.4
AA (1 ml/l)	28.2	50.2	55.0	61.8	48.8	32.2	55.6	58.0	63.0	52.2
AA (2 ml/l)	32.7	58.0	65.3	70.0	56.5	36.8	60.4	63.5	67.2	57.0
SAE (1.5 ml/l)	42.5	63.2	70.5	74.0	62.6	42.1	66.5	67.5	69.5	61.4
SAE (3 ml/l)	50.5	64.0	73.5	74.1	65.5	46.0	69.8	70.5	73.4	64.9
Vit. E (100 ppm)	57.1	70.5	75.0	77.3	70.0	52.7	73.1	74.0	79.0	69.7
Vit. E (200 ppm)	56.0	69.5	72.5	73.8	68.0	49.0	71.0	72.8	76.0	67.2
Mean (A)	41.3	60.3	66.0	69.4	59.2	40.7	63.8	65.5	69.3	59.8
L.S.D. at 5 %	A: 4.2		B: 3.1		AB: 6.2	A: 4.1		B: 3.0		AB: 6.0
Cut number 3										
Control	20.0	23.5	28.3	29.0	25.2	16.5	22.0	23.3	27.0	22.2
AA (1 ml/l)	24.5	29.5	32.3	33.6	30.0	19.0	24.0	25.0	29.5	24.4
AA (2 ml/l)	27.2	31.2	34.1	35.1	31.9	22.4	28.4	29.8	31.4	28.0
SAE (1.5 ml/l)	31.1	35.7	36.2	36.7	34.9	26.7	30.0	30.6	33.4	30.2
SAE (3 ml/l)	33.7	36.8	39.3	39.8	37.4	29.6	31.2	32.5	34.5	32.0
Vit. E (100 ppm)	36.5	38.3	42.3	42.7	40.0	32.1	34.0	35.8	36.7	34.7
Vit. E (200 ppm)	34.8	37.0	40.1	42.2	38.5	30.0	33.5	34.8	35.1	33.4
Mean (A)	29.7	33.1	36.1	37.0	34.0	25.2	29.0	30.3	32.5	29.2
L.S.D. at 5 %	A: 2.6		B: 1.4		AB: 2.8	A: 2.5		B: 1.3		AB: 2.6

Where: AA (amino acids), SAE (sea algae extract) and Vit. E (vitamin E)

Table 2. Response of *Melissa officinalis* leaf area (cm^2) to compost fertilization and some antioxidants throughout the three cuttings during both seasons (2021/2022 and 2022/2023).

Antioxidant treatments (B)	Compost fertilization level, ton/feddan (A)									
	0.0	4	8	12	Mean (B)	0.0	4	8	12	Mean (B)
	First season (2021/2022)					Second season (2022/2023)				
	Cut number 1									
Control	0.86	0.99	1.05	1.15	1.01	0.88	1.04	1.09	1.18	1.05
AA (1 ml/l)	1.06	1.18	1.26	1.37	1.22	1.09	1.25	1.30	1.48	1.28
AA (2 ml/l)	1.16	1.19	1.27	1.38	1.25	1.18	1.27	1.32	1.50	1.32
SAE (1.5 ml/l)	1.37	1.40	1.48	1.59	1.46	1.38	1.48	1.53	1.69	1.52
SAE (3 ml/l)	1.47	1.50	1.58	1.69	1.56	1.49	1.59	1.64	1.80	1.63
Vit. E (100 ppm)	1.68	1.71	1.79	1.89	1.77	1.71	1.78	1.86	1.92	1.82
Vit. E (200 ppm)	1.57	1.60	1.68	1.78	1.66	1.61	1.69	1.75	1.81	1.72
Mean (A)	1.31	1.37	1.44	1.55	1.42	1.33	1.44	1.50	1.63	1.48
L.S.D. at 5 %	A: 0.06		B: 0.02		AB: 0.04	A: 0.1		B: 0.06		AB: 0.12
	Cut number 2									
Control	0.84	0.97	1.03	1.13	0.99	0.86	1.02	1.07	1.16	1.03
AA (1 ml/l)	1.04	1.16	1.23	1.34	1.19	1.07	1.23	1.27	1.45	1.25
AA (2 ml/l)	1.14	1.17	1.24	1.35	1.23	1.16	1.24	1.29	1.47	1.29
SAE (1.5 ml/l)	1.34	1.37	1.45	1.56	1.43	1.35	1.45	1.50	1.66	1.49
SAE (3 ml/l)	1.44	1.47	1.55	1.66	1.53	1.46	1.56	1.61	1.76	1.60
Vit. E (100 ppm)	1.65	1.68	1.75	1.85	1.73	1.68	1.74	1.82	1.88	1.78
Vit. E (200 ppm)	1.54	1.57	1.65	1.74	1.62	1.58	1.66	1.72	1.77	1.68
Mean (A)	1.28	1.34	1.42	1.52	1.39	1.31	1.41	1.47	1.59	1.45
L.S.D. at 5 %	A: 0.05		B: 0.02		AB: 0.04	A: 0.08		B: 0.06		AB: 0.12
	Cut number 3									
Control	0.83	0.95	1.01	1.10	0.97	0.85	1.00	1.05	1.13	1.01
AA (1 ml/l)	1.02	1.13	1.21	1.32	1.17	1.05	1.20	1.25	1.42	1.23
AA (2 ml/l)	1.11	1.14	1.22	1.33	1.20	1.13	1.22	1.27	1.44	1.27
SAE (1.5 ml/l)	1.32	1.34	1.42	1.53	1.40	1.33	1.42	1.47	1.62	1.46
SAE (3 ml/l)	1.41	1.44	1.52	1.62	1.50	1.43	1.53	1.58	1.73	1.57
Vit. E (100 ppm)	1.61	1.64	1.72	1.82	1.70	1.64	1.71	1.79	1.84	1.75
Vit. E (200 ppm)	1.51	1.54	1.61	1.71	1.59	1.55	1.62	1.68	1.74	1.65
Mean (A)	1.26	1.31	1.39	1.49	1.36	1.28	1.39	1.44	1.56	1.42
L.S.D. at 5 %	A: 0.04		B: 0.03		AB: 0.06	A: 0.06		B: 0.02		AB: 0.04

Where: AA (amino acids), SAE (sea algae extract) and Vit. E (vitamin E)

Table 3. Response of *Melissa officinalis* stem diameter (mm) to compost fertilization and some antioxidants throughout the three cuttings during both seasons (2021/2022 and 2022/2023).

Antioxidant treatments (B)	Compost fertilization level, ton/feddan (A)									
	0.0	4	8	12	Mean (B)	0.0	4	8	12	Mean (B)
	First season (2021/2022)					Second season (2022/2023)				
	Cut number 1									
Control	3.25	3.46	3.52	3.57	3.45	3.32	3.53	3.59	3.64	3.52
AA (1 ml/l)	3.28	3.48	3.56	3.59	3.48	3.35	3.55	3.63	3.66	3.55
AA (2 ml/l)	3.31	3.52	3.59	3.61	3.51	3.38	3.59	3.66	3.68	3.58
SAE (1.5 ml/l)	3.29	3.49	3.58	3.60	3.49	3.36	3.56	3.65	3.67	3.56
SAE (3 ml/l)	3.33	3.54	3.62	3.63	3.53	3.40	3.61	3.69	3.70	3.60
Vit. E (100 ppm)	3.36	3.57	3.65	3.67	3.56	3.43	3.64	3.72	3.74	3.63
Vit. E (200 ppm)	3.34	3.55	3.53	3.64	3.52	3.41	3.62	3.60	3.71	3.59
Mean (A)	3.31	3.52	3.58	3.62	3.50	3.37	3.59	3.65	3.69	3.57
L.S.D. at 5 %	A: 0.12		B: 0.02		AB: 0.04	A: 0.13		B: 0.03		AB: 0.06
	Cut number 2									
Control	3.35	3.56	3.63	3.68	3.55	3.42	3.64	3.71	3.75	3.63
AA (1 ml/l)	3.38	3.58	3.67	3.70	3.58	3.47	3.66	3.75	3.77	3.66
AA (2 ml/l)	3.41	3.63	3.70	3.72	3.61	3.49	3.70	3.78	3.79	3.69
SAE (1.5 ml/l)	3.39	3.59	3.69	3.71	3.59	3.48	3.67	3.78	3.78	3.68
SAE (3 ml/l)	3.43	3.65	3.73	3.74	3.64	3.52	3.72	3.81	3.81	3.72
Vit. E (100 ppm)	3.46	3.68	3.76	3.78	3.67	3.54	3.75	3.84	3.86	3.75
Vit. E (200 ppm)	3.44	3.66	3.64	3.75	3.62	3.53	3.73	3.72	3.82	3.70
Mean (A)	3.41	3.62	3.69	3.72	3.61	3.49	3.70	3.77	3.80	3.69
L.S.D. at 5 %	A: 0.14		B: 0.03		AB: 0.06	A: 0.16		B: 0.03		AB: 0.06
	Cut number 3									
Control	3.46	3.66	3.74	3.78	3.66	3.48	3.71	3.77	3.82	3.70
AA (1 ml/l)	3.49	3.68	3.78	3.79	3.69	3.51	3.73	3.81	3.84	3.72
AA (2 ml/l)	3.52	3.72	3.8	3.82	3.72	3.55	3.77	3.84	3.87	3.76
SAE (1.5 ml/l)	3.49	3.72	3.81	3.83	3.71	3.52	3.74	3.83	3.86	3.74
SAE (3 ml/l)	3.54	3.75	3.83	3.85	3.74	3.57	3.79	3.88	3.89	3.78
Vit. E (100 ppm)	3.56	3.77	3.84	3.86	3.76	3.61	3.82	3.91	3.93	3.82
Vit. E (200 ppm)	3.55	3.79	3.83	3.85	3.76	3.58	3.81	3.78	3.91	3.77
Mean (A)	3.52	3.73	3.80	3.83	3.72	3.55	3.77	3.83	3.87	3.75
L.S.D. at 5 %	A: 0.17		B: 0.03		AB: 0.06	A: 0.18		B: 0.02		AB: 0.04

Where: AA (amino acids), SAE (sea algae extract) and Vit. E (vitamin E)

Table 4. Response of *Melissa officinalis* number of branches to compost fertilization and some antioxidants throughout the three cuttings during both seasons (2021/2022 and 2022/2023).

Antioxidant treatments (B)	Compost fertilization level, ton/feddan (A)									
	0.0	4	8	12	Mean (B)	0.0	4	8	12	Mean (B)
	First season (2021/2022)					Second season (2022/2023)				
	Cut number 1									
Control	2.6	3.2	4.4	5.8	4.0	4.6	6.2	8.8	10.0	7.4
AA (1 ml/l)	5.0	5.8	7.8	9.2	7.0	6.0	7.4	10.2	11.2	8.7
AA (2 ml/l)	5.8	7.0	8.6	11.0	8.1	7.6	8.4	10.6	12.0	9.7
SAE (1.5 ml/l)	6.4	8.0	10.6	13.0	9.5	8.8	10.0	13.0	13.8	11.4
SAE (3 ml/l)	7.6	9.4	12.0	15.0	11.0	10.4	11.6	14.2	15.4	12.9
Vit. E (100 ppm)	9.8	13.0	14.0	17.6	13.6	11.4	13.2	15.2	17.6	14.4
Vit. E (200 ppm)	8.8	10.6	12.2	16.8	12.1	12.0	12.6	15.0	16.6	14.1
Mean (A)	6.6	8.1	9.9	12.6	9.3	8.7	9.9	12.4	13.8	11.2
L.S.D. at 5 %	A: 0.6		B: 0.4		AB: 0.8	A: 0.6		B: 0.4		AB: 0.8
	Cut number 2									
Control	6.0	7.2	7.8	8.4	7.4	7.0	8.4	9.6	11.8	9.2
AA (1 ml/l)	7.6	8.0	9.6	10.4	8.9	7.8	10.2	11.4	13.6	10.8
AA (2 ml/l)	8.4	9.4	10.4	13.4	10.4	9.2	12.0	12.6	14.8	12.2
SAE (1.5 ml/l)	10.0	10.6	11.2	15.6	11.9	10.2	13.4	14.4	16.0	13.5
SAE (3 ml/l)	12.0	12.4	13.0	16.4	13.5	11.4	14.0	15.0	17.4	14.5
Vit. E (100 ppm)	14.2	14.6	17.6	20.2	16.7	14.2	15.6	17.0	20.0	16.7
Vit. E (200 ppm)	12.4	13.6	15.2	19.2	15.1	12.6	15.0	16.6	19.0	15.8
Mean (A)	10.1	10.8	12.1	14.8	12.0	10.3	12.7	13.8	16.1	13.2
L.S.D. at 5 %	A: 0.8		B: 0.6		AB: 1.2	A: 1.0		B: 0.8		AB: 1.6
	Cut number 3									
Control	6.0	8.9	12.2	13.4	10.1	7.2	11.3	13.0	14.4	11.5
AA (1 ml/l)	7.2	11.0	14.4	16.8	12.4	8.4	13.2	15.6	17.8	13.7
AA (2 ml/l)	7.7	14.4	15.1	17.8	13.7	10.3	15.8	16.8	18.5	15.4
SAE (1.5 ml/l)	10.8	16.1	18.2	20.4	16.4	13.2	17.0	18.2	20.4	17.2
SAE (3 ml/l)	11.8	18.0	20.2	22.1	18.0	14.4	18.5	19.7	21.6	18.5
Vit. E (100 ppm)	19.4	21.1	21.8	29.0	22.9	17.8	19.0	21.1	23.3	20.3
Vit. E (200 ppm)	15.6	18.2	20.6	23.0	19.4	15.8	17.5	20.2	22.8	19.1
Mean (A)	11.2	15.4	17.5	20.4	16.1	12.4	16.0	17.8	19.8	16.5
L.S.D. at 5 %	A: 1.2		B: 1.0		AB: 2.0	A: 1.0		B: 0.6		AB: 1.2

Where: AA (amino acids), SAE (sea algae extract) and Vit. E (vitamin E)

Table 5. Response of *Melissa officinalis* herbage fresh weight (g/plant/cut) to compost fertilization and some antioxidants throughout the three cuttings during both seasons (2021/2022 and 2022/2023).

Antioxidant treatments (B)	Compost fertilization level, ton/feddan (A)									
	0.0	4	8	12	Mean (B)	0.0	4	8	12	Mean (B)
	First season (2021/2022)					Second season (2022/2023)				
Cut number 1										
Control	2.8	6.1	7.2	10.6	6.7	4.4	6.1	6.7	8.3	6.4
AA (1 ml/l)	3.9	7.2	8.3	11.1	7.6	5.0	7.8	9.4	10.6	8.2
AA (2 ml/l)	5.3	7.8	8.9	11.7	8.4	6.1	8.9	10.0	13.3	9.6
SAE (1.5 ml/l)	7.2	9.4	10.0	16.1	10.7	7.2	10.6	12.2	15.0	11.3
SAE (3 ml/l)	8.3	10.0	10.6	16.4	11.3	8.3	11.1	12.8	17.2	12.4
Vit. E (100 ppm)	11.7	12.8	15.6	19.4	14.9	10.0	13.3	20.0	21.7	16.3
Vit. E (200 ppm)	9.4	10.6	11.3	16.7	12.0	9.4	11.7	16.1	20.6	14.4
Mean (A)	6.9	9.1	10.3	14.6	10.2	7.2	9.9	12.5	15.2	11.2
L.S.D. at 5 %	A: 2.2		B: 0.6	AB: 1.2		A: 2.4		B: 0.8	AB: 1.6	
Cut number 2										
Control	10.8	15.0	23.3	28.3	19.4	8.9	14.4	16.7	22.8	15.7
AA (1 ml/l)	12.2	21.1	30.6	35.0	24.7	13.1	16.1	33.9	36.1	24.8
AA (2 ml/l)	13.2	23.3	37.8	42.8	29.3	14.1	21.7	38.9	42.2	29.2
SAE (1.5 ml/l)	13.6	27.8	43.9	49.4	33.7	16.9	42.8	47.2	53.9	40.2
SAE (3 ml/l)	16.9	31.1	46.7	52.8	36.9	22.8	33.9	51.1	58.3	41.5
Vit. E (100 ppm)	31.1	35.7	50.0	55.6	43.1	34.4	42.8	56.1	62.8	49.0
Vit. E (200 ppm)	22.8	33.3	47.2	53.9	39.3	31.1	37.2	52.2	59.4	45.0
Mean (A)	17.2	26.8	39.9	45.4	32.3	20.2	29.8	42.3	47.9	35.1
L.S.D. at 5 %	A: 4.3		B: 1.6	AB: 3.2		A: 4.9		B: 1.8	AB: 3.6	
Cut number 3										
Control	11.7	18.9	24.4	31.1	21.5	20.6	22.2	24.4	32.8	25.0
AA (1 ml/l)	20.0	22.2	27.2	34.4	26.0	23.3	28.3	31.7	35.6	29.7
AA (2 ml/l)	22.8	30.0	35.6	38.9	31.8	30.0	30.6	33.9	43.3	34.4
SAE (1.5 ml/l)	26.7	37.8	43.9	46.1	38.6	35.0	38.9	42.2	50.0	41.5
SAE (3 ml/l)	35.6	42.2	47.2	52.8	44.4	35.6	41.1	43.3	55.6	43.9
Vit. E (100 ppm)	46.7	50.0	53.9	60.6	52.8	40.0	42.8	46.1	65.0	48.5
Vit. E (200 ppm)	40.0	45.6	48.7	57.2	47.9	36.7	41.9	45.6	56.7	45.2
Mean (A)	29.0	35.2	40.1	45.9	37.6	31.6	35.1	38.2	48.4	38.3
L.S.D. at 5 %	A: 5.2		B: 2.1	AB: 4.2		A: 4.5		B: 2.2	AB: 4.4	

Where: AA (amino acids), SAE (sea algae extract) and Vit. E (vitamin E)

Table 6. Response of *Melissa officinalis* herbage dry weight (g/plant/cut) to compost fertilization and some antioxidants throughout the three cuttings during both seasons (2021/2022 and 2022/2023).

Antioxidant treatments (B)	Compost fertilization level, ton/feddan (A)									
	0.0	4	8	12	Mean (B)	0.0	4	8	12	Mean (B)
	First season (2021/2022)					Second season (2022/2023)				
	Cut number 1									
Control	2.1	2.4	3.0	3.3	2.7	2.5	2.8	3.7	4.0	3.3
AA (1 ml/l)	2.5	2.8	3.7	3.9	3.2	2.8	3.6	3.9	4.1	3.6
AA (2 ml/l)	2.8	3.3	3.9	4.4	3.6	3.5	4.1	4.3	4.5	4.1
SAE (1.5 ml/l)	3.0	3.7	4.1	4.6	3.8	3.9	4.3	4.4	4.5	4.3
SAE (3 ml/l)	3.2	4.2	4.7	5.0	4.3	4.2	4.7	4.9	5.2	4.7
Vit. E (100 ppm)	4.0	5.0	5.5	6.0	5.1	4.9	7.1	7.3	8.5	6.9
Vit. E (200 ppm)	3.6	4.7	5.3	5.8	4.8	4.6	4.8	5.4	6.1	5.2
Mean (A)	3.0	3.7	4.3	4.7	3.9	3.8	4.5	4.8	5.3	4.6
L.S.D. at 5 %	A: 0.6		B: 0.1		AB: 0.2	A: 0.6		B: 0.2		AB: 0.4
	Cut number 2									
Control	3.6	4.3	6.1	9.0	5.7	3.0	5.1	7.0	9.0	6.0
AA (1 ml/l)	4.4	8.0	8.4	10.6	7.8	4.1	6.6	7.5	9.5	6.9
AA (2 ml/l)	4.8	9.1	11.1	12.5	9.4	4.9	7.4	10.3	16.2	9.7
SAE (1.5 ml/l)	5.6	9.7	12.0	13.0	10.1	5.2	8.8	13.8	18.0	11.4
SAE (3 ml/l)	6.4	10.3	12.9	13.6	10.8	7.1	10.6	16.6	19.9	13.5
Vit. E (100 ppm)	7.2	11.9	14.7	16.2	12.5	8.0	17.9	18.7	21.3	16.5
Vit. E (200 ppm)	7.0	11.2	13.8	14.3	11.6	7.5	12.1	18.0	20.7	14.6
Mean (A)	5.6	9.2	11.3	12.7	9.7	5.7	9.8	13.1	16.4	11.2
L.S.D. at 5 %	A: 1.5		B: 0.9		AB: 1.8	A: 3.4		B: 0.8		AB: 1.6
	Cut number 3									
Control	6.4	7.9	7.8	8.7	7.7	6.4	8.6	8.7	12.0	8.9
AA (1 ml/l)	7.0	8.8	8.5	10.0	8.6	8.4	9.1	11.0	11.9	10.1
AA (2 ml/l)	7.2	9.2	9.9	13.3	9.9	10.1	10.7	13.1	15.0	12.2
SAE (1.5 ml/l)	7.9	9.6	11.0	14.3	10.7	12.9	14.8	16.2	16.7	15.2
SAE (3 ml/l)	8.4	10.1	13.8	14.4	11.7	16.0	17.3	17.9	18.4	17.4
Vit. E (100 ppm)	9.2	11.1	16.0	16.2	13.1	18.6	20.0	20.9	21.5	20.3
Vit. E (200 ppm)	8.8	10.6	14.9	15.1	12.4	18.0	19.2	19.2	20.1	19.1
Mean (A)	7.8	9.6	11.7	13.1	10.6	12.9	14.2	15.3	16.5	14.7
L.S.D. at 5 %	A: 1.7		B: 0.4		AB: 0.8	A: 1.3		B: 0.3		AB: 0.6

Where: AA (amino acids), SAE (sea algae extract) and Vit. E (vitamin E)

Table 7. Response of *Melissa officinalis* total herb fresh and dry weights (g/plant/season) to compost fertilization and some antioxidants during both seasons (2021/2022 and 2022/2023).

Antioxidant treatments (B)	Compost fertilization level, ton/feddan (A)									
	0.0	4	8	12	Mean (B)	0.0	4	8	12	Mean (B)
	First season (2021/2022)					Second season (2022/2023)				
	Fresh weight (g/plant/season)									
Control	25.3	40.0	55.0	70.0	47.6	33.9	42.8	47.8	63.9	47.1
AA (1 ml/l)	36.1	50.6	66.1	80.6	58.3	41.4	52.2	75.0	82.2	62.7
AA (2 ml/l)	41.3	61.1	82.2	93.3	69.5	50.2	61.1	82.8	98.9	73.3
SAE (1.5 ml/l)	47.5	75.0	97.8	111.7	83.0	59.2	92.2	101.7	118.9	93.0
SAE (3 ml/l)	60.7	83.3	104.4	121.9	92.6	66.7	86.1	107.2	131.1	97.8
Vit. E (100 ppm)	89.4	98.5	119.4	135.6	110.7	84.4	98.9	122.2	149.4	113.8
Vit. E (200 ppm)	72.2	89.4	107.2	127.8	99.2	77.2	90.7	113.9	136.7	104.6
Mean (A)	53.2	71.1	90.3	105.8	80.1	59.0	74.9	92.9	111.6	84.6
L.S.D. at 5 %	A: 15.6		B: 10.7	AB: 21.4		A: 15.9		B: 9.8	AB: 19.6	
	Dry weight (g/plant/season)									
Control	12.1	14.6	16.9	20.9	16.1	11.9	16.6	19.4	25.1	18.3
AA (1 ml/l)	13.9	19.7	20.5	24.4	19.6	15.3	19.3	22.4	25.5	20.6
AA (2 ml/l)	14.7	21.6	25.0	30.1	22.9	18.5	22.1	27.7	35.7	26.0
SAE (1.5 ml/l)	16.5	23.0	27.1	31.9	24.6	22.0	27.9	34.4	39.1	30.9
SAE (3 ml/l)	18.0	24.6	31.4	33.0	26.8	27.2	32.6	39.3	43.5	35.7
Vit. E (100 ppm)	20.4	28.1	36.2	38.4	30.8	31.5	44.9	47.0	51.3	43.7
Vit. E (200 ppm)	19.4	26.5	34.0	35.2	28.8	30.2	36.1	42.5	46.9	38.9
Mean (A)	16.4	22.6	27.3	30.6	24.2	22.4	28.5	33.2	38.2	30.6
L.S.D. at 5 %	A: 3.5		B: 2.1	AB: 4.2		A: 5.1		B: 2.3	AB: 4.6	

Where: AA (amino acids), SAE (sea algae extract) and Vit. E (vitamin E)

Table 8. Response of *Melissa officinalis* total herb fresh and dry weights (t/fed./season) to compost fertilization and some antioxidants during both seasons (2021/2022 and 2022/2023).

Antioxidant treatments (B)	Compost fertilization level, ton/feddan (A)									
	0.0	4	8	12	Mean (B)	0.0	4	8	12	Mean (B)
	First season (2021/2022)					Second season (2022/2023)				
	Fresh weight (ton/fed/season)									
Control	1.282	2.028	2.788	3.548	2.412	1.718	2.169	2.423	3.239	2.387
AA (1 ml/l)	1.830	2.565	3.351	4.086	2.958	2.099	2.646	3.802	4.167	3.178
AA (2 ml/l)	2.093	3.097	4.167	4.729	3.522	2.545	3.097	4.197	5.013	3.713
SAE (1.5 ml/l)	2.408	3.802	4.957	5.662	4.207	3.001	4.674	5.155	6.027	4.714
SAE (3 ml/l)	3.077	4.222	5.292	6.179	4.693	3.381	4.364	5.434	6.845	4.956
Vit. E (100 ppm)	4.532	4.993	6.052	6.873	5.613	4.278	5.013	6.194	7.573	5.765
Vit. E (200 ppm)	3.660	4.532	5.434	6.478	5.026	3.913	4.597	5.773	6.929	5.303
Mean (A)	2.697	3.605	4.577	5.365	4.061	2.991	3.794	4.711	5.656	4.288
L.S.D. at 5 %	A: 0.790		B: 0.347	AB: 0.694		A: 0.780		B: 0.385	AB: 0.770	
	Dry weight (ton/fed/season)									
Control	0.613	0.740	0.857	1.059	0.817	0.603	0.841	0.983	1.272	0.925
AA (1 ml/l)	0.705	0.999	1.039	1.237	0.995	0.776	0.978	1.135	1.293	1.045
AA (2 ml/l)	0.745	1.095	1.267	1.526	1.158	0.938	1.120	1.404	1.810	1.318
SAE (1.5 ml/l)	0.836	1.166	1.374	1.617	1.248	1.115	1.414	1.744	1.982	1.564
SAE (3 ml/l)	0.912	1.247	1.592	1.673	1.356	1.379	1.652	1.992	2.205	1.807
Vit. E (100 ppm)	1.034	1.424	1.835	1.946	1.560	1.597	2.276	2.382	2.600	2.214
Vit. E (200 ppm)	0.983	1.343	1.723	1.784	1.459	1.531	1.830	2.154	2.377	1.973
Mean (A)	0.833	1.145	1.384	1.549	1.228	1.134	1.445	1.685	1.934	1.549
L.S.D. at 5 %	A: 0.170		B: 0.137	AB: 0.274		A: 0.260		B: 0.198	AB: 0.396	

Where: AA (amino acids), SAE (sea algae extract) and Vit. E (vitamin E)

65.97% for herb dry weight per feddan due to vitamin E at 100, vitamin E at 200 and sea algae at 3 ml/l in the first season. Similar results were obtained in the second season.

Antioxidants are effective when applied to plants, leading to plant growth enhancement (Li and Ni, 1996 and Mau *et al*., 2001).

In accordance with our results Ismail (2008) and Ayyat *et al*. (2021) on *Nigella sativa*, Abdou *et al*. (2012) on mint, Abdou *et al*. (2014a and 2017a) on basil, and Ali and Hussein (2019) on Senna coffee plant for vitamin E. In addition, Sari and Ceylan (2002) on *Melissa officinalis*, Mansori *et al*. (2016) and Mansori *et al*. (2019) on *Salvia officinalis*, Salam and Yousef (2015) and El-Naggar *et al*. (2020) on *Ocimum spp.*, Al-Mohammadi and Alshaheen (2022) on *Rosmarinus officinalis* and El-Ziat *et al*. (2024) on *Tagetes patula* L. concerning sea algae. Also, Ahmed (2009) and Majkowska-Gadomska *et al*. (2022) on *Melissa officinalis* L., Mohamed *et al*. (2020) on *Origanum majorana*, and Al-Fraihat *et al*. (2023) on *Rosmarinus officinalis*, regarding the effect of amino acids.

The interaction effect between compost and antioxidant treatments was significant for all vegetative studied parameters in all cases. The best values overall were obtained from plants fertilized with 8 or 12 ton compost per feddan and sprayed with vitamin E (100 or 200 ppm) or sea algae at 3 ml/l.

REFERENCES

Abdelaziz, M.E.; Pokluda, R. and Abdelwahab, M.M. (2007). Influence of compost, microorganisms and NPK fertilizer upon growth, chemical composition and essential oil production of *Rosmarinus officinalis* L. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 35(1):86-90.

Abdou, M.A.H.; Taha, R.A. and Abdel Gaber, Amany F.M. (2024b). Effect of salicylic acid and active yeast on growth of marjoram plant under salinized water irrigation. Scientific Journal of Horticultural Research, 2(2):13-21. https://10.21608/sjhr.2024.379245

Abdou, M.A.H.; Abdel-Rahim, A.F.A. and Gahory, A.M.O. (2024a). Influence potassium humate on rosemary plants grown in sandy soil under irrigation with saline water. Scientific Journal of Flowers and Ornamental Plants, 11(1):1-15. https://10.21608/sjfop.2024.267307.1029

Abdou, M.A.H.; Aly, M.K.; El-Sayed, A.A.; Ahmed, E.E.T. and Helmy, T.A. (2015a). Effect of compost and some bio-stimulant treatments on: A. Growth and fruit yield production of cumin (*Cuminum cyminum*, L.) plants. Scientific Journal of Flowers and Ornamental Plants, 2(3):227-236.

Abdou, M.A.H.; Attia, F.A.; Ahmed, E.T. Ahmed, A.A. and Abd El-Naeem, L. (2012). Physiological studies on mint plants. Proc. 2nd Inter. Conf. of Physio. Microb. and Ecological Sci., Faculty of Science, Minia University, Egypt, pp. 207-228.

Abdou, M.A.H.; El-Sayed, A.A.; Ahmed, E.T. and Abdel Salam, A.A. (2014a). Response of sweet basil plants to some agricultural treatments. Minia J. of Agric. Res. and Develop, 34(1):49-67.

Abdou, M.A.H.; El-Sayed, A.A.; Taha, R.A. and Marzok, Z.S. (2017a). Effect of plant density and some vitamins, as well as, active yeast on sweet basil (*Ocimum basilicum*) plant, A: Vegetative growth characters. Scientific Journal of Flowers and Ornamental Plants, 4(1):83-100.

Abdou, M.A.H.; Helmy, T.; Salam, M. and Hassan, A.A. (2020a). Effect of organic and bio-fertilization treatments on fennel plant under drip irrigation system in Bahria Oases I: Vegetative growth parameters and yield production. Scientific Journal of Agricultural Sciences, 2(2):64-71.

Ahmed, Mona M.A. (2009). Effect of Amino Acids and Yeast on Growth Yield Essential Oil Production and Chemical

Constituents of Common Balm (*Melissa officinalis* L.) Plant. M.Sc. Thesis, Fac. Agric., Cairo Univ., Egypt. 99 p.

Al-Fraihat, A.H.; Al-Dalain, S.Y.; Zatimeh, A.A. and Haddad, M.A. (2023). Enhancing rosemary (*Rosmarinus officinalis*, L.) growth and volatile oil constituents grown under soil salinity stress by some amino acids. Horticulturae, 9(2):1-14. https://doi.org/10.3390/horticulturae9020252

Ali, B.A.A. and Hussein, J.K. (2019). Effect of some antioxidants on the growth of Senna coffee plant (*Cassia occidentalis*) growing under the influence of salt stress. Euphrates Journal of Agricultural Science, 11(4):1-12.

Al-Mohammadi, H.K.A. and Alshaheen, M.R. (2022). Effect of spraying with nano-proline and seaweed extract on the growth of rosemary plant *Rosmarinus officinalis* L. Sciences, 20(2):404-415.

Ayad, H.S.; El-Din, K.G. and Reda, F. (2009). Efficiency of stigmasterol and α-tocopherol application on vegetative growth, essential oil pattern, protein and lipid peroxidation of geranium (*Pelargonium graveolens* L.). J. Appl. Sci. Res., 5:887-892.

Ayyat, A.M.; Kenawy, A.G.M.; Aboel-Ainin, M.A. and Abdel-Mola, M.A.M. (2021). Improving growth, productivity and oil yield of *Nigella sativa*, L. plants by foliar spraying with some stimulants. Journal of Plant Production, 12(3):339-344. https://doi.org/10.21608/jpp.2021.69108.1024

Bagdat, R.B. and Cosge, B. (2006). The essential oil of lemon balm (*Melissa officinalis* L.), its components and using fields. J. Fac. Agric. Omu, 21 (1): 116-121.

El-Naggar, A.H.M.; Hassan, M.R.A.; Shaban, E.H. and Mohamed, M.E.A. (2015). Effect of organic and biofertilizers on growth, oil yield and chemical composition of the essential oil of *Ocimum basillicum* L. plants. Alex. J. Agric. Res, 60(1):1-16.

El-Ziat, R.A.M.; Saudy, H.S. and Hewidy, M. (2024). The alteration in physiological status, growth and essential oil profile of French marigold (*Tagetes patula* L.) owing to seaweed extract and salicylic acid application. Journal of Soil Science and Plant Nutrition, 24: 3909–3922. https://doi.org/10.1007/s42729-024-01811-z

Ismail, S.I.I. (2008). Anatomical and Physiological Studies on *Nigella sativa*, L. Plant. Ph.D. Thesis, Fac. Agric., Mansoura Univ., Egypt, 146 p.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice-Hall of India Private Ltd. M-97, New Delhi, India, 498 p.

Jafr, S.M. Rahimi, A.R.; Hashemi, M. and Rokhzadi, A. (2022). Influence of N, K, and seaweed extract fertilization on biomass, photosynthetic pigments, and essential oil of *Thymus vulgaris*: Optimization study by response surface methodology. Agronomy, 12(12):1-18. https://doi.org/10.3390/agronomy12123222

Khalil, M.Y.; Kandil, M.A.M. and Swaef, H.M.F. (2008). Effect of three different compost levels on fennel and salvia growth character and their essential oils. Res. J. of Agric. and Biol. Sci., 4(1):34-39.

Li, W.J. and Ni, Y.Z. (1996). Researches on application of microbial inoculant in crop production. Agriculture University Press, Beijing, China.

Majkowska-Gadomska, J.; Jadwisieńczak, K.; Francke, A. and Kaliniewicz, Z. (2022). Effect of biostimulants on the yield and quality of selected herbs. Applied Sciences, 12(3):1-11. https://doi.org/10.3390/app12031500

Mansori, M.; Chernane, H.; Latique, S.; Benaliat, A.; Hsissou, D. and El Kaoua, M. (2016). Effect of seaweed extract

(*Ulva rigida*) on the water deficit tolerance of *Salvia officinalis* L. Journal of Applied Phycology, 28:1363-1370. https://doi.org/10.1007/s10811-015-0671-9

Mansori, M.; Farouk, I.A.; Hsissou, D. and El Kaoua, M. (2019). Seaweed extract treatment enhances vegetative growth and antioxidant parameters in water stressed *Salvia officinalis* L. Journal of Materials and Environmental Sciences, 10(8): 756-766.

Mau, J.L.; Chao, G.R. and Wu, K.T. (2001). Antioxidant properties of methanolic extracts from several ear mushrooms. J. Agric. Food Chem., 49:5461-5467.

Mohamed, A.A.; El-Hefny, M.; El-Shanhorey, N.A. and Ali, H.M. (2020). Foliar application of bio-stimulants enhancing the production and the toxicity of *Origanum majorana* essential oils against four rice seed-borne fungi. Molecules, 25(10):1-19. https://doi.org/10.3390/molecules25102363

MSTAT–C (1986). A Microcomputer Program for the Design Management and Analysis of Agronomic Research Experiments (version 4.0), Michigan State Univ., U.S.A.

Rahimpoor, M. and Fallah, S. (2018). Effect of organic and chemical fertilizers on growth and yield of green basil (*Ocimum basilicum* L.). Journal of Agroecology, 10(1):146-159. https://10.22067/jag.v10i1.54975

Said-Al, A.H.; Omer, E.A. and Abdou, M.A.A. (2009). Effect of potassium fertilizer on lemon balm (*Melissa officinalis* L.) grown under water stress conditions. Journal of Medicinal Food Plants, 1(2):16-29. https://www.researchgate.net/publication/266910868

Salama, Azza M. and Yousef, R.S. (2015). Response of basil plant (*Ocimum sanctum* L.) to foliar spray with amino acids or seaweed extract. Journal of Horticultural Science and Ornamental Plants, 7:94-106. https://10.5829/idosi.jhsop.2015.7.3.1161

Sari, A.O. and Ceylan, A. (2002). Yield characteristics and essential oil composition of lemon balm (*Melissa officinalis* L.) grown in the Aegean region of Turkey. Turkish Journal of Agriculture and Forestry, 26 (4):217-224.

Simon, J.E.; Chadwick, A.F. and Craker, L.E. (1984). Herbs: An Indexed Bibliography 1971-1980, the Scientific Literature on Selected Herbs, and Aromatic and Medicinal Plants of the Temperate Zone. Archon Books, USA, 770 p.

Youssef, A.S.M.; Ghatas, Y.A.A.; Mohamed, Y.F.Y.; Toaima, W.I.M. and Mady, M.A. (2020). Response of caraway (*Carum carvi* L.) plant to bio-fertilizers in substitution of chemical fertilization. Journal of Medicinal Plants, 8(6):45-54.

استجابة النمو الخضري لنبات الميليسا لمعاملات الكمبوست ومضادات الأكسدة

محمود عبدالهادي حسن عبده، رجاء على طه، رندا أبوبكر محمود
قسم البساتين، كلية الزراعة، جامعة المنيا، مصر

تم إجراء هذا البحث في موسمي ٢٠٢١/٢٠٢٢ و ٢٠٢٢/٢٠٢٣ بمشتل نباتات الزينة، كلية الزراعة، جامعة المنيا، مصر لدراسة استجابة النمو الخضري لنبات الميليسا للمعاملات بالكمبوست (٠ ، ٨ و ١٢ طن/للفدان) وبعض مضادات الأكسدة وهى الأحماض الأمينية (١ و ٢ مل/لتر)، مستخلص الأعشاب البحرية (١,٥ و ٣ مل/لتر) وفيتامين هـ (١٠٠ و٢٠٠ جزء في المليون). أظهرت النتائج أن جميع صفات النمو الخضري (ارتفاع النبات، قطر الساق، عدد الفروع، مساحة الورقة والوزن الطازج والجاف للنبات) قد زادت زيادة معنوية مع تسميد النباتات بالكمبوست مقارنة بمجموعة الكنترول خلال الثلاث حشات في كلا الموسمين. علاوة على ذلك، زادت جميع الصفات المذكورة أعلاه من القطفة الأولي حتى القطفة

الثالثة باستثناء ارتفاع النبات الذي اتخذ الاتجاه العكسي. أدت جميع المعاملات المستخدمة لمضادات الأكسدة إلى زيادة جميع الصفات المذكورة أعلاه زيادة معنوية مقارنة بمجموعة الكنترول من خلال الحشات الثلاثة في كلا موسمي النمو. وكان فيتامين هـ بالتركيز المنخفض متفوقًا في هذا الشأن. كانت أفضل معاملة تفاعل هي امداد النباتات بالكمبوست بمعدل ٨ أو ١٢ طن/فدان وفيتامين هـ عند ١٠٠ جزء في المليون أو بالتركيز العالي من الطحالب البحرية (٣ مل/لتر).

.