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The effect of foliar spraying with a natural growth stimulant (ascobein) on sweet basil (*Ocimum basilicum* L.) production

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Abstract
The present research was conducted during 2023/2024 seasons at the Sabahia Horticulture Research Station, Alexandria Governorate, Egypt, to study the effect of foliar spraying with Ascobein and the number of sprays on vegetative growth; plant height (cm), number of main branches, fresh and dry weights of plant (g/plant) and chlorophyll content. In addition to oil percentage (%) and chemical composition of essential oil (EO), also fresh herb yield (t/fed) and oil yield (L/fed) of Sweet basil (*Ocimum basilicum* L.). The treatments were; control 0, 50,100 and 150 ppm of Ascobein in two sprays (spray^2) or three sprays (spray^3)/cut in both seasons. Results revealed that all Ascobein treatments achieved the higher vegetative growth as well as major compounds content of EO compared to control. Moreover, Ascobein treatments 50,100 ppm achieved average values, while 150 ppm treatment recorded higher values for the vegetative growth, oil%, chemical composition of EO and herb yield or oil during this study than other treatments. On the other hand, it was observed that foliar spraying with Ascobein (spray^3) was better than (spray^2)/cut in both seasons. From the above, we recommend spraying with Ascobein at a concentration of 150 ppm (spray^3)/cut to obtain high quality and productivity of Sweet basil.

Keywords: Sweet basil, (*Ocimum basilicum*, L.), volatile oils, essential oil (EO), ascobein

1. Introduction

Sweet basil (*Ocimum basilicum* L.), also known as French or Sweet basil, is a widespread annual herb of the Lamiaceae (Labiatae) family grown as a perennial in warm tropical climates, native to East Africa and India [1]. Basil contains volatile oil are separated from the leaves and flowering tops by steam distillation (SD) and are consumed for food seasoning, dental and oral products, perfumes and in traditional rituals and medicines [2]. The oil, principal components are linalool, methyl cinnamate, eugenol, 1,8-cineole, methyl chavicol, geranial, neral and caryophyllene oxide [3, 4]. The known components were linalool and eugenol as a major components followed by 1.8 cineole, borneol, camphor, methyl chavicole, α-terpineol, terpinene-4-ol, terpinolene, β- pinene, bornyl-acetate, α-pinene, camphene and β-caryophyllene while rest of the compounds were undefined [5]. Many investigators have found that the main compounds are; linalool, 1, 8, cineol, eugenol, methyl cinnamate, camphor, methyl eugenol, methyl chavicol, β-ocimene, β-elemene, camphene, carvacrol, α-bergamotene or α-cadinol and geranial [6]. The essential oil (EO) composition influenced by location, growing conditions, cultivars, different agronomic management, seasonal variation, harvesting, drying and processing methods [7]. The productivity and quality of Basil EO change under the influence of field conditions [8, 9]. Leaves of basil used in folk medicine as a tonic and vermifuge, basil tea taken hot is good for treating nausea, flatulence and dysentery [10], its oil has been found to be beneficial for the alleviation of colds, rhinitis, spasm, or mental fatigue, and as a first aid treatment for wasp stings and snakebites. Basil volatile oil has been reported to have antimicrobial as well as antioxidant [11, 12]. It is also insecticidal [13, 14] and antifungal [15]. Properties 1, 8-cineole, linalool, and camphor, are known to be biologically active [16] as well as food industry and cosmetics [17]. In traditional medicine, its seeds use in Asian beverages and desserts as a source of dietary fiber [18]. It is also used in treatment of cough, headache, worms, diarrhea and skin infections [19]. It is also part of mediterranean diets especially in south of Europe, for example Italian and Greek cuisines [20].

polysaccharides in Basil have been used to treat cancer in Chinese medicine (traditional) [21], and still is widely used in people's lives [22]. The geographical location significantly impacts the chemical composition and antioxidant activity of basil plants [23].

The Ascobein contains ascorbic and citric acids (2:1) and has been shown to have a tonic effect on growth and active compounds in many plants, e.g. the Maize (*Zea mays*), and Wheat (*Triticum aestivum*) [24], fenugreek plant [25], Plantago species [26]. Many researchers, reported the vital role of foliar spraying on some medicinal and aromatic plants, such as *Cymbopogon flexuosus* [27] and on *Mentha species* [28]. From the obtained results it is worthy to note that spraying Rue (*Ruta graveolens*) plants with Ascobein foliar fertilizer caused a promotion of vegetative and flowering growth as well as increased the accumulation of active constituents including EO, cumarin and rutin [29]. Furthermore, Ascobein treatment stimulated growth parameters, endogenous growth hormones, carbohydrate constituents and grain yield (Wheat) under normal and salinity conditions [30]. Spraying the plants (Nigella) with Ascobein (100 ppm) significantly increased vegetative growth, crop characteristics and oil yield as well as major components, antioxidant activity and total phenolic contents of the oil compared to untreated plants (control) [31]. Ascobein (ascorbic and citric acid in a ratio of 2:1), had a promotion effect on growth and active constituents' compounds of various plants under stressed conditions or normal [32, 30]. Ascorbic acid has been shown to play many roles in plant growth, such as regulation of cell elongation [33], cell division, cell wall expansion, and other developmental processes, [34]. It participates in a variety of processes including photosynthesis, cell wall development and cell expansion [35]. Citric acid is an important substrate in Krebs cycle and plays a significant role in stimulating biosynthesis processes, application of some organic acids such as citric acid improved plant growth and chemical constituents of sweet pepper fruits [36]. Ascorbic and citric exert a promotional effect on vegetative growth and yield characters of different plants e.g. on grapevine [37]. [38], in generally, foliar spraying (Ascobein) increased the Lettuce leaves content of N, P and chlorophyll, as well as total phenol and total amino acids. The increase of chlorophyll content may be attributed to the positive effect of citric and ascorbic acids. [39] on Tomato and [40] on Sugar beet, found that vitamin C increased total chlorophylls and attributed this to stimulation the biosynthesis of chlorophylls.

The objective of this work was to evaluate the effect of foliar spraying with Ascobein (natural growth stimulant) on Sweet basil production.

2. Materials and Methods

2.1 Plant material and experimental design

A field experiment was performed in the 2023 / 2024 seasons at the Sabahiya Horticulture Research Station, Alexandria, Egypt. Sweet basil (*Ocimum basilicum* L.) Seedlings were acquired from El-Kanater Medicinal and Aromatic plants Research Station, Horticulture Research Institute, Agriculture Research Center, Giza, Egypt. The seedlings (6 weeks old) at 10 cm were transplanted on April 15th, 2023 and 2024 respectively on 30 cm× 50 cm plant spacing. All agricultural practices were done according to the Ministry of Agriculture and Land Reclamation (Egypt) recommendation.

Foliar spraying with Ascobein, contains 38% ascorbic and citric acid (25% ascorbic acid, and 13% citric acid), is one of the products Egyptian Ministry of Agriculture. The experiment was performed randomized complete block design (RCBD) with (3) replications. First factor; Treatments, (0, 50, 100, 150 ppm) Ascobein and second factor; number of sprays; two sprays/cut (spray^2)/30 days or three sprays/cut (spray^3)/20 days. As for the frequency of spraying for (spray^2); the first spray was 30 days after planting, while second spray was 30 days after the first spray/cut. While (spray^3); the first spray was 20 days after planting, while second spray was 20 days after the first spray, and the third spray was 20 days after the second spray /cut in the experimental seasons. It is repeated with the same time periods between sprays after the first cut in both seasons.

The treatments (T) were as follows

- T_1 sprayed with water, control.
- T_2 sprayed with Ascobein at concentration at 50 ppm, twice/cut (spray^2) and three/cut (spray^3).
- T_3 sprayed with Ascobein at concentration at 100 ppm, twice/cut (spray^2) and three/cut (spray^3).
- T_4 sprayed with Ascobein at concentration at 150 ppm, twice/cut (spray^2) and three/cut (spray^3).

Harvest

Plants were harvested at mid flowering stage July 15th and September 30th in 2023 and 2024 seasons.

2.2 Recorded data

Plant height (cm)

Number of main branches

Plant fresh weight (g/plant) and plant dry weight (g/plant)

Fresh herb yield (t/fed.): The plants were harvested by hand with a knife 10 cm above the land surface, and instantly weighed for the obtained plot yield. Then the plot yield was converted to a yield fed^{-1}.

Chlorophyll

Chlorophyll contents measurement (SPAD, values) were performed using the SPAD-502 meter (Minolta Co. LTD, Japan). The device measures transition of red light at 650 nm, at which chlorophyll absorbs light, as well as transmission of infrared light at 940 nm, at which no absorption happens [41].

Volatile oil (%): Volatile oil percentage (%) of the fresh and dried herbs (100g) was utilized to a 3 h water-distillation (WD) using a Neo Clevenger apparatus, volatile oil ratio was calculated as a relative percentage (v/w) according to [42]. Oils were dried by anhydrous sodium sulfate (Na_2SO_4) and stored in dark vials at 4 ˚C for analysis.

Chemical composition of volatile oil: The volatile oil was analyzed by Gas Chromatography (GC) of using DS 6200 GC with BPX5 capillary column and a flame ionization detector under the following operating conditions: sample size of 1µl and temperature increasing rate of 10 °C/min (from 70 °C to 200 °C). The carrier gases were; nitrogen, hydrogen, and air with flow rate of 30, 30 and 300 mL/min, respectively. Major compounds of the volatile oils were identified by matching their retention times with those of the authentic samples injected under the same conditions. The percentage of volatile components were obtained by calculating the area under the peak appeared for each compound, according to [43, 44]

2.3 Statistical Analysis

The obtained data were statistically analyzed using analysis of variance (ANOVA) randomized complete block design

(RCBD). The LSD was calculated to estimate the significant differences ($p<0.05$) using a statistical software (Costat, version 6.45, 2022) according to [45].

3. Results and Discussion

3.1 Results: Effect of foliar spraying with Ascobein on plant height (cm) and number of main branches/plants of Sweet basil in both seasons.

All treatments led to a sharp increase in Sweet basil plant height and number of branches/plants compared to control during the 2023/2024 seasons, Table (1) and Fig. (1). In addition, treatments (100 and 150 ppm) recorded a marked increase in plant height and number of branches/plan than other treatments. A treated plant with 150 ppm was the highest values than other treatments. Regarding the effect of number of sprays, the results showed that three sprays/cut (spry^3) in both seasons gave the highest significance in plant height and number of branches compared to the two sprays/cut (spray^2). The interaction influence between treatments x number of sprays, the obtained results indicated that the interactions registered the significant of plant height (cm) and main branches number of Sweet basil (*Ocimum basilicum* L.) in both seasons 2023 and 2024. In general, the interaction showed that the best treatments were; 150 and 100 ppm / (spry3) respectively, on increased plant height and number of main branches/plants.

Table 1: Effect of foliar spraying with Ascobein, number of sprays and their interaction on plant height (cm) and main branches number of Sweet basil (*Ocimum basilicum* L.) during the two cuts of both seasons 2023 and 2024.

Treatments	Plant height (cm)											
	1st Season						2nd Season					
	Cut 1			Cut 2			Cut 1			Cut 2		
	Spray^2	Spray^3	Means	Spray^2	Spray^3	Means	Spray^2	Spray^3	Means	Spray^2	Spray^3	Means
Control	69.00	71.66	70.33 c	67.50	69.00	68.25 d	76.66	78.33	77.49 d	72.66	73.66	73.16 c
50 ppm	73.00	78.00	75.50 b	70.66	75.00	72.83 c	81.66	87.00	84.33 c	80.66	86.33	83.49 b
100 ppm	88.43	92.00	90.21 a	81.66	86.00	83.83 b	89.00	92.66	90.83 b	85.66	91.00	88.33 a
150 ppm	90.66	95.00	92.83 a	86.33	90.00	88.16 a	94.00	98.66	96.33 a	90.66	93.66	92.16 a
Means	80.27 b	84.16 a		76.53 b	80.00 a		85.33 b	89.16 a		82.41 b	86.16 a	
LSD at 0.05	2.98		4.22	2.86		4.05	2.81		3.97	2.75		3.89
Interaction	4.90			4.70			4.60			4.51		
	Branches No.											
Control	7.00	7.33	7.16 c	9.00	10.66	9.83 c	9.66	10.33	9.99 c	10.33	11.00	10.66 c
50 ppm	8.00	10.33	9.16 b	11.00	13.00	12.00 b	10.66	12.00	11.33 bc	11.33	13.33	12.33 b
100 ppm	10.00	12.00	11.00 a	13.00	15.00	14.00 a	11.66	14.00	12.83 ab	13.00	15.00	14.00 a
150 ppm	11.16	12.66	11.91 a	14.00	15.66	14.83 a	13.00	14.00	13.50 a	14.00	15.00	14.50 a
Means	9.04 b	10.58 a		11.75 b	13.58 a		11.24 b	12.58 a		12.16 b	13.58 a	
LSD at 0.05	0.81		1.15	1.03		1.47	1.12		1.59	1.02		1.45
Interaction	1.34			1.70			1.83			1.67		

Means designed by the same letter at each cell are not significantly different at the 5% level according to Duncan's multiple range test.

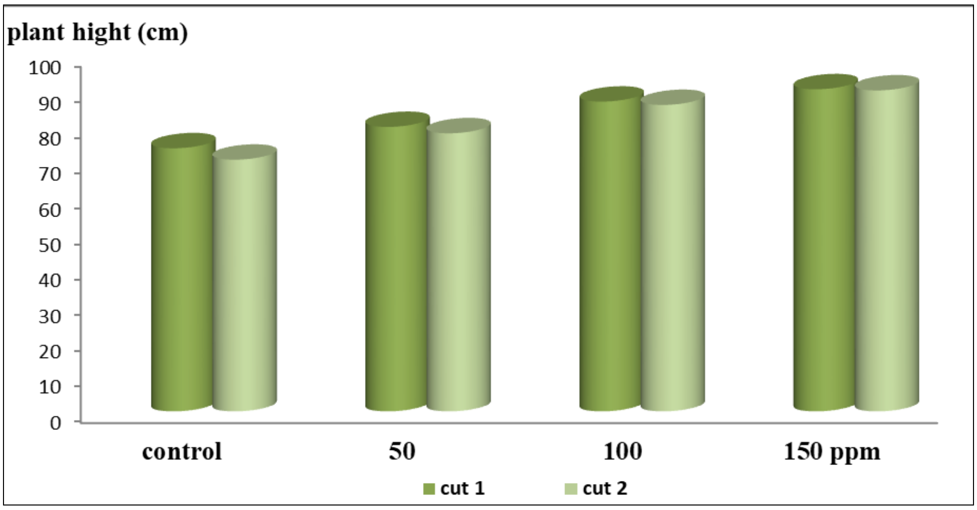

Fig 1: Effect of foliar spraying with Ascobein on plant height (cm) of Sweet basil in both seasons.

3.1.2 Effect of foliar spraying with Ascobein on fresh and dry weight (g/plant) of Sweet basil in both seasons.

The present data revealed that, all the Ascobein treatments led to a significant increase in the fresh and dried herbs weight of Sweet basil. The lowest values for fresh and dried weight of herbs were obtained as a result of control treatment in both seasons. On the other hand, the best treatments to obtain the highest fresh and dry weight of Sweet basil were 100 and 150 ppm compared to the rest of the treatments in both seasons, Table (2).

As for the effect of the number of sprays with Ascobein on changes in the weight of fresh and dried herbs, there was a significant increase in the weight of fresh and dried herbs with spraying three times (spry^3) compared to the two sprays (spry^2) in both seasons. Looking to the interaction effect between the tested treatments and number of sprays with Ascobein, it was significant in both seasons.

Table 2: Effect of foliar spraying with Ascobein, number of sprays and their interaction on fresh and dry weights (g/plant) of Sweet basil (*Ocimum basilicum* L.) during the two cuts of both seasons 2023 and 2024.

Treatments	Fresh weight (g/plant)											
	1st Season						2nd Season					
	Cut 1			Cut 2			Cut 1			Cut 2		
	Spray2	Spray3	Means	Spray2	Spray3	Means	Spray2	Spray3	Means	Spray2	Spray3	Means
Control	250	264.33	257.16 c	263.33	271.66	267.50 d	255.00	265.00	260 c	275	271.66	273.33 d
50 ppm	263.33	313.33	288.33 c	296.66	330.00	313.33 c	300.00	335.66	317.83 b	313.33	348.66	331.00 c
100 ppm	280.00	363.33	321.66 b	330.00	380.00	355.00 b	325.00	371.66	348.33 b	341,66	380.00	360.83 b
150 ppm	343.33	390.00	366.66 a	380.00	421.66	400.83 a	370.00	420.00	395.00 a	360.00	430.00	395.00 a
Means	284.16 b	332.75 a		317.50 b	350.83 a		312.50 b	348.08 a		322.50 b	357.58 a	
LSD at 0.05	22.47		31.78	22.97		32.49	23.65		33.45	20.89		29.55
Interaction	36.88			37.70			38.82			34.29		
	Dry weight (g/plant)											
Control	80.00	86.66	83.33 c	78.33	80.00	79.16 c	78.33	81.66	80.00 c	83.33	83.33	83.33 c
50 ppm	81.66	100.00	90.83 bc	90.00	106.66	98.33 b	85.00	103.33	94.16 b	86.66	106.66	96.66 bc
100 ppm	91.66	108.33	100.00 ab	100.00	120.00	110.00 ab	101.66	110.00	105.83 a	105.00	116.66	110.83 b
150 ppm	98.33	116.66	107.50 a	103.33	118.33	110.83 a	106.33	117.00	111,66 a	121.66	140.00	130.83 a
means	87.91 b	102.91 a		92.91 b	106.25 a		92.83 b	103.00 a		99.16 b	111.66 a	
LSD at 0.05	7.79		11.02	8.46		11.97	7.84		11.08	10.19		14.41
Interaction	12.79			13.89			12.86			16.73		

Means designed by the same letter at each cell are not significantly different at the 5% level according to Duncan's multiple range test.

Effect of foliar spraying with Ascobein on chlorophyll content (SPAD units) of Sweet basil in both seasons.

The Ascobein spray was shown to affect chlorophyll content during 2023 / 2024 seasons (Table, 3 and fig., 2). Data revealed that, 150 ppm treatment increased chlorophyll content when compared with other treatments. And also, 50,100 ppm treatments, respectively recorded average values from chlorophyll content during this study.

Regarding the number of sprays, data in Table, (3) showed that, in both seasons of study, the chlorophyll content significantly increased gradually with the three sprays (spray^3). The interaction influence between treatments x number of sprays, the obtained results indicated that the interactions registered the significant of chlorophyll content of Sweet basil in both seasons. The interaction showed that the best treatment was 150 ppm / (spry3) or (spry2) respectively, on increased chlorophyll content.

Table 3: Effect of foliar spraying with Ascobein, number of sprays and their interaction on chlorophyll content (SPAD units) of Sweet basil (*Ocimum basilicum* L.) during the two cuts of both seasons 2023 and 2024.

Treatments	Chlorophyll content (SPAD units)											
	1st Season						2nd Season					
	Cut 1			Cut 2			Cut 1			Cut 2		
	Spray2	Spray3	Means	Spray2	Spray3	Means	Spray2	Spray3	Means	Spray2	Spray3	Means
Control	37.40	37.51	37.45 d	40.06	39.96	40.01 c	39.16	39.30	39.23 c	39.20	40.03	39.61 d
50 ppm	38.00	39.35	38.67 c	40.70	42.13	41.41 b	40.13	41.83	40.98 b	40.70	42.03	41.37 c
100 ppm	39.60	40.23	39.92 b	40.93	41.37	41.15 b	41.50	42.63	42.06 a	42.08	43.20	42.64 b
150 ppm	41.16	41.70	41.43 a	42.60	43.03	42.81 a	42.36	42.80	42.58 a	43.88	44.21	44.05 a
Means	39.04 b	39.70 a		41.07 b	41.62 a		40.79 b	41.64 a		41.46 b	42.37 a	
LSD at 0.05	0.57		0.80	0.47		0.66	0.65		0.92	0.75		1.06
Interaction	0.93			0.77			1.07			1.23		

Means designed by the same letter at each cell are not significantly different at the 5% level according to Duncan's multiple range test.

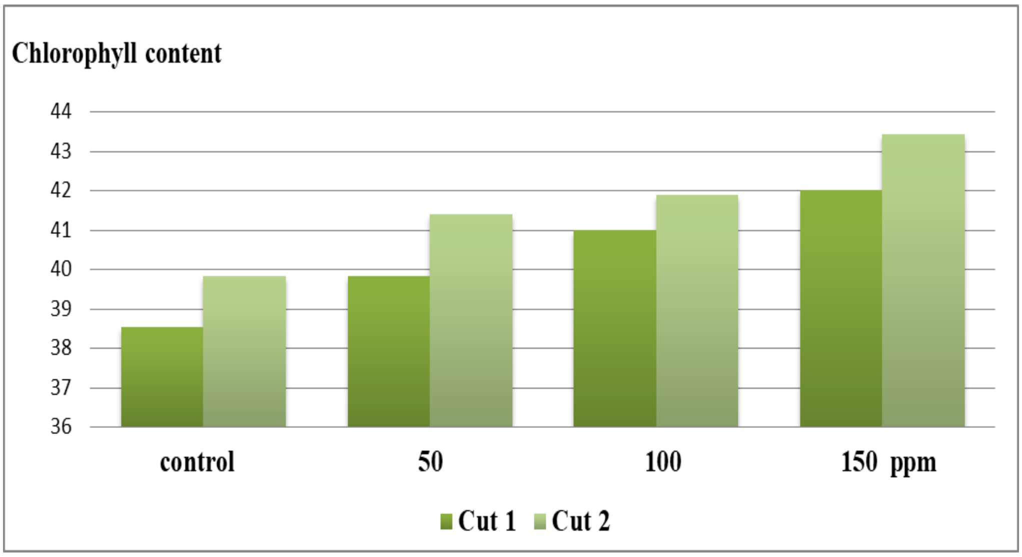

Fig 2: Effect of foliar spraying with Ascobein on chlorophyll content of Sweet basil in both seasons.

Effect of foliar spraying with Ascobein on the oil percentage (%) of fresh and dried herbs of Sweet basil in both seasons: The influence of foliar spraying with Ascobein applications of various used treatments were reported in Table (4) in terms of their influence on oil percentage of fresh and dried herbs of Sweet basil during 2023 and 2024 seasons. Results indicated that, all Ascobein treatments significantly increased oil% compared with control. In addition, 150 ppm treatment effective on increasing oil% and the differences were big enough to be significant compared with control.

Regarding the number of sprays, the data in Table, (4) indicated that, the oil percentage in both seasons of the study, significantly increased with the spray^3 compared with spray^2. The interaction influence, the obtained results showed that the interactions registered the significant of oil percentage of Sweet basil in both seasons.

Table 4: Effect of foliar spraying with Ascobein, number of sprays and their interaction on oil % of fresh and dried herbs of Sweet basil (*Ocimum basilicum* L.) during the two cuts of both seasons 2023 and 2024.

Treatments	Oil % of fresh herb											
	1st Season						2nd Season					
	Cut 1			Cut 2			Cut 1			Cut 2		
	Spray^2	Spray^3	Means	Spray^2	Spray^3	Means	Spray^2	Spray^3	Means	Spray^2	Spray^3	Means
Control	0.177	0.180	0.178 c	0180	0.186	0.183 c	0.192	0.194	0.193 c	0.193	0.193	0.193 c
50 ppm	0.186	0.201	0.193 b	0.197	0.211	0.204 b	0.200	0.216	0.208 b	0.208	0.216	0.212 b
100 ppm	0.190	0.210	0.200 ab	0.200	0.215	0.207 b	0.208	0.221	0.215 ab	0.211	0.228	0.219 ab
150 ppm	0.200	0.213	0.206 a	0.216	0.218	0.217 a	0.218	0.225	0.221 a	0.221	0.230	0.225 a
Means	0.188 b	0.201 a		0.198 b	0.207 a		0.204 b	0.214 a		0.208 b	0.217 a	
LSD at 0.05	0.008		0.012	0.006		0.008	0.007		0.011	0.008		0.011
Interaction	0.014			0.009			0.012			0.013		
	Oil % of dried herb											
Control	0.466	0.466	0.466 c	0.470	0.463	0.466 d	0.506	0.516	0.511 d	0.511	0.514	0.512 d
50 ppm	0.503	0.526	0.515 b	0.510	0.530	0.520 c	0.536	0.549	0.542 c	0.536	0.553	0.545 c
100 ppm	0.523	0.543	0.533 b	0.536	0.546	0.541 b	0.572	0.581	0.577 b	0.576	0.602	0.589 b
150 ppm	0.546	0.580	0.563 a	0.543	0.593	0.568 a	0.609	0.645	0.627 a	0.602	0.662	0.632 a
means	0.509 b	0.529 a		0.515 b	0.533 a		0.556 b	0.573 a		0.556 b	0.583 a	
LSD at 0.05	0.016		0.023	0.012		0.017	0.014		0.021	0.014		0.020
Interaction	0.027			0.020			0.024			0.024		

Means designed by the same letter at each cell are not significantly different at the 5% level according to Duncan's multiple range test.

Effect of foliar spraying with Ascobein on the chemical composition of Sweet basil EO

The components of Sweet basil EO were determined by GC, table (5) the main constituents of EO were linalool, 1.8 cineole, α-terpineol, eugenol, methyl chavicole, β-caryophyllene, α-pinene and β- pinene, while rest of the compounds were undefined. Results in table (5) indicated that the effect of spraying Ascobein on the chemical composition of Sweet basil EO, the 150-ppm treatment saved active compounds content in high level than other treatments. As for the influence of the number of sprays on the compounds content; the data in table (5) generally revealed that, three sprays/ cut (spry^3) at 150 ppm gave the highest in active compounds compared to two sprays /cut (spray^2).

Table 5: Effect of foliar spraying with Ascobein and number of sprays on the chemical composition of Sweet basil EO during cut[1] in the second season

N.	Compounds (%)	Control	Spray²			Spray³		
			50 ppm	100 ppm	150 ppm	50 ppm	100 ppm	150 ppm
1	α-Pinene	0.98	1.30	0.00	0.00	0.00	1.17	1.32
2	β-Pinene	0.61	0.00	0.13	0.00	0.00	0.00	0.00
3	1,8-cineole	10.59	14.99	9.27	9.38	9.76	8.41	9.63
4	Linalool	51.91	51.33	53.67	53.70	48.38	54.00	60.71
5	α-Terpineol	9.09	5.84	3.76	7.72	9.16	8.33	11.41
6	Methyl chavicol	7.35	7.21	7.90	6.10	4.06	7.90	2.70
7	Eugenol	4.31	3.67	3.46	4.00	3.76	3.69	4.39
8	β-caryophyllene	4.54	4.34	3.45	5.20	6.27	5.62	4.96
9	Known compounds	89.38	88.68	81.64	86.10	81.39	89.12	95.12
10	Unknown compounds	10.62	11.32	18.36	13.90	18.61	10.88	4.88

Effect of foliar spraying with Ascobein on yield (herb, t/fed. and oil, l/fed.) of Sweet basil in both seasons

It is clear from Table, (6) that the foliar spraying with Ascobein, 150 ppm treatment gave the highest average yield of fresh herbs (t/fed.) also oil yield (l/fed.); followed by a 50, 100 ppm. These results were supported by significance differences when compared to the control treatment (sprayed with water). The aforementioned results held true during both years of study. The results in Table, (6) revealed that, significant differences between the spray^3 and spray^2. When looking at the interaction effect between the tested treatments and number of sprays with Ascobein, it was significant in both seasons. The interaction showed that the best treatment was 150 ppm / (spry3) on increased yield of fresh herbs (t/fed.) also oil yield (l/fed.).

Table 6: Effect of foliar spraying with Ascobein, number of sprays and their interaction on fresh herb yield (t/fed.) and oil yield (l/fed.) of Sweet basil (*Ocimum basilicum* L.) during seasons 2023 and 2024.

Treatments	Fresh herb and oil yield											
	Fresh herb yield (t/fed.)						Oil yield (l/fed.)					
	1st Season			2nd Season			1st Season			2nd Season		
	Spray²	Spray³	Means	Spray²	Spray³	Means	Spray²	Spray³	Means	Spray²	Spray³	Means
Control	11.494	11.862	11.678 c	12.156	12.341	12.248 c	21.951	22.582	22.267 d	22.495	22.521	22.508 c
50 ppm	13.335	14.794	14.065 b	13.262	15.104	14.183 bc	25.443	30.099	27.771 c	27.127	31.924	29.525 b
100 ppm	13,693	15.398	14.546 b	13.999	17.314	15.656 b	28.177	33.718	30.948 b	29.368	34.505	31.936 ab
150 ppm	15.472	17.977	16.724 a	17.314	18.604	17.959 a	30.467	37.990	34.228 a	32.105	37.789	34.947 a
Means	13.498 b	15.008 a		14.183 b	15.841 a		26.509 b	31.097 a		27.774 b	31.685 a	
LSD at 0.05	1.311		1.854	1.565		2.214	2.109		2.982	2.802		3.963
Interaction	2.150			2.566			3.460			4.598		

Means designed by the same letter at each cell are not significantly different at the 5% level according to Duncan's multiple range test.

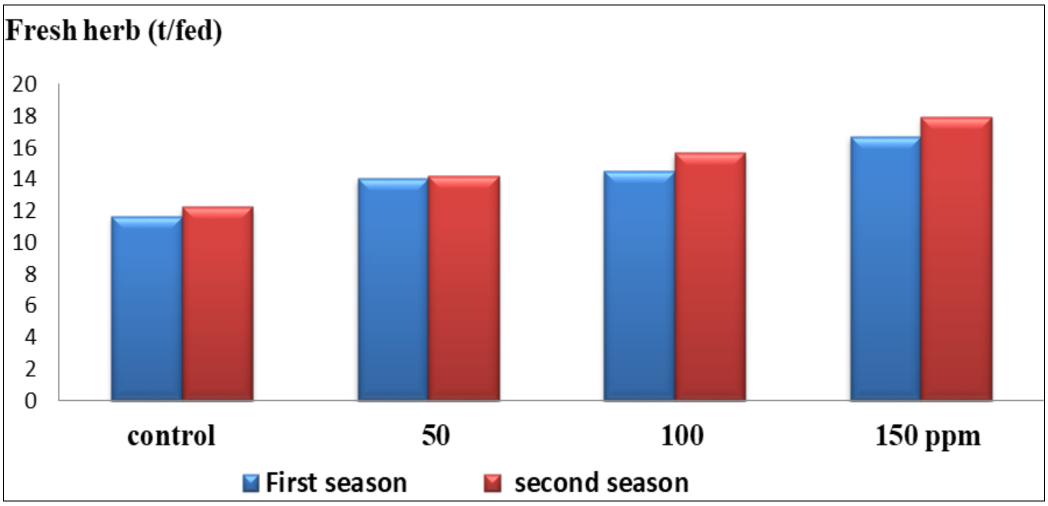

Fig 3: Effect of foliar spraying with Ascobein on fresh herb yield (t/fed.) of Sweet basil in both seasons.

Discussion

Vegetative growth

In the present experiment, the obtained results showed that all Ascobein treatments led to enhanced vegetative growth. These results may be due to the Ascobein foliar fertilizer contains ascorbic and citric acids (2:1) and has been shown to have a stimulatory effect on growth in many plants, including the maize, wheat [24], fenugreek plant [25], Plantago species [26]. Spraying plants with Ascobein (100 ppm) caused a significant increase in the vegetative growth and yield characteristics of *Nigella sativa* [31]. Many studies have reported the vital role of foliar spraying on some medicinal and aromatic plants, on lemongrass *(Cymbopogon flexuosus)* [27] and on *Mentha species* [28]. Ascorbic acid has been shown to play many roles in plant growth, such as regulation of cell elongation [33], cell division, cell wall expansion, and other developmental processes [34]. It participates in a variety of processes including photosynthesis, cell wall development and cell expansion [35]. Citric acid is an important substrate in Krebs cycle and plays a significant role in stimulating biosynthesis processes, application of some organic acids such as citric acid improved the growth of sweet pepper [36]. Ascorbic + citric exert a promotional effect on various vegetative growth and yield characters of grapevine plants [37]. [38], in generally, foliar spraying (Ascobein) increased the lettuce leaves content of N, P, and chlorophyll, as well as total phenol and total amino acids. The increase of chlorophyll content may be attributed to the positive effect of citric acid and ascorbic acid. [39] on tomato and [40] on sugar beet, found that ascorbic acid increased total chlorophylls and attributed this to stimulation the biosynthesis of chlorophylls.

Oil % and the chemical composition of EO

From the obtained results that spraying sweet basil plants with Ascobein caused increased the oil % and active constituents of EO, such results may be due to ascorbic acid and citric acid exerted their active effects on the biosynthesis of oil and its compounds. These results are consistent with both [32] and [30] reported that, Ascobein (ascorbic acid and citric acid in a ratio of 2:1), had a promotion effect on growth and active compounds of various plants under stressed conditions or normal. It is worth noting that spraying rue (*Ruta graveolens*) plants with Ascobein foliar fertilizer caused increased the accumulation of active constituents including EO, cumarin and rutin [29]. In addition to, [46], found that the oil seed content was significantly affected by number of sprays, whereas oil seed value was significantly increased by spraying Ascobeine up to 200 g/fed once or twice in both seasons. Spraying plants (*Nigella sativa*) with Ascobein (100 ppm) caused a significant increase in the oil yield, major components and total phenolic contents [31]. Such results may be due to the fact that citric and ascorbic acids exerted its effects on the metabolism and biosynthesis of oil and its related compounds [46].

The components of Sweet basil EO were determined by GC, the main constituents were linalool, 1.8 cineole, α-terpineol, eugenol, methyl chavicole, β-caryophyllene, α-pinene and β-pinene. This result is in line with [47] who found that the known components were α-pinene, β-pinene, 1,8 cineole, linalool, α-terpineol, geranyl acetate, methyl chavicol, β-caryophyllene. Many investigators have found that the main compounds are; linalool, 1, 8, cineol, eugenol, methyl cinnamate, camphor, methyl eugenol, methyl chavicol, β-ocimene, β-elemene, camphene, carvacrol, α-bergamotene or α-cadinol and geranial [6].

Conclusion

The results revealed that, all Ascobein treatments achieved the highest vegetative growth, oil% and main compounds of EO. Moreover, treatment; 150 ppm recorded higher values for quality parameters of sweet basil during this study than other treatments. From the above, we recommend spraying with Ascobein at a concentration of 150 ppm (spray3)/cut to obtain high quality and productivity of Sweet basil.

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