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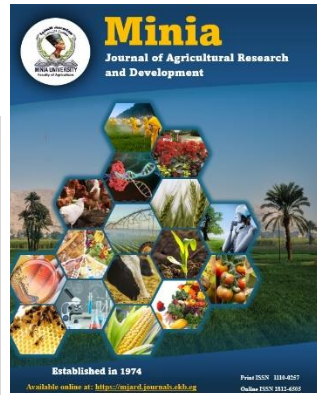

Effect of Chicken Manure, Tryptophan, Seaweed Extract and Vitamin B1 on Volatile Oils and Some Chemicals Constitute of *Carum carvi* Plants

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ABSTRACT

Carum carvi L., a biennial herbaceous plant, has been grown and used for its fragrant seeds and medicinal benefits. To enhance the yield and quality of aromatic plants, sustainable nutrient management is essential. Accordingly, in randomized complete design experiment caraway plants were treated with chicken manure (CM) at rates of 0.0, 2.5, 5.0, and 7.5 tons per feddan (main factor), along with of tryptophan (0, 200, and 300 ppm), seaweed extract (200 and 300 ppm), and vitamin B1 (100 and 200 ppm) (secondary factor). Both factors significantly improved the seed as well as volatile oil production. Moreover, there were significant interactions between the two factors for both factors. That effect was combined with similar effect on photosynthetic pigments and NPK content. Untreated plats had the lowest % (2.012 and 2.212) and yield (0.155 and 0.150 ml/plant) in both seasons respectively. Whereas the highest percentages (2.703 and 2.723) were for plants treated with (5.0 to/feddan of CM in addition to seaweed at 300 ppm) and (7.5 to/feddan of CM in addition to vitamin B1 at 200 ppm) respectively. This last treatment resulted in the highest volatile oil yield in both seasons 0.374 and 0.403 ml/plant. nevertheless, some other treatments had similar yield. Therefore, the previous study suggested that *C. carvi* volatile oil production could be significantly improved under the same experiment condition by application of CM at 5 ton/feddan in addition to tryptophan at 300 ppm, seaweed extract at 300 ppm or thiamin at 200ppm.

Keywords: Caraway, Chicken manure, tryptophan, seaweed extract and thiamine

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INTRODUCTION

Caraway (*Carum carvi* L.) is a biennial herbaceous plant from the Apiaceae family that has been cultivated and used for centuries because of its aromatic fruit and medicinal benefits. Originally native to Europe, western Asia, and North Africa, caraway is now grown in many temperate regions around the world. It is mainly cultivated for its seeds, which have a unique aroma and flavor and are rich in essential oils (Bailer et al., 2001). These fruits are commonly used as a spice in cooking and as an ingredient in herbal treatments for digestive issues such flatulence (Miraldi et al., 2001). Beyond its traditional applications, caraway has attracted scientific attention for its possible pharmacological effects, including antimicrobial, antioxidant, and anti-inflammatory properties (Matthäus and Özcan, 2005).

Aromatic plants are cultivated for their essential oils, which are extensively utilized in the pharmaceutical, cosmetic, and food sectors (Bolouri et al., 2008). To maximize their yield, sustainable nutrient management is essential. Chicken manure (CM) serves as a highly effective organic fertilizer, abundant in NPK, and micronutrients which are vital for plant development and the production of secondary metabolites (Moore et al., 1995). It enhances soil fertility, boosts microbial activity, and supports the sustainable cultivation of aromatic plants (Ghosh et al., 2020). Research indicates that organic fertilizers can notably improve vegetative growth, increase both fresh and dry biomass, by and elevate photosynthetic pigments and nutrient uptake. Hence essential oil production in many aromatic crops could be augmented following the manure application (Reddy et al., 2017 and Nada et al., 2022).

Tryptophan, an essential amino acid, acts as a precursor to IAA, a crucial plant growth regulator that influences cell elongation, division, and differentiation (Radwanski and Last, 1995). Foliar application of tryptophan has been shown to promote plant growth, enhance nutrient absorption, and stimulate the production of secondary metabolites, including essential oils (Ali et al., 2007). In aromatic plants, where both biomass and essential oil determine yield, tryptophan can serve as an affordable biostimulants that supports sustainable cultivation (Kumar et al., 2012). Its ability to regulate physiological processes make it as a potential agronomic tool to boost both productivity and quality of aromatic plant.

Seaweed extracts have gained recognition as effective biostimulants because they are rich in minerals, phytohormones, and bioactive compounds that promote plant growth and increase secondary metabolite production (Khan et al., 2009). Studies show that seaweed extracts enhance soil fertility, encourage root growth, and improve stress resistance, resulting in greater biomass and essential oil yields in aromatic plants (Craigie, 2011 and Singh et al., 2016).

Vitamin B1, an important coenzyme in carbohydrate metabolism, also acts as a signaling molecule that boosts plant growth, and secondary metabolite synthesis (Tunc-Ozdemir et al., 2009). Vitamin B1 applications have been found to increase antioxidant activity, photosynthetic efficiency, and resistance to abiotic stresses, thereby supporting higher biomass and metabolite accumulation (Rapala-Kozik et al., 2012). In aromatic plants, vitamin B1 supplementation offers a promising approach to sustainably essential oil productivity (Ali et al., 2019).

Additionally, the combined use of chicken manure, tryptophan, seaweed extracts, and vitamin B1 promotes environmentally friendly farming practices and represents a promising strategy to improve both yield and quality in aromatic plant cultivation (Tunc-Ozdemir et al., 2009; Shukla et al., 2019; Asadu et al., 2021). Therefore, this study aimed to enhance the volatile oil production of caraway plants by applying these plant biostimulants.

MATERIAL AND METHODS

Experimental design

A field experiment was conducted over two consecutive seasons, 2020/2021 and 2021/2022, at Arab El-Awammer Res. Sta. in Assiut, Egypt. The physical and chemical properties of the soil used are presented in Table 1. Seeds were sourced from the Hort. Res. Inst., Agric. Res. Center, Giza, and were sown on Oct. 15th and harvested during the third week of May in both seasons.

Experimental Design

The study was set up as a randomized complete block design with a split-plot arrangement and three replicates. The main plots (factor A) consisted of four levels of CM application (0.0, 2.5, 5.0, and 7.5 tons per feddan), while the subplots (factor B) included seven treatments: a control treated with tap water, (tryptophan at 200 and 300 ppm), (seaweed extract at 200 and 300 ppm), and (vitamin B1at 100 and 200 ppm). This resulted in a total of 28 treatment combinations. Each experimental unit measured 6 m² (2 x 3 m) and contained 3 rows spaced 50 cm apart. Seeds were planted in hills spaced 40 cm apart, and 4 weeks after sowing, plants were thinned to 2 per hill.

Chicken manure was sourced from a private farm, whereas tryptophan, seaweed extract, and Vitamin B1 were procured from Shoura Chemical Company in Cairo. The analysis of the CM is presented in Table 2. The 3 biostimulants were applied as foliar sprays 3 times, beginning Nov. 25th, with 3 weeks intervals between applications. The plants were sprayed until the solution ran off. All other farming practices were conducted as usual in the cultivation area.

All cultivated plants received fertilization with 300 kg/feddan of ammonium sulfate containing 20.6% nitrogen, 200 kg/feddan of calcium superphosphate containing 15.5% P2O5, and 50 kg/feddan of potassium sulfate containing 48% K2O. The N fertilizer was divided into 3 equal portions, applied at 15, 30, and 45 days after sowing. Potassium fertilizer was applied together with the first N application, while P fertilizer was applied during soil preparation. All other farming practices were carried out following local agricultural traditions. At harvest, plants were cut just above the soil surface. Measurements were taken for seed yield/plant.

Photosynthetic Pigments

The contents of the 3 photosynthetic pigments; Chl a, Chl b, and carotenoids were determined in fresh plant leaves according to the method described by Ritchie (2008). Fresh leaves were collected from the middle section of the branches 3 weeks after the final treatments. A photosynthetic pigment extract was prepared from a 0.5 g leaf sample using 10 ml of 99.5% methanol. The extract’s absorbance was measured with a spectrophotometer at wavelengths of 666, 653, and 470 nm. Subsequently, the concentrations of chlorophyll a, chlorophyll b, and carotenoids were calculated.

NPK Content in Herbs

Leaves were oven-dried at 70 ºC for 24 hour then a 1 g portion of the powdered sample was wet-digested using 96% sulfuric acid with phosphorus-free hydrogen peroxide (30% W/V) at 300 ºC to measure N, following the method of AOAC (1990). Leaf N was determined using the micro-Kjeldahl digestion technique. For P and K analysis, ground samples were digested with a nitric-perchloric-sulfuric acid mixture according to AOAC (1990) procedures. Phosphorus content was measured calorimetrically using the vanado molybdate method, while potassium levels were determined using a flame photometer (AOAC, 1990).

Estimation of Essential Oils:

A 20 g fruit sample was used to measure the percentage of volatile oils through hydro-distillation in a Clevenger apparatus for 3 hours, following the British Pharmacopoeia (1963) method. The yield of volatile oils was calculated per plant per feda.

Statistical analysis

The collected data were analyzed using analysis of variance (ANOVA) with MSTAT-C software (1986). The Least Significant Difference (LSD) test at a 0.05 significance level was applied to compare the mean values of the treatments.

RESULTS AND DISCUSSION

Photosynthetic pigments

The obtained results (Table 3) showed a significant repose of Chl a content of *C. carvi* plants due to both application factors with similar trend in both seasons. There was no significant difference between 0.0 and 2.5 ton/feddan of CM. All biostimulants treatments significantly increased the Chl a content over the control plants which had 2.397 mg/g of fresh weight. Plants which treated with the highest level of tryptophan, seaweed extracts, and vitamin B1 had the highest Chl a content (2.730, 2.70, and 2.764 mg/g fresh weight) without significant difference among them in the 1st season. The interaction between the two applied factors was significant in both seasons. Overall, the lowest contents in both seasons (2.206 and 2.213 mg/g fresh weight, respectively) being for the control plants. Whereas the highest values (2.909 and 2.876 mg/g) were estimate for planta applied with 7.5 ton/feddan of CM in addition to vitamin B1 at 200 ppm. Overall, the was no significant difference between plants treated with 5.0 and 7.5 ton/feddan under the same concentration of the applied biostimulants. Similar observations were estimated in the 2nd season (Table3).

Carum carvi leaves content of Chl b was significantly improved due both investigated factors moreover there was significant interaction between them with similar trend in both growing seasons. In the 1st one a gradual significant increase was estimated by increasing CM up to 5.0 ton/feddan however the difference between 5.0 and 7.5 ton/feddan (0.826 and 0.838 mg/g fresh weight) was not significant. Regarding to the 2nd factor all its levels significantly increased leaves content of Chl b. Moreover, the highest concentration of any of these substances has a significant effect compared to the lowest one. Results showed that plants applied with seaweed at 300 ppm and vitamin B1 at 200 ppm had the highest Chl b content 0.872 and 0.857 mg/g fresh weight. The interaction between the two factors showed that untreated plants had the lowest content (0.638 and 0.601 mg/g fresh weight for both seasons respectively) were for untreated plants. However, the highest contents (0.897 and 0.855 mg/g fresh weight) were for plants applied with (5.0 ton/feddan of CM in addition to seaweed extracts at 300 ppm) and 7.5 ton/feddan in addition to vitamin B1 at 200 ppm) respectively.

The ANOVA of the *C. carvi* leaf carotenoids content showed linear significant increase following increasing CM application in the 2nd season unlike the 1st one where the difference between 5.0 and 7.5 ton/feddan was not significant (Table 5). All applied concentration of the biostimulants significantly increased carotenoid content over the control plans which had 0.932 and 0.924 mg/g fresh weight in both seasons respectively. Plants which received 200 ppm of vitamin B1 contend the highest values 1.172 and 1.205 mg/g fresh weight respectively. The interaction between the two applied factors suggested the untreated plants content the lowest values 0.714 and 0.701 mg/g in the two growing seasons respectively. But these treated with 5.0 or 7.5 ton/feddan in combination with vitamin B1 had the highest values without significant difference between them in both seasons.

Chicken manure significantly enhanced the photosynthetic pigments; Ch a and b and carotenoids of *C. carvi* leaves (Tables 3-5). This is primarily due to the improved nutrient availability, especially N and Mg, which are essential for chlorophyll synthesis (Mahfouz and Sharaf Eldin, 2007). Organic inputs also improve soil structure, microbial activity, and moisture retention, all of which support better nutrient uptake and pigment formation (Ramesh et al., 2009). Additionally, organic amendments can increase endogenous hormones like cytokinins, which delay chlorophyll degradation and enhance chloroplast development (Abou El-Magd et al., 2008).

Tryptophan, is a precursor of IAA, positively influences photosynthetic pigments in *C. carvi*. Tryptophan application enhances Chl a and b, and carotenoids by promoting chloroplast development and delaying pigment degradation (El-Tohamy et al., 2008). Therefore, plant photosynthesis, growth, and essential oil yield could be improved. Tryptophan also improves nutrient uptake and stress tolerance, indirectly supporting pigment synthesis (El-Awadi et al., 2011; Glick, 2014). Our recent observed results confirm these of Amer et al. (2024) and Zatimeh and Al-Fraihat (2025).

Seaweed extracts are rich in natural growth regulators, amino acids, and micronutrients, which have been shown to enhance photosynthetic pigment content in various medicinal and aromatic plants (Eisa, 2016, and Tursun, 2022). Application of seaweed extracts improves levels of Ch a and b, and, carotenoids, resulting in increased photosynthetic activity and plant vitality. This effect is mainly due to the presence of cytokinins, auxins, and betaines in seaweed, which stimulate chloroplast development and delay chlorophyll degradation (Khan et al., 2009). In caraway, foliar application of seaweed extract has been associated with enhanced pigment concentration and biomass, likely due to improved nutrient uptake and stress resistance (Shaheen et al., 2013 and Elansary et al., 2016).

Recent results showed that vitamin B_1 has been demonstrated to significantly enhance photosynthetic pigments in *C. carvi* which agree with these of Hassan et al. (2025) and Badr and Abdou (2022). These findings indicate that vitamin B_1 enhances pigment biosynthesis and stability, likely through its role in enzymatic activation and oxidative stress mitigation, thereby improving photosynthetic efficiency and plant vigor.

Nitrogen, P and K %

In both seasons obtained results showed that N, P and K % of *C. carvi* leaves were significantly increased due to CM as well as biostimulants application (Tables 6-8). Moreover, there was significant interaction between these factors with similar observation in both of them. In the 1st one the N and K unlike P did not significantly differ between 5.0 and 7.5 ton/feddan treatments however, in the 2nd one a significant increase in these three elements were observed by increasing CM levels. Therefor the lowest N, P and K % in the 1st season being (2.40, 0.115 and 3.19% respectively) were for untreated plants. Whereas the highest % (2.89, 0.150, and 3.61) were for these treated with the highest level of CM.

The biostimulants application showed a significant increase in N, P, and K % of *C. carvi* leaves. Interestingly in both season these elements were significantly increased by increasing any of these biostimulants concentration. Overall, the highest % of N, P and K (2.88, 0.155, and 3.71%, respectively) were for plants treated with thiamine at 200 ppm, tryptophan at 300 and seaweed 300 ppm respectively (Tables 6-8).

Regarding the interaction between these two applied factors untreated plants had significantly the lowest N and P % compared with the other treatments in both seasons. However, K % did not significantly differ in both seasons between plants treated with 5 or 7.5 ton/feddan of CM. Overall, untreated plants had the lowest values of these elements (2.02, 0.91, and 2.52% respectively). The highest N% (3.02 and 3.09 in both seasons respectively) was estimated for plants treated with the highest level of CM in addition to seaweed extract at 300 ppm). But these treated with the same level of CM in addition to tryptophan at 300 ppm had the highest P and K % (0.176 and 3.80) in the 1st season with similar values in the 2nd season. Almost plants treated with seaweed at 300 ppm came the next.

These significant enhancement of NPK of caraway plants due to CM application were similar to observations of (Abou El-Magd et al., 2015, Nada et al., 2022). Chicken manure is a rich organic amendment that provides a balanced supply of macro- and micronutrients and improves soil structure and microbial activity, which collectively enhance nutrient availability and uptake. The high N supports vegetative growth and chlorophyll synthesis, while P promotes root development and energy transfer, and K regulates physiological functions such as water balance and enzyme activation (Reddy et al., 2017).

The application of tryptophan, seaweed extract and vitamin B1 has been shown to significantly improve NPK content of caraway plants (Tables 6-8). Tryptophan as a precursor of IAA enhances root development facilitates more efficient absorption of N, P, and K. Beyond nutrient uptake, tryptophan stimulates enzymatic activities like nitrate reductase and acid phosphatase, which optimize nutrient assimilation and mobilization (Hussein et al., 2021). Other studies (Amer et al., 2024 and Zatimeh and Al-Fraihat, 2025) on different aromatic plants showed higher herb content of NPK due to tryptophan application.

Recent results about the impact of seaweed on NPK of *C. carvi* are agree with these of Eisa (2016) and Tursun (2022). Seaweed extracts are rich in macro- and micronutrients, amino acids, and natural plant growth regulators, which stimulate root growth and microbial activity in the rhizosphere. Enhanced root architecture improves nutrient acquisition, leading to higher NPK accumulation in plant tissues. That supports chlorophyll synthesis and protein metabolism, root development and energy transfer, and regulates water balance and enzyme activation, all contributing to improved plant vigor (Khan et al., 2009 and Elansary et al., 2016).

Thiamine plays a key role as a coenzyme in carbohydrate and amino acid metabolism, which supports energy production and the synthesis of compounds involved in nutrient uptake and translocation. Improved root growth and function under thiamine application increase the plant's ability to absorb NPK (Sadak et al., 2019). These physiological improvements collectively lead to better plant growth, higher tissue nutrient content was previously recorded by (Abdou et al., 2015 and Singh et al., 2017).

Volatile oils production/plant

Results (Tables 9 and 10) illustrated the significant impact of CM as well as applied biostimulants on percentage of volatile oils as well as their yield of *C. carvi* fruits. Volatile oils % significantly increased by increasing CM level up to 5 ton/feddan (2.593 and 2.479% in both seasons respectively) then slightly decreased. However, the volatile oil yield/plant had a significant linear response to CM levels yielded the highest yield (0.349 and 0.352 ml/plant in both seasons respectively) for plants treated with 7.5 ton/feddan. However, plants did not treat with CM had the lowest % and yield (2.359 and 0.303 ml/plant, respectively) in the 1st season and similar trend was recorded in the 2nd one.

The biostimulants had a significant positive effect on volatile oil % as well as yield/plant with similar trend in bot seasons. In the 1st one seeds of the control plants had 2.270 % and 0.217 ml/plant of volatile oil which was significantly the lowest. On the other hand, plants treated with vitamin B1 at 200 ppm resulted in the highest percentage (2.598) in both seasons but the highest yield (0.362 and 0.373 2.598 ml/plant of the two seasons respectively) being for plants treated with seaweed extract at 300 ppm. Generally, the higher concentration of any of these biostimulants resulted in significantly higher yield (Tables 9 and 10).

The interaction among the two applied factor resulted in significant augmentation of seed content of volatile oils (Tables 9 and 10). Untreated plats had the lowest % (2.012 and 2.212) and yield (0.155 and 0.150 ml/plant) in both seasons respectively. Whereas the highest volatile oil percentages (2.703 and 2.723) in these seasons were for plants treated with (5.0 to/feddan of CM in addition to seaweed at 300 ppm) and (7.5 to/feddan of CM in addition to vitamin B1 at 200 ppm). This last treatment resulted in the highest volatile oil yield in both seasons 0.374 and 0.403 ml/plant. nevertheless, some other treatments had similar yield (Table 10).

Table 11 shows the response of volatile oil yield/feddan of *C. carvi* plants to the investigated factors. Results show both of volatile oil yield/plant and /feddan has the same trend.

This positive impact of CM on volatile oils of *C. carvi* is matching the achievements of Shaalan (2005) and Ali et al. (2020). Results listed in tables 3-5 showed treated plants had higher photosynthetic pigments. Moreover tables 6-8 represent higher NPK content due to CM application. All of which are crucial for the biosynthesis of secondary metabolites, including volatile oils. Studies have reported that organic manures enhance the accumulation of essential oil in caraway by stimulating enzymatic pathways involved in terpenoid biosynthesis (Abou El-Magd et al., 2015). Studies of Ali et al. (2020) have shown that caraway plants treated with organic manures exhibit higher chlorophyll and carotenoid levels, leading to improved photosynthesis and growth therefore volatile oil production.

Tryptophan application has been reported to enhance the production of volatile oils in other aromatic plants (Hussein et al., 2021 and Nada et al., 2022) by stimulating key physiological and biochemical pathways. It promotes root development and nutrient uptake (tables 6-9), leading to improved photosynthesis and biomass accumulation both critical factors for secondary metabolite biosynthesis.

Our investigation suggested that seaweed extract application has been found to significantly enhance the quantity of volatile oils in caraway plants. Seaweed extracts are rich in natural growth-promoting compounds such as cytokinins, auxins, betaines, and trace elements that stimulate vegetative and root development, and secondary metabolism. These effects lead to improved nutrient uptake (tables 6-8) and enhanced biosynthesis of terpenoids, the main constituents of caraway volatile oils. Research has shown that seaweed extract treatments can increase both the overall essential oil yield (Elansary et al., 2016 and Rasouli et al., 2023).

Vitamin B1 application has been shown to positively influence the production of volatile oils in caraway plants. It plays a crucial role as a coenzyme in key metabolic pathways, enhancing carbohydrate metabolism and energy production, which fuels the biosynthesis of secondary metabolites (Aly et al., 2022 and Hassan et al., 2025). By promoting better root development, chlorophyll content, and photosynthetic efficiency, vitamin B1 increases the availability of metabolic precursors necessary for terpenoid synthesis; the main pathway responsible for volatile oil production (Rehman et al., 2016).

Therefore, the previous study suggested that *C. carvi* volatile oil production could be significantly improved under the same experiment condition by application of CM at 5 ton/feddan in addition to tryptophan at 300 ppm, seaweed extract at 300 ppm or thiamin at 200ppm.

Table (1): Physical and chemical properties of the experimental soil.

Soil character	Value	Soil character	Value
Sand %	91.1	Available phosphorus ppm	7.01
Silt%	5.7	Soluble anions (meq/l)	
Clay%	3.2	Cl-	1.64
Texture class	Sandy	Soluble cations (meq/l)	
Organic matter %	0.40	Ca++	1.59
$CaCO_3$ %	29.80	Mg++	1.25
pH (1:1)	8.44	N+	0.38
E.C. (d/m (1:1)	0.41	K+	0.78
Total N%	0.01		

Table 2: Chemical analysis of chicken manure used in the present study.

Content	Value	Content	Value
Organic matter %	68.03	K%	2.19
Carbon %	38.82	Fe (ppm)	4046
N%	3.09	Zn (ppm)	279
C/N ratio	1: 12.6	Mn (ppm)	301
NH_4 (ppm)	71.0	Cu (ppm)	34.4
NO_3 (ppm)	21.0	pH	6.87
Ash %	25.5	E.C (mmhos/cm)	2.20
P %	1.18		

Table (3): Effect of chicken manure, tryptophan, seaweed extract and vitamin B1 on chlorophyll a mg/g fresh weight of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	**2.5**	**5.0**	**7.5**	**Mean (B)**
Biostimulants (ppm) (B)	**First season**				
Control	2.206	2.364	2.45	2.5695	**2.397**
Tryptophan 200	2.416	2.741	2.825	2.724	**2.677**
Tryptophan 300	2.725	2.717	2.702	2.775	**2.730**
Seaweed 200	2.390	2.646	2.781	2.625	**2.611**
Seaweed 300	2.628	2.563	2.879	2.811	**2.720**
Vitamin B1 100	2.519	2.408	2.509	2.712	**2.537**
Vitamin B1 200	2.618	2.686	2.841	2.909	**2.764**
Mean (A)	**2.500**	**2.589**	**2.712**	**2.732**	
L.S.D. 5%	**A: 0.101**		**B: 0.132**		**AB: 0.264**
Second season					
Control	2.213	2.280	2.244	2.297	**2.259**
Tryptophan 200	2.461	2.495	2.737	2.761	**2.614**
Tryptophan 300	2.534	2.630	2.779	2.700	**2.661**
Seaweed 200	2.699	2.703	2.705	2.720	**2.707**
Seaweed 300	2.795	2.714	2.791	2.756	**2.764**
Vitamin B1 100	2.603	2.641	2.722	2.785	**2.688**
Vitamin B1 200	2.68	2.734	2.863	2.876	**2.788**
Mean (A)	**2.569**	**2.600**	**2.692**	**2.699**	
L.S.D. 5%	**A: 0.111**		**B: 0.1370**		**AB: 0.272**

Table (4): Effect of chicken manure, tryptophan, seaweed extract and vitamin B1 on chlorophyll (b) of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	**2.5**	**5.0**	**7.5**	**Mean (B)**
Biostimulants (ppm) (B)	**First season**				
Control	0.638	0.693	0.665	0.666	**0.666**
Tryptophan 200	0.720	0.732	0.812	0.854	**0.780**
Tryptophan 300	0.745	0.777	0.860	0.867	**0.812**
Seaweed 200	0.823	0.838	0.862	0.840	**0.841**
Seaweed 300	0.838	0.868	0.897	0.885	**0.872**
Vitamin B1 100	0.768	0.787	0.807	0.862	**0.806**
Vitamin B1 200	0.827	0.831	0.876	0.892	**0.857**
Mean (A)	**0.766**	**0.789**	**0.826**	**0.838**	
L.S.D. 5%	**A: 0.012**		**B: 0.021**		**AB: 0.042**
Second season					
Control	0.601	0.671	0.706	0.767	**0.691**
Tryptophan 200	0.608	0.749	0.757	0.753	**0.717**
Tryptophan 300	0.704	0.826	0.783	0.778	**0.773**
Seaweed 200	0.772	0.707	0.763	0.707	**0.737**
Seaweed 300	0.724	0.716	0.794	0.776	**0.753**
Vitamin B1 100	0.618	0.644	0.728	0.776	**0.692**
Vitamin B1 200	0.59	0.788	0.786	0.855	**0.755**
Mean (A)	**0.660**	**0.727**	**0.760**	**0.773**	
L.S.D. 5%	**A: 0.019**		**B: 0.026**		**AB: 0.052**

Table (5): Effect of chicken manure, tryptophan, seaweed extract and vitamin B1 on carotenoids of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	2.5	5.0	7.5	Mean (B)
Biostimulants (ppm) (B)	**First season**				
Control	0.714	0.894	1.014	1.104	**0.932**
Tryptophan 200	0.913	1.111	1.159	1.252	**1.109**
Tryptophan 300	0.926	1.111	1.218	1.105	**1.090**
Seaweed 200	1.053	1.143	1.131	1.104	**1.108**
Seaweed 300	1.077	1.009	1.189	1.136	**1.103**
Vitamin B1 100	1.027	1.063	1.172	1.185	**1.112**
Vitamin B1 200	1.096	1.206	1.191	1.194	**1.172**
Mean (A)	**0.972**	**1.077**	**1.153**	**1.154**	
L.S.D. 5%	**A: 0.018**		**B: 0.021**		**AB: 0.042**
Second season					
Control	0.704	0.884	0.914	1.194	**0.924**
Tryptophan 200	0.99	1.111	1.122	1.125	**1.087**
Tryptophan 300	1.013	1.169	1.139	1.176	**1.124**
Seaweed 200	1.113	1.115	1.166	1.238	**1.158**
Seaweed 300	1.143	1.143	1.191	1.194	**1.168**
Vitamin B1 100	1.017	1.053	1.192	1.199	**1.115**
Vitamin B1 200	1.200	1.216	1.201	1.201	**1.205**
Mean (A)	**1.026**	**1.099**	**1.132**	**1.190**	
L.S.D. 5%	**A: 0.016**		**B: 0.019**		**AB: 0.038**

Table (6): Effect of chicken manure, tryptophan, seaweed extract and vitamin B1 on N% of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	2.5	5.0	7.5	Mean (B)
Biostimulants (ppm) (B)	**First season**				
Control	2.02	2.56	2.77	2.62	**2.49**
Tryptophan 200	2.35	2.54	2.69	2.19	**2.54**
Tryptophan 300	2.43	2.52	2.69	2.95	**2.65**
Seaweed 200	2.31	2.62	2.82	2.99	**2.69**
Seaweed 300	2.53	2.75	2.89	3.02	**2.80**
Vitamin B1 100	2.52	2.8	2.87	2.62	**2.70**
Vitamin B1 200	2.62	2.86	3.01	3.02	**2.88**
Mean (A)	**2.40**	**2.66**	**2.82**	**2.89**	
L.S.D. 5%	**A: 0.06**		**B: 0.09**		**AB: 0.19**
Second season					
Control	1.99	2.46	2.7	2.79	**2.49**
Tryptophan 200	2.25	2.44	2.61	2.9	**2.55**
Tryptophan 300	2.45	2.56	2.75	3.02	**2.70**
Seaweed 200	2.35	2.72	2.82	2.99	**2.72**
Seaweed 300	2.53	2.75	2.89	3.09	**2.89**
Vitamin B1 100	2.42	2.72	2.67	2.82	**2.66**
Vitamin B1 200	2.62	2.79	2.8	3.09	**2.83**
Mean (A)	**2.37**	**2.63**	**2.75**	**2.95**	
L.S.D. 5%	**A: 0.06**		**B: 0.09**		**AB: 0.20**

Table (7): Effect of chicken manure, tryptophan, seaweed extract and vitamin B1 on P% of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	**2.5**	**5.0**	**7.5**	**Mean (B)**
Biostimulants (ppm) (B)	**First season**				
Control	0.091	0.111	0.123	0.132	**0.114**
Tryptophan 200	0.102	0.131	0.135	0.145	**0.128**
Tryptophan 300	0.130	0.153	0.160	0.176	**0.155**
Seaweed 200	0.102	0.123	0.134	0.139	**0.125**
Seaweed 300	0.130	0.140	0.145	0.160	**0.143**
Vitamin B1 100	0.122	0.133	0.142	0.145	**0.136**
Vitamin B1 200	0.130	0.140	0.150	0.156	**0.145**
Mean (A)	**0.115**	**0.133**	**0.141**	**0.150**	
L.S.D. 5%	**A: 0.006**		**B: 0.004**		**AB: 0.008**
Second season					
Control	0.098	0.113	0.125	0.136	**0.118**
Tryptophan 200	0.105	0.134	0.138	0.144	**0.130**
Tryptophan 300	0.129	0.158	0.158	0.169	**0.154**
Seaweed 200	0.109	0.128	0.136	0.148	**0.130**
Seaweed 300	0.136	0.142	0.149	0.157	**0.146**
Vitamin B1 100	0.12	0.136	0.144	0.148	**0.137**
Vitamin B1 200	0.129	0.146	0.153	0.161	**0.147**
Mean (A)	**0.118**	**0.137**	**0.143**	**0.152**	
L.S.D. 5%	**A: 0.006**		**B: 0.002**		**AB: 0.00٤**

Table (8): Effect of chicken manure, tryptophan, seaweed extract and vitamin B1 on K% of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	**2.5**	**5.0**	**7.5**	**Mean (B)**
Biostimulants (ppm) (B)	**First season**				
Control	2.52	2.63	3.25	3.29	**2.93**
Tryptophan 200	3.05	3.07	3.39	3.39	**3.23**
Tryptophan 300	3.15	3.59	3.84	3.83	**3.61**
Seaweed 200	3.12	3.43	3.65	3.69	**3.47**
Seaweed 300	3.57	3.67	3.75	3.85	**3.71**
Vitamin B1 100	3.12	3.21	3.44	3.51	**3.32**
Vitamin B1 200	3.54	3.62	3.73	3.73	**3.65**
Mean (A)	**3.15**	**3.32**	**3.58**	**3.61**	
L.S.D. 5%	**A: 0.19**		**B: 0.11**		**AB: 0.22**
Second season					
Control	2.49	2.53	3.15	3.32	**2.87**
Tryptophan 200	3.10	3.11	3.24	3.34	**3.20**
Tryptophan 300	3.19	3.55	3.79	3.89	**3.61**
Seaweed 200	3.21	3.40	3.69	3.67	**3.49**
Seaweed 300	3.52	3.78	3.79	3.99	**3.77**
Vitamin B1 100	3.32	3.43	3.45	3.65	**3.46**
Vitamin B1 200	3.46	3.57	3.77	3.78	**3.64**
Mean (A)	**3.19**	**3.34**	**3.55**	**3.67**	
L.S.D. 5%	**A: 0.10**		**B: 0.12**		**AB: 0.24**

Table (9): Effect of chicken manure, tryptophan, seaweed extract and vitamin B1 on volatile oil percentage of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	2.5	5.0	7.5	Mean (B)
Biostimulants (ppm) (B)	**First season**				
Control	2.012	2.123	2.423	2.523	**2.270**
Tryptophan 200	2.383	2.323	2.512	2.612	**2.458**
Tryptophan 300	2.423	2.623	2.523	2.423	**2.498**
Seaweed 200	2.423	2.524	2.623	2.523	**2.523**
Seaweed 300	2.323	2.523	2.703	2.623	**2.548**
Vitamin B1 100	2.523	2.623	2.623	2.423	**2.548**
Vitamin B1 200	2.423	2.623	2.723	2.623	**2.598**
Mean (A)	**2.359**	**2.480**	**2.593**	**2.536**	
L.S.D. 5%	**A: 0.010**		**B: 0.021**		**AB: 0.043**
Second season					
Control	2.112	2.412	2.212	2.112	**2.212**
Tryptophan 200	2.223	2.123	2.523	2.523	**2.348**
Tryptophan 300	2.423	2.423	2.623	2.622	**2.523**
Seaweed 200	2.223	2.523	2.523	2.323	**2.398**
Seaweed 300	2.523	2.523	2.623	2.523	**2.548**
Vitamin B1 100	2.423	2.423	2.323	2.423	**2.398**
Vitamin B1 200	2.523	2.623	2.523	2.723	**2.598**
Mean (A)	**2.350**	**2.436**	**2.479**	**2.464**	
L.S.D. 5%	**A: 0.017**		**B: 0.025**		**AB: 0.050**

Table (10): Effect of chicken manure, tryptophan, seaweed extract and vitamin B1 on volatile oil yield/plant of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	2.5	5.0	7.5	Mean (B)
Biostimulants (ppm) (B)	**First season**				
Control	0.155	0.177	0.262	0.274	**0.217**
Tryptophan 200	0.298	0.29	0.355	0.357	**0.325**
Tryptophan 300	0.304	0.367	0.389	0.339	**0.350**
Seaweed 200	0.341	0.347	0.371	0.355	**0.354**
Seaweed 300	0.354	0.363	0.347	0.385	**0.362**
Vitamin B1 100	0.331	0.319	0.327	0.362	**0.335**
Vitamin B1 200	0.339	0.355	0.369	0.374	**0.359**
Mean (A)	**0.303**	**0.317**	**0.346**	**0.349**	
L.S.D. 5%	**A: 0.012**		**B: 0.022**		**AB: 0.044**
Second season					
Control	0.150	0.193	0.213	0.232	**0.197**
Tryptophan 200	0.258	0.265	0.356	0.369	**0.312**
Tryptophan 300	0.301	0.342	0.388	0.393	**0.356**
Seaweed 200	0.306	0.307	0.362	0.346	**0.330**
Seaweed 300	0.354	0.358	0.394	0.385	**0.373**
Vitamin B1 100	0.355	0.359	0.327	0.339	**0.345**
Vitamin B1 200	0.314	0.359	0.376	0.403	**0.336**
Mean (A)	**0.291**	**0.312**	**0.345**	**0.352**	
L.S.D. 5%	**A: 0.012**		**B: 0.021**		**AB: 0.043**

Table (11): Effect of chicken manure, tryptophan, seaweed extract and thiamine on oil yield/fed. of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	**2.5**	**5.0**	**7.5**	**Mean (B)**
Biostimulants (ppm) (B)	**First season**				
Control	4.82	5.48	8.13	8.50	**6.73**
Tryptophan 200	9.25	8.98	11.00	11.05	**10.07**
Tryptophan 300	9.41	11.38	12.05	10.52	**10.84**
Seaweed 200	11.00	10.75	11.49	10.59	**10.95**
Seaweed 300	10.98	11.26	10.76	11.94	**11.23**
Thiamine 100	11.58	11.02	11.42	10.51	**11.13**
Thiamine 200	10.26	9.90	10.13	11.21	**10.38**
Mean (A)	**9.61**	**9.82**	**10.71**	**10.62**	
L.S.D. 5%	**A: 0.11**		**B: 0.25**		**AB: 0.51**
	Second season				
Control	4.66	5.99	6.60	7.18	**6.11**
Tryptophan 200	7.99	8.21	11.03	11.43	**9.66**
Tryptophan 300	9.34	10.59	12.04	12.19	**11.04**
Seaweed 200	9.48	9.51	11.21	10.73	**10.23**
Seaweed 300	10.99	11.10	12.21	11.94	**11.56**
Thiamine 100	11.00	11.12	10.14	10.51	**10.69**
Thiamine 200	9.75	11.12	11.65	12.48	**11.25**
Mean (A)	**9.03**	**9.66**	**10.70**	**10.92**	
L.S.D. 5%	**A: 0.10**		**B: 0.021**		**AB: 0.042**

REFERENCES

Abdou, M. H., El-Sayed, A. A., Ahmed, E. T. and Abdel Salam, A. A. (2015). Effect of compost, mineral NPK, effective microorganisms and some vitamin treatments on growth, fruit yield and essential oil content of coriander (*Coriandrum sativum* L.) plants. *Scientific Journal of Flowers and Ornamental Plants*, 2(3): 203–212.

Abou El-Magd, M. M., El-Bassiony, A. M. and Fawzy, Z. F. (2015). Effect of organic manure and bio-fertilizers on growth, yield and quality of plants. *Journal of Agricultural Science*, 7(2): 134–142.

Ali, Q., Ashraf, M. and Athar, H. R. (2007). Exogenously applied proline at different growth stages enhances growth of two maize cultivars grown under water deficit conditions. *Pak. J. Bot.*, 39(4): 1133–1144.

Ali, Q., Ashraf, M. and Shahbaz, M. (2019). Humic acid and thiamin mitigate salinity-induced adverse effects by enhancing photosynthesis and antioxidant defense in maize. *Pak. J. Bot.*, 51(3): 1101–1109.

Ali, R., Ibrahim, M. E. and El-Sayed, A. (2020). Effect of organic and bio-fertilizers on growth and essential oil composition of caraway (*Carum carvi* L.). *Egyptian Journal of Agronomy*, 42(3): 201–212.

Aly, M. K. A., Ahmed, E. T., Mohamed, M. A. H. and Kasem,

M. T. H. (2022). Response of anise plants to humic acid, amino acids and thiamine treatments. *Scientific Journal of Flowers and Ornamental Plants*, 9(3): 153–165.

Amer, H. M., Hussein, M. S., Khalid, K. A. and Mohammad, A. A. (2024). Improving productivity and chemical constituents of *Coriandrum sativum* L. under foliar application of tryptophan. *Vegetos*, 37(5): 1989–1996.

Asadu, C. L. A., Okechukwu, R. U. and Igwe, C. A. (2021). Influence of organic and inorganic fertilizers on the growth and yield of basil (*Ocimum basilicum*). *Agro-Science*, 20(1): 22–30.

Badr, M., & Abdou, A. (2022). *Influence of Some Natural Substances on Growth, Yield and Oil Composition of Caraway (Carum carvi L.) Plants.* Middle East Journal of Applied Agricultural Research, 11(3), 654–666.

Bailer, J., Aichinger, T., Hackl, G., de Hueber, K. and Dachler, M. (2001). Essential oil content and composition in commercially available caraway (*Carum carvi* L.) seeds. *Pharm. Biol.*, 39(3): 221–225.

Bolouri, P., Salami, R., Kouhi, S., Kordi, M., Asgari Lajayer, B., Hadian, J. and Astatkie, T. (2022). Applications of essential oils and plant extracts in different industries. *Molecules*, 27(24): 8999.

British Pharmacopoeia. (1963). *Determination of Volatile Oil Drugs.* The Pharmaceutical Press, London, UK: 1210 pp.

Craigie, J. S. (2011). Seaweed extract stimuli in plant science and agriculture. *J. Appl. Phycol.*, 23(3): 371–393.

Eisa, E. A. (2016). Effect of some different sources of organic fertilizers and seaweed extract on growth and essential oil of sweet fennel (*Foeniculum vulgare* Mill.) plants. *Journal of Plant Production*, 7(6): 575–584.

Elansary, H. O., Yessoufou, K., Abdel-Hamid, A. M. E., El-Esawi, M. and Ali, H. M. (2016). Seaweed extracts enhance caraway (*Carum carvi* L.) growth, metabolism, and essential oil yield under different irrigation levels. *Journal of Plant Nutrition*, 39(10): 1450–1460.

El-Awadi, M. E. and Hassan, E. A. (2010). Physiological responses of fennel (*Foeniculum vulgare* Mill.) plants to some growth substances: the effect of certain amino acids and a pyrimidine derivative. *J. Am. Sci.*, 6(7): 120–125.

El-Awadi, M. E., El-Tohamy, W. A., & Gruda, N. (2011). Ameliorative effects of amino acids on productivity and quality of green bean plants grown under salt stress. *Journal of Applied Botany and Food Quality*, 84(2), 155–162.

El-Tohamy, W. A., El-Abagy, H. M., & Ali, M. K. (2008). Indole acetic acid and tryptophan-induced physiological responses in tomato plants. *Journal of Applied Sciences Research*, 4(4), 367–372.

Ghosh, S., Majumdar, S. and Goswami, L. (2020). Effect of organic manures on growth, yield and quality of aromatic plants: A review. *J. Med. Plants Stud.*, 8(3): 66–72.

Glick, B. R. (2014). Bacteria with ACC deaminase can promote plant growth and help to feed the world.

Microbiological Research, 169(1), 30–39.

Hassan, A. A., Abdel-Rahim, A. F., Al Hawas, G. H., Alshammari, W. K., Zewail, R. M., Badawy, A. A. and El-Desouky, H. S. (2025). Optimizing caraway growth, yield and phytochemical quality under drip irrigation: Synergistic effects of organic manure and foliar application with vitamins B1 and E and active yeast. *Horticulturae*, 11(8): 977.

Hassan, A., El-Sayed, S., & Khalil, M. (2025). *Optimizing Caraway Growth, Yield and Phytochemical Quality Under Drip Irrigation: Synergistic Effects of Organic Manure and Foliar Application with Vitamins B_1 and E and Active Yeast.* Horticulturae, 11(8), 977. https://doi.org/10.3390/horticulturae11080977

Hussein, M. M., Taha, R. A. and Mekki, B. B. (2021). Influence of tryptophan on growth, yield and essential oil of some medicinal plants. *Plant Physiology Reports*, 26(4): 785–793.

Khalil, H. E., El-Saadony, M. T. and Abd El-Hack, M. E. (2020). Role of tryptophan and its derivatives in plant growth and development. *Journal of Plant Growth Regulation*, 39(3): 897–910.

Khan, W., Rayirath, U. P., Subramanian, S., et al. (2009). Seaweed extracts as biostimulants of plant growth and development. *Journal of Plant Growth Regulation*, 28(4), 386–399.

Khan, W., Rayirath, U. P., Subramanian, S., Jithesh, M. N., Rayorath, P., Hodges, D. M. and Prithiviraj, B. (2009). Seaweed extracts as biostimulants of plant growth and development. *J. Plant Growth Regul.*, 28(4): 386–399.

Kumar, V., Sharma, S. and Prasad, R. (2012). Influence of amino acid application on growth, yield and essential oil composition of peppermint (*Mentha piperita* L.). *Ind. Crops Prod.*, 39: 69–74.

Mahfouz, S. A. and Sharaf Eldin, M. A. (2007). Effect of mineral vs. biofertilizer on growth, yield and essential oil content of fennel (*Foeniculum vulgare* Mill.). *International Agrophysics*, 21: 361–366.

Matthäus, B. and Özcan, M. (2005). Determination of fatty acid, tocopherol and sterol contents of some Turkish seed oils. *Grasas y Aceites*, 56(3): 175–179.

Miraldi, E., Ferri, S. and Mostaghimi, V. (2001). Botanical drugs and preparations in the traditional medicine of West Azerbaijan (Iran). *J. Ethnopharmacol.*, 75(2–3): 77–87.

Moore, P. A., Daniel, T. C., Sharpley, A. N. and Wood, C. W. (1995). Poultry manure management: Environmentally sound options. *J. Soil Water Conserv.*, 50(3): 321–327.

Nada, R. S., Ashmawi, A. E., Mady, E., Randhir, T. O. and Elateeq, A. A. (2022). Effect of organic manure and plant growth promoting microbes on yield, quality and essential oil constituents of fennel bulb (*Foeniculum vulgare* Mill.). *Journal of Ecological Engineering*, 23(5): 149–164.

Radwanski, E. R. and Last, R. L. (1995). Tryptophan biosynthesis and metabolism: biochemical and molecular genetics. *Plant Cell*, 7(7): 921.

Ramesh, P., Singh, M. and Subba Rao, A. (2009). Organic farming: Its relevance to the Indian context. *Current Science*, 88(4): 561–568.

Rapala-Kozik, M., Kowalska, E. and Ostrowska, K. (2012). Modulation of thiamine metabolism in *Zea mays* seedlings under conditions of abiotic stress. *J. Exp. Bot.*, 63(15): 5803–5811.

Rasouli, F., Nasiri, Y., Hassanpouraghdam, M. B., Asadi, M., Qaderi, T., Trifa, A. and Szczepanek, M. (2023). Seaweed extract and arbuscular mycorrhiza co-application affect the growth responses and essential oil composition of *Foeniculum vulgare* L. *Scientific Reports*, 13(1): 11902.

Reddy, D. D., Subba Rao, A. and Takkar, P. N. (2017). Integrated nutrient management for sustainable crop production. *Indian Journal of Fertilisers*, 13(2): 20–28.

Rehman, R., Hanif, M. A., Mushtaq, Z. and Al-Sadi, A. M. (2016). Biosynthesis of essential oils in aromatic plants: A review. *Food Reviews International*, 32(2): 117–160.

Ritchie, R. J. (2008). Universal chlorophyll equations for estimating chlorophylls a, b, c, and d and total chlorophylls in natural assemblages of photosynthetic organisms using acetone, methanol, or ethanol solvents. *Photosynthetica*, 46: 115–126.

Sadak, M. S., Abdelhamid, M. T. and Schmidhalter, U. (2019). Effect of foliar application of thiamine on growth, biochemical constituents, and yield of plants under stress conditions. *Bulletin of the National Research Centre*, 43(1): 1–9.

Shaalan, M. N. (2005). Influence of biofertilizers and chicken manure on growth, yield and seed quality of (*Nigella sativa* L.) plants. *Egyptian Journal of Agricultural Research*, 83(2): 811–828.

Shaheen, A. M., Ragab, M. E., & Abd El-Samad, E. H. (2013). Effect of seaweed extract and compost on growth and oil content of caraway plant. *Middle East Journal of Applied Sciences*, 3(4), 144–149.

Shukla, P. S., Borza, T., Critchley, A. T., Hiltz, D., Norrie, J. and Prithiviraj, B. (2019). *Ascophyllum nodosum* extract application increases freezing tolerance in *Arabidopsis thaliana*. *Planta*, 249(6): 1895–1911.

Singh, M., Ali, A. A. and Irfan, Q., M. (2017). Unravelling the impact of essential mineral nutrients on active constituents of selected medicinal and aromatic plants. In: *Essential Plant Nutrients: Uptake, Use Efficiency, and Management*. Springer International Publishing, Cham: 183–209.

Singh, M., Khan, M. M. A. and Naqvi, A. A. (2016). Effect of organic and inorganic fertilizers on the growth and yield of aromatic plants. *J. Essent. Oil Bear. Plants*, 19(5): 1221–1229.

Tel, D. A. and Hagarty, M. (1984). Soil and Plant Analysis. IITA/University of Guelph: 277 pp.

Tunc-Ozdemir, M., Miller, G., Song, L., Kim, J., Sodek, A., Koussevitzky, S. and Mittler, R. (2009). Thiamin confers enhanced tolerance to oxidative stress in *Arabidopsis* by influencing multiple stress response pathways. *Plant Physiol.*, 151(1): 421–432.

Tursun, A. O. (2022). Effect of foliar application of seaweed (organic fertilizer) on yield, essential oil and chemical composition of coriander. *PLoS ONE*, 17(6): e0269067.

Zatimeh, A. A. and Al-Fraihat, A. H. (2025). Influence of tryptophan and glycine acids on growth and productivity of fennel under different organic fertilizer levels. *International Journal of Horticultural Science and Technology*, 12(1): 207–218.

الملخص العربي:

تأثير سبلة الدجاج، والتريبتوفان، ومستخلص الأعشاب البحرية، وفيتامين ب١ على الزيوت الطيارة وبعض المكونات الكيميائية لنباتات الكراوية

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الكراوية نبات عشبي ثنائي الحول، يُزرع ويُستخدم ثماره العطرية وفوائده الطبية. ولتحسين إنتاجية وجودة النباتات العطرية، تُعد الإدارة المستدامة للمغذيات أمرًا بالغ الأهمية. بناءً على ذلك، صممت تجربة في قطاعات كاملة العشوائية، حيث تم معاملة نباتات الكراوية بسبلة الدجاج بمعدلات ٠.٠، ٢.٥، ٥.٠، و٧.٥ طن للفدان (العامل الرئيسي)، إلى جانب التربتوفان (٠، ٢٠٠، و٣٠٠ جزء في المليون)، ومستخلص الأعشاب البحرية (٢٠٠ و٣٠٠ جزء في المليون)، وفيتامين ب١ (١٠٠ و٢٠٠ جزء في المليون) (العامل الثانوي). حسّن كلا العاملين بشكل ملحوظ إنتاج البذور والزيوت الطيارة. علاوة على ذلك، كانت هناك تفاعلات مهمة بين العاملين. وقد اقترن هذا التأثير بتأثير مماثل على الصبغات البناء الضوئي ومحتوى النيتروجين والفوسفور والبوتاسيوم. سجلت النباتات غير المعالجة أقل نسبة مئوية من الزيت الطيار (٢.٠١٢ و٢.٢١٢) ومحصول زيت طيار (٠.١٥٥ و٠.١٥٠ مل/نبات) في كلا الموسمين على التوالي. بينما سجلت أعلى النسب (٢.٧٠٣ و٢.٧٢٣) للنباتات المعالجة بـ٥.٠ طن للفدان من سماد بسبلة الدجاج بالإضافة إلى الأعشاب البحرية بتركيز ٣٠٠ جزء في المليون و 7.5 طن/فدان من سماد بسبلة الدجاج بالإضافة إلى فيتامين B1 بتركيز ٢٠٠ جزء في المليون على التوالي. وقد أسفرت هذه المعاملة الأخيرة عن أعلى محصول للزيت المتطاير في كلا الموسمين، حيث بلغت ٠.٣٧٤ و٠.٤٠٣ مل/نبات. ومع ذلك، فقد حققت بعض المعاملات الأخرى غلة مماثلة. لذلك، اقترحت الدراسة السابقة أن إنتاج الزيت المتطاير لنباتات الكراوية يمكن تحسينه بشكل كبير تحت نفس ظروف التجربة عن طريق تطبيق سبلة الدجاج بمعدل ٥ طن/ فدان بالإضافة إلى التربتوفان بنسبة ٣٠٠ جزء في المليون، أو مستخلص الأعشاب البحرية بنسبة ٣٠٠ جزء في المليون أو الثيامين بنسبة ٢٠٠ جزء في المليون.