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Effect of Chicken Manure, and Some Plant Biostimulants on Vegetative Growth and Fruit Yield of Caraway

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ABSTRACT

Carum carvi L. a biennial herbaceous plant has been cultivated and utilized for its aromatic seeds and medicinal properties. Optimizing aromatic plants yield and quality requires sustainable nutrient management. Therefore, caraway plants were fertilized with chicken manure (0.0, 2.5, 5.0 and 7.5 ton/fed) in addition to tryptophan (0, 200 and 300 ppm), seaweed extract (200 and 300 ppm) and thiamine (100 and 200 ppm). Both investigated factors significantly affect plant height, number of branch/plants, herb fresh an dry weights. However, for most traits there were no significant differences between 5.0 and 7.5 ton/fed treatment. The lowest herb dry being for untreated plants. However, the highest herb dry weights were for plants treated with 5 ton/fed of chicken manure in addition to tryptophan at 200 ppm. There was no significant difference in seed yield/plant between 0 and 2.5 ton/fed treatments or between ton 5.0 and 7.5 ton/fed treatments. Results showed a significant interaction between the two studies factors. The untreated plants yielded the lowest yield 7.72 In the first one plants treated with 5 ton/fed of chicken manure and tryptophan at 300 ppm had the highest yield (15.41 g/plant) followed by 15.26 g/plan for these treated with 7.5 ton/fed of manure in addition to seaweed at 300 ppm without significant difference between them. Therefore, this study suggested that seed yield of caraway plants grown under the experimental conditions could be improved by the application of 5.0 ton/fed of chicken manure in addition to tryptophan at 300 ppm.

KEYWORDS: Chicken manure, tryptophan, seaweed extract and thiamine.

1. INTRODUCTION

Caraway (*Carum carvi* L.), a biennial herbaceous plant belonging to the Apiaceae family, has been cultivated and utilized for centuries due to its aromatic seeds and medicinal properties. Native to Europe, western Asia, and North Africa, caraway is now cultivated in various temperate regions worldwide. It is primarily

grown for its distinctive aroma and flavor seeds, which are rich in essential oils (Bailer et al., 2001). These seeds are widely used as a spice in culinary traditions and as a component in herbal remedies for digestive disorders, and flatulence (Miraldi et al., 2001). In addition to its traditional uses, caraway has garnered scientific interest for its potential pharmacological properties, including antimicrobial, antioxidant, and anti-inflammatory effects (Matthäus and Özcan, 2005).

Aromatic plants are valued for their essential oils, which are widely used in medicine, cosmetics, and food industries (Bakkali et al., 2008). Optimizing their yield and quality requires sustainable nutrient management. Chicken manure is a highly effective organic fertilizer, rich in nitrogen, phosphorus, potassium and micronutrients, which are essential for plant growth and secondary metabolite production (Moore et al., 1995). It improves soil fertility, enhances microbial activity, and promotes the sustainable growth of aromatic plants (Ghosh et al., 2020). Studies have shown that organic amendments can significantly increase vegetative growth, fresh and dry biomass, and essential oil yield in aromatic crops such as lemongrass and basil (Javanmard et al., 2013; Javanmard et al., 2014).

Tryptophan, a key amino acid, serves as a precursor for indole-3-acetic acid (IAA), an important plant growth regulator influencing cell elongation, division, and differentiation (Radwanski and Last, 1995). Exogenous application of tryptophan has been reported to enhance plant growth, improve nutrient uptake, and stimulate the biosynthesis of secondary metabolites, including essential oils (Ali et al., 2007). In aromatic plants, where yield and quality are determined by both biomass and essential oil composition, tryptophan may function as a cost-effective biostimulants that supports sustainable production (Kumar et al., 2012).

Seaweed extracts have emerged as effective biostimulants due to their rich content of minerals, phytohormones, and bioactive compounds that enhance plant growth and secondary metabolite production (Khan et al., 2009). Research indicates that seaweed extracts improve soil health, stimulate root development, and increase resistance to stress, leading to higher biomass and essential oil yields in aromatic plants (Craigie, 2011 and Singh et al., 2016).

Thiamin (vitamin B1), a vital coenzyme in carbohydrate metabolism, also functions as a signaling molecule that enhances plant growth and secondary metabolite production (Tunc-Ozdemir et al., 2009). Applications of thiamin have been shown to improve antioxidant activity, photosynthetic efficiency, and resistance to abiotic stresses, thereby supporting higher biomass and metabolite accumulation (Rapala-Kozik et al., 2012). In many aromatic plants, where essential oil yield and composition are sensitive to stress and metabolic regulation, thiamin supplementation represents a promising tool to enhance productivity and quality in a sustainable manner (Ali et al., 2019). Furthermore, the use of chicken manure, tryptophan, seaweed extracts and thiamin promoting eco-friendly cultivation practices environmentally friendly farming and represent a promising strategy for enhancing both productivity and quality in aromatic plant cultivation (Tunc-Ozdemir et al., 2009, Shukla et al., 2019 and Asadu et al., 2021).

Therefor this investigation aimed to improve the growth of caraway plants using chicken manure in addition to some plant biostimulants (tryptophan, seaweed and thiamine).

2. MATERIAL AND METHODS

2.1.Experimental design

A field experiment was carried out during the two successive seasons of 2020/2021 and 2021/2022 at the Research Farm of Arab El-Awammer Research Station, Assiut, Egypt. The physical and chemical analysis of the used soil are shown in Table 1. Caraway seeds were obtained from Horticultural Research Institute, Agricultural Research Center, Giza and sown on the October, 15th and harvested on the third week of May for both experimental seasons.

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. (ds/m^{-1} (1:1)	0.41	K+	0.78
Total N%	0.01		

2.2.Layout of the experiment

The investigation was arranged in a randomized complete block design in a split plot arrangement with three replicates (Clewer and Scarisbrick, 2001). The main plots (factor A) included four chicken manure rates (0.0, 2.5, 5.0 and 7.5 ton/fed) while the subplots (factor B), were seven treatments of control which treated with tap water, tryptophan (200 and 300 ppm), seaweed extract (200 and 300 ppm) and thiamine (100 and 200 ppm) therefore, the experiment included 28 treatments. The experimental unit was 6 m^2 (2x3 m) and contained three rows, 50 cm apart. The seeds were cultivated in hills, 40 cm apart. After four weeks from seed sowing the plants were thinned to two plants per hill.

All cultivated plants were fertilized with 300 kg/fed of ammonium sulfate that contains 20.6% of nitrogen, 200 kg/fed of calcium superphosphate that contains 15.5% of P_2O_5, and 50 kg/fed of potassium sulfate that contains 48% K_2O. The nitrogen fertilizer was split into three equal batches, at 15, 30, and 45 days after sowing. Potassium fertilizer was applied alongside the first dose of nitrogen, while phosphorus fertilizer was applied during soil preparation. All other agricultural practices were performed according to local farming customs

Chicken manure was obtained from a local private farm add during soil preparation. While tryptophan, seaweed extract and thiamine were obtained from Shoura chemical company, Cairo. Chicken manure analysis is shown in Table 2. The three biostimulants substances were applied as foliar spray three times starting November 25th with three-week intervals. The treatments were applied till run off. All other agricultural practices were carried out as usual in the cultivation region.

At the harvest time plants were cut above the soil surface. Plant height, and main branch numbers were assessed. Herb fresh weight g/plant was measured then plants after seed harvesting were air dried to measure the herb dry weight. Number of umbels/plant, and fruit yield /plant as well as/feddan were estimated.

2.3.Statistical analysis

The recorded data were subjected to the statistical analysis of variance using MSTAT-C (1986) and LSD test at 0.05 was used to compare the average mean of treatments.

3. RESULTS AND DISCUSSION

3.1.Plant height (cm)

Results showed that both investigated factors significantly affected caraway plant height in both seasons. In the 1st one plant height was significantly increased by the application of chicken manure up to 5.0 ton/fed. All applied biostimulants significantly improved plant height compared with the control plants. The ANOVA showed a significant interaction between both investigated factors. The lowest plant height (84.17 cm) was for plants which did treat with chicken manure or biostimulants. However, the tallest one (119.5 cm) being for plants treated with 7.5 ton/fed in addition to tryptophan 300 ppm followed by these treated with the same treatment of chicken manure and 200 ppm of tryptophan (Table 3). Similar responses were observed in the 2nd season but the tallest plants (106.4 and 103.3 cm) being for the application of the same level of

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 and some biostimulants (tryptophan, seaweed extract and thiamine) on plant height (cm) 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	94.43	84.17	95.83	100.80	88.92
Tryptophan 200	91.00	106.90	114.31	115.00	106.80
Tryptophan 300	99.07	111.40	114.69	119.51	111.21
Seaweed 200	91.43	91.60	106.11	111.09	100.11
Seaweed 300	94.23	102.20	106.4	110.81	103.39
Thiamine 100	85.27	90.83	98.33	98.07	93.13
Thiamine 200	89.27	94.17	105.3	109.20	99.47
Mean (A)	89.24	97.33	105.90	109.20	
L.S.D. 5%	A: 6.45		B: 3.57		AB 7.14
	Second season				
Control	76.93	79.13	78.37	79.17	78.40
Tryptophan 200	90.83	91.67	91.13	97.23	92.72
Tryptophan 300	96.13	99.24	89.20	98.83	95.85
Seaweed 200	91.37	95.57	100.30	103.30	97.64
Seaweed 300	87.23	94.17	94.73	96.97	93.28
Thiamine 100	93.90	95.90	98.97	106.40	98.57
Thiamine 200	87.20	95.27	92.43	91.43	91.58
Mean (A)	89.08	92.96	92.16	96.19	
L.S.D. 5%	A: 2.63		B: 5.11		AB 10.22

chicken manure in addition to thiamine 100 ppm and seaweed 200 ppm respectively.

3.2. Branch number/plant

The application of chicken manure led to a significant increment of branch number/plant in the two experimental seasons (table 4). However, the lowest level (2.5 ton/fed) had no significant in the first season. Branch number/plant was also affected by biostimulants substances, and the highest number of branches were recorded due to tryptophan at 200 and 300 ppm and thiamine at 200 ppm in the first and second seasons. There was significant interaction between the two tested factors in the two growing seasons. The highest values (5.9 and 5.7) were obtained from chicken manure at 7.5 ton/fed. plus tryptophan at 200 and 300 ppm respectively (table 4). Slightly differ observations were recorded in the second season.

Table 4. Effect of chicken manure and some biostimulants (tryptophan, seaweed extract and thiamine) on branch number of main branch/plant caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	2.5	0.0	7.5	0.0
Biostimulants (ppm) (B)	First season				
Control	3.6	3.6	3.7	5.1	4.0
Tryptophan 200	5.6	5.7	5.8	6.6	5.9
Tryptophan 300	5.7	4.8	5.1	7.1	5.7
Seaweed 200	4.8	5.9	5.3	5.7	5.4
Seaweed 300	4.7	4.5	5.3	4.6	4.8
Thiamine 100	6.2	5.7	5.7	4.4	5.5
Thiamine 200	5.2	5.0	6.5	5.1	5.4
Mean (A)	5.1	5.0	5.3	5.5	
L.S.D. 5%	A: 0.2		B: 0.8		AB 1.6
	Second season				
Control	4.0	3.9	4.0	3.8	3.9
Tryptophan 200	5.1	5.0	6.9	6.0	5.7
Tryptophan 300	5.1	7.0	6.7	7.1	6.5
Seaweed 200	5.9	5.2	5.3	6.3	5.7
Seaweed 300	5.5	5.3	4.6	4.9	5.1
Thiamine 100	5.8	6.6	5.1	5.1	5.6
Thiamine 200	5.3	6.2	7.0	7.0	6.4
Mean (A)	5.2	5.6	5.7	5.7	
L.S.D. 5%	A: 0.1		B: 0.8		AB 1.6

3.3.Herb fresh weight

Chicken manure significantly enhanced the herb fresh weight compared with control treatment in two experimental seasons. However, the lowest level had no significant influence in the second season. Moreover, increasing the application dose had a gradual increase of herb fresh weight/plant in the two growing seasons.

(Table 5). Biostimulants substances significantly augmented the herb fresh in comparison with check treatment in both seasons. The most effective treatments were thiamine at 200 and 100 ppm followed by tryptophan at 300 and 200 ppm in the first season (Table 5). Similar data were recorded in the second season.

The combined effect of both examined factors, on the herb fresh weight/plant was significant in the two experimental seasons (Table 5). The most effective interaction treatments were chicken manure at 5.0 ton/fed. In addition to thiamine at 200 ppm or thiamine at 100 ppm in the first experimental season (485.2 and 470. 6 g/plant, respectively) and chicken manure at 5 ton/fed. combined with tryptophan at 200 ppm in the second one (577.7 g). Whereas the untreated plants only yielded 300.9 and 283.3 g/plant in both seasons respectively.

3.4. Herb dry weight

In both season caraway herb dry weight was significantly affected with both investigated factors. Results showed no significant difference between the 5.0 and 7.5 ton/fed in both seasons. Moreover, all applied the biostimulants significantly increased herb dry weight over the control plants which had 75.88 g/plant. Overall ANOVA showed significant interaction between both factors and the lowest herb dry weights (61.43 and 65.97 g/plant for both seasons respectively) being for untreated plants. However, the highest herb dry weights (137.55 and 131.74 g) in the first season were assessed for plants treated with 5 or 7.5 ton/fed of chicken manure respectively in addition to tryptophan at 200 ppm. In the second season the highest herb dry weight

Table 5. Effect of chicken manure and some biostimulants (tryptophan, seaweed extract and thiamine) on herb fresh weight (g/plant) of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	2.5	0.0	7.5	0.0
Biostimulants (ppm) (B)	First season				
Control	300.9	313.1	331.7	363.3	327.3
Tryptophan 200	420.6	426.7	430.8	436.7	428.7
Tryptophan 300	336.7	433.3	420.4	443.3	408.4
Seaweed 200	366.7	396.7	406.7	420.6	397.7
Seaweed 300	350.3	353.3	373.3	408.3	371.3
Thiamine 100	406.7	433.3	470.6	443.9	438.5
Thiamine 200	383.3	443.3	485.2	473.3	446.4
Mean (A)	366.5	399.9	416.9	426.9	
L.S.D. 5%	A: 10.1		B: 15.1	AB:30.2	
	Second season				
Control	283.3	300.0	319.1	341.7	311.0
Tryptophan 200	466.7	516.7	577.7	553.3	528.6
Tryptophan 300	440.1	460.5	500.2	503.3	476.0
Seaweed 200	426.7	426.7	500.4	486.7	460.1
Seaweed 300	416.7	413.3	450.2	483.2	440.9
Thiamine 100	486.0	500.3	498.3	450.5	483.8
Thiamine 200	476.2	433.3	490.0	416.7	454.1
Mean (A)	427.9	435.8	476.6	462.2	
L.S.D. 5%	A: 11.2		B: 14.0	AB A:28.0	

Table 6. Effect of chicken manure and some biostimulants (tryptophan, seaweed extract and thiamine) on plant dry weight (g) of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	2.5	0.0	7.5	0.0
Biostimulants (ppm) (B)	First season				
Control	**61.43**	**80.94**	**79.78**	**81.36**	**75.88**
Tryptophan 200	**113.34**	**123.02**	**137.55**	**131.74**	**126.41**
Tryptophan 300	**104.79**	**115.13**	**129.48**	**119.83**	**117.31**
Seaweed 200	**99.21**	**101.6**	**122.05**	**113.19**	**109.01**
Seaweed 300	**99.21**	**98.42**	**107.19**	**116.48**	**105.32**
Thiamine 100	**95.71**	**110.53**	**118.64**	**107.26**	**108.04**
Thiamine 200	**98.12**	**103.17**	**106.67**	**99.29**	**101.81**
Mean (A)	**95.97**	**104.68**	**114.48**	**109.88**	
L.S.D. 5%	**A: 6.13**		**B: 8.10**	**AB: 8:20**	
	Second season				
Control	65.97	74.55	85.93	96.5	80.74
Tryptophan 200	102.57	101.6	120.17	103.98	107.08
Tryptophan 300	80.17	108.33	110.1	107.93	101.63
Seaweed 200	87.31	94.45	101.63	107.81	97.80
Seaweed 300	93.4	94.12	117.21	108.88	103.40
Thiamine 100	85.4	100.77	115.62	106.98	102.19
Thiamine 200	93.64	105.55	115.52	115.07	107.45
Mean (A)	86.92	97.05	109.45	106.74	
L.S.D. 5%	A: 7.61		B: 9.32	AB A:27.56	

being for plants treated with 5.0 ton/fed of chicken manure in addition to 200 ppm of tryptophan or 200 ppm of thiamine respectively (Table 6).

The improvements of organic fertilization on plant height, number of branch/plant and herb fresh and dry weights obtained in the present study were also reported by Awad et al. (2016) and Mohamed (2022) on caraway, Tanious (2008) and Eisa (2016) on fennel plants, Hendawy (2017) on anise and El-Leithy (2019) on coriander. That significant positive impact of chicken manure could be due to its organic matter contribution and high nutrient content particularly rich in nitrogen, phosphorus, potassium, and micronutrients that are essential for vegetative development and photosynthetic activity (Eghball, 2002 and Fitzpatrick and Chapman, 2020).). The availability of these nutrients is critical during the early stages of growth, as it directly influences leaf number, stem elongation, and canopy formation (Naguib et al., 2011). Adekiya and Agbede (2009) reported that poultry manure enhances soil structure and water-holding capacity, leading to more vigorous vegetative growth. This improvement in root proliferation and nutrient uptake provides a favorable environment for caraway plants to establish strong vegetative structures. Furthermore, organic matter in chicken manure stimulates microbial activity, which promotes mineralization and the slow release of nutrients, ensuring a sustained supply throughout the growth cycle (Ghosh et al., 2015).

Tryptophan, a precursor of indole-3-acetic acid (IAA), plays a central role in promoting vegetative growth in caraway. Its application enhances auxin biosynthesis, which stimulates cell elongation, branching, and leaf expansion, thereby increasing plant height, branch number/plant and both of fresh and dry weight and canopy development (Amer et al., 2024 and Zatimeh et al., 2025). Improved root proliferation under tryptophan treatment also enhances nutrient and water uptake, supporting vigorous shoot growth (Rapparini et al., 1999). In addition, tryptophan contributes to greater photosynthetic activity and biomass accumulation by regulating hormone-mediated assimilate distribution (Ali et al., 2019).

Seaweed extracts act as natural biostimulants which enhance vegetative growth of caraway as seen in the recent study which were similar these of Al-Hatem (2018) and Ali et al. (2023). Rich in cytokinins, auxins, and micronutrients, they promote cell division, leaf expansion, and branching, leading to improved plant height and canopy development (Khan et al., 2009). Enhanced root growth under seaweed treatment also improves nutrient and water uptake, supporting vigorous shoot development (Craigie, 2011). Moreover, seaweed-derived compounds increase chlorophyll content and photosynthetic efficiency, resulting in greater biomass accumulation and overall plant vigor (Shukla et al., 2019). These improvements in vegetative growth establish a strong physiological base for higher yield potential in caraway cultivation.

Thiamine plays a key role in energy metabolism, making it an important regulator of vegetative growth. Exogenous thiamine enhances carbohydrate metabolism and chlorophyll synthesis, which promotes higher photosynthetic activity and biomass accumulation (Rapala-Kozik et al., 2012). Improved physiological efficiency under thiamine treatment supports greater plant height, leaf area, and branching (Tunc-Ozdemir et al., 2009, Ali et al., 2019 and Aly et al., 2022).

3.5. Number of umbels/plant

Obtained results showed significant effects of both applied factors on number of umbels/plant during the two seasons. Increasing the manure levels gradually increased this trait to achieve the highest values 32.96 and 33.75 for both seasons respectively for plants treated with 7.5 ton/fed of chicken manure (Table 7). In respect to the second factor all treatments significantly increased number of umbels/plant compared with the control plants which only had 18.58 and 1874 umbels/plant for the two seasons respectively. However, plants treated with thiamine had the highest values in the two seasons (33.69 and 33.54). Overall, a significant interaction between the two applied factors was observed during the two seasons. Plant which did not treat with manure or biostimulants had the lowest value 14.93 and 15.09 (Table 7). Almost in both seasons

Table 7. Effect of chicken manure and some biostimulants (tryptophan, seaweed extract and thiamine) on number of umbels/plant of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	2.5	0.0	7.5	0.0
Biostimulants (ppm) (B)	First season				
Control	14.93	17.57	19.73	22.07	18.58
Tryptophan 200	25.67	27.40	30.73	32.43	29.06
Tryptophan 300	29.00	28.73	33.17	36.50	31.85
Seaweed 200	24.83	25.17	27.63	33.57	27.80
Seaweed 300	25.20	27.73	31.43	36.27	30.16
Thiamine 100	25.67	26.53	29.87	30.63	28.18
Thiamine 200	28.77	29.23	37.50	39.27	33.69
Mean (A)	24.87	26.05	30.01	32.96	
L.S.D. 5%	A: 2.40		B: 3.99	AB:8.02	
	Second season				
Control	15.09	18.00	19.80	22.07	18.74
Tryptophan 200	24.60	29.17	30.77	33.47	29.50
Tryptophan 300	30.77	32.10	34.43	36.27	33.39
Seaweed 200	25.67	28.47	28.63	32.30	28.77
Seaweed 300	27.73	27.90	30.40	39.67	31.43
Thiamine 100	24.90	29.23	31.10	33.97	32.54
Thiamine 200	27.00	32.37	36.27	38.50	33.54
Mean (A)	25.11	28.18	30.20	33.75	
L.S.D. 5%	A:3.10		B: 4.86	AB: 8.99	

plants treated with 7.5 ton/fed of chicken manure and any concentration of the second factor had significantly higher number of umbels (without significant difference among them) compared with these treated only with 7.5 ton/fed of chicken manure. Nevertheless, plants treated with the highest concentration of thiamin had the highest values 39.27 and 38.50 for both seasons respectively.

3.6. Seed yield/plant

Seed yield of caraway plants was significantly augmented due to chicken manure application. However, in both seasons there were no significant difference between 0 and 2.5 ton/fed treatments or between ton 5.0 and 7.5 ton/fed treatments. The biostimulants application significantly increased seed yield over the untreated plants which had the lowest yield in both seasons (9.44 and 8.93 g/plant respectively). Nevertheless, there were no significant differences among the different treatments in both seasons (Table 8). Results showed a significant interaction between the two studies factors. The untreated plants yielded the lowest yield (7.72 and 7.12 g/plant) in both seasons respectively. In the first one plants treated with 5 ton/fed of chicken manure and tryptophan at 300 ppm had the highest yield (15.41 g/plant) followed by 15.26 g/plan for these treated with 7.5 ton/fed of manure in addition to seaweed at 300 ppm without significant difference between them. However, in the second one plants treated with (7.5 ton/fed in addition to seaweed at 300 ppm) and (5 ton/fed of manure in addition to the same concentration of seaweed) had 15.27 and 15.02 g/fed without significant difference between them (Table 8).

3.7. Seed yield/fed

Table 9 shows that seed yield of caraway plants/fed has the same trend as seed yield/plant. The lowest yield being for plants that did not treat neither with chicken manure nor biostimulants. For most cases there were no significant difference between plants treated with 5.0 and 7.5 ton/fed of chicken manure under the same

Table 8. Effect of chicken manure and some biostimulants (tryptophan, seaweed extract and thiamine) on seed yield/plant (g) of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	2.5	0.0	7.5	0.0
Biostimulants (ppm) (B)	First season				
Control	7.72	8.32	10.83	10.87	9.44
Tryptophan 200	12.52	12.47	14.12	13.65	13.19
Tryptophan 300	12.53	14	15.41	14	13.99
Seaweed 200	14.06	12.73	14.13	14.7	13.91
Seaweed 300	12.55	14.39	14.32	15.26	14.13
Thiamine 100	14.81	13.55	14.05	13.99	14.10
Thiamine 200	12.16	12.17	13.49	13.79	12.90
Mean (A)	12.34	12.52	13.76	13.75	
L.S.D. 5%	A: 0.54		B: 0.95	AB: 1.00	
	Second season				
Control	7.12	8.01	9.63	10.97	8.93
Tryptophan 200	11.59	12.47	14.10	14.61	13.19
Tryptophan 300	12.44	14.10	14.81	15.00	14.09
Seaweed 200	13.76	12.16	14.33	14.90	13.79
Seaweed 300	14.05	14.19	15.02	15.27	14.63
Thiamine 100	14.65	14.81	14.08	13.99	14.38
Thiamine 200	12.46	13.67	14.89	14.79	13.95
Mean (A)	12.30	12.77	13.84	14.22	
L.S.D. 5%	A: 0.60		B: 1.37	AB:2.74	

Table 9. Effect of chicken manure and some biostimulants (tryptophan, seaweed extract and thiamine) on seed yield (kg/feddan) of caraway plant during two seasons 2020/2021 and 2021/2022.

Treatments	Chicken manure (ton/fed) (A)				
	0.0	2.5	0.0	7.5	0.0
Biostimulants (ppm) (B)	First season				
Control	239.3	257.9	335.7	337.0	292.5
Tryptophan 200	388.1	386.6	437.7	423.2	408.9
Tryptophan 300	388.4	434.0	477.7	434.0	433.5
Seaweed 200	435.9	394.6	438.0	455.7	431.1
Seaweed 300	389.1	446.1	443.9	473.1	438.0
Thiamine 100	459.1	420.1	435.6	433.7	437.1
Thiamine 200	377.0	377.3	418.2	427.5	400.0
Mean (A)	382.4	388.1	426.7	426.3	
L.S.D. 5%	A: 16.3		B: 28.6	AB: 57.2	
	Second season				
Control	220.7	248.3	298.5	340.1	276.9
Tryptophan 200	359.3	386.6	437.1	452.9	409.0
Tryptophan 300	385.6	437.1	459.1	465.0	436.7
Seaweed 200	426.6	377.0	444.2	461.9	427.4
Seaweed 300	435.6	439.9	465.6	473.4	453.6
Thiamine 100	454.2	459.1	436.5	433.7	445.9
Thiamine 200	386.3	423.8	461.6	458.5	432.5
Mean (A)	381.2	396.0	429.0	440.8	
L.S.D. 5%	A:18.9		B:23.3	AB: 46.6	

biostimulants treatment. In both seasons the highest yield 477.71 and 473.37 kg/fed were estimated for plants treated with (5 ton/fed of chicken manure and tryptophan at 300 ppm) and (7.5 ton/fed in addition to seaweed at 300 ppm) in both seasons respectively.

Chicken manure application significantly enhances the reproductive performance of caraway plants, particularly umbel production per plant and overall seed yield. Umbel formation is a key determinant of productivity, as it contributes directly to the seeds yield. Chicken manure provides a balanced supply of macro- and micronutrients, which are essential for differentiation, and reproductive growth (Eghball, 2002). By improving soil fertility and microbial activity, chicken manure ensures a continuous release of nutrients, thereby sustaining plant vigor during the critical reproductive stage (Ghosh et al., 2015). Many authors emphasized the positive role of organic fertilization on number of umbels/plant and seed yield of caraway plants (Abd El-Latif, 2002, and Mohamed, 2022). Moreover, Naguib et al. (2012) and Singh et al. (2016) in caraway, concluded that a greater number of umbels/plant is closely associated with increased seed yield. Studies on other aromatic plants have shown that manure increase the numbers of umbels/plant through their positive effects on vegetative vigor, which translates into more branches capable of bearing inflorescences (Adekiya and Agbede, 2009).

Tryptophan, application has been shown to stimulate branching, assimilate partitioning, and floral initiation, leading to a higher number of umbels/plant in caraway (Barea and Azcón-Aguilar, 1982). These results were similar to the recent observation. By improving auxin-mediated processes, tryptophan enhances root growth and nutrient uptake, which supports stronger vegetative vigor and greater seed production (Rapparini et al., 1999). Increased umbel production translates directly into higher seed yield. Studies on aromatic plants indicate that exogenous tryptophan improves seed filling, seed weight, and overall yield by boosting photosynthetic efficiency and antioxidant activity under field conditions (Ali et al., 2019).

Results showed seaweed extracts are effective biostimulants that enhance the reproductive performance of caraway, particularly umbel production and seed yield. Seaweed extracts stimulate branching, floral initiation, and assimilate allocation toward reproductive structures (Khan et al., 2009). This leads to an increased number of umbels/plant, a key factor determining seed output. Improved physiological activity, including enhanced photosynthesis and supports reproductive growth and seed development (Craigie, 2011). Studies on aromatic plants confirm that seaweed extracts increase yield, offering a sustainable strategy for boosting caraway productivity (Shukla et al., 2019).

Thiamine application has been associated with improved reproductive development in several crops, which directly influences umbel formation and seed yield in caraway. By enhancing energy metabolism and photosynthetic efficiency, thiamine supports vigorous vegetative growth that provides a strong foundation for branching and subsequent umbel production (Rapala-Kozik et al., 2012). Exogenous thiamine application promotes antioxidant activity and alleviates oxidative stress, allowing plants to allocate more resources toward reproductive structures (Tunc-Ozdemir et al., 2009). In caraway, this translates into a higher number of umbels per plant, as well as better seed set and filling. Enhanced nutrient uptake and assimilate partitioning under thiamine treatment contribute to increased seed weight and overall yield (Ali et al., 2019).

Therefore, results of this study suggested that caraway plants grown under the experimental conditions could be improved by the application of 5.0 to/fed of chicken manure in addition to tryptophan at 300 ppm. That treatment had about two-fold of the seed yield compared with untreated ones.

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الملخص العربي

تأثير سبلة الدجاج وبعض المحفزات الحيوية النباتية على النمو الخضري وإنتاجية ثمار الكراوية

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يُزرع نبات الكراوية وهو نبات عشبي ثنائي الحول، يستغل لبذوره العطرية وخصائصه الطبية. يتطلب تحسين إنتاجية وجودة النباتات العطرية إدارة مستدامة للمغذيات بالتربة. لذلك، سُمِّدت نباتات الكراوية بسبلة الدجاج بتركيز (٠.٠، ٢.٥، ٥.٠، و٧.٥ طن/فدان) بالإضافة إلى التربتوفان (٠، ٢٠٠ و٣٠٠ جزء في المليون)، ومستخلص الأعشاب البحرية (٢٠٠ و٣٠٠ جزء في المليون)، والثيامين (١٠٠ و٢٠٠ جزء في المليون). وضحت النتائج تأثير كلا العاملين المدروسين بشكل كبير على ارتفاع النبات، وعدد الفروع/النباتات، ووزن العشب الطازج والجاف. ومع ذلك، لم تكن هناك فروق معنوية في معظم الصفات بين المعاملة ٥.٠ و٧.٥ طن/فدان. وكان أقل معدل لوزن العشب الجاف للنباتات غير المعالجة. ومع ذلك، كانت أعلى أوزان جافة لأعشاب النباتات المعالجة بـ ٥ طن/فدان من سبلة الدجاج بالإضافة إلى التربتوفان بتركيز ٢٠٠ جزء في المليون. لم يكن هناك فرق كبير في محصول البذور/النبات بين ٠ و٢.٥ طن/فدان من المعاملات أو بين ٥.٠ و٧.٥ طن/فدان من المعاملات. أظهرت النتائج تفاعلًا كبيرًا بين عاملي الدراستين. وأنتجت النباتات غير المعالجة أقل محصول ٧.٧٢، كان للنباتات المعالجة بـ ٥ طن/فدان من سماد الدجاج والتريبتوفان بتركيز ٣٠٠ جزء في المليون أعلى محصول (١٥.٤١ جم/نبات) تليها ١٥.٢٦ جم/نبات للنباتات المعالجة بـ ٧.٥ طن/فدان من السماد بالإضافة إلى الأعشاب البحرية بتركيز ٣٠٠ جزء في المليون دون فرق كبير بينهما. لذلك اقترحت هذه الدراسة أن إنتاجية بذور نبات الكراوية المزروعة تحت الظروف التجريبية يمكن تحسينها من خلال إضافة ٥.٠ طن/ فدان من روث الدجاج بالإضافة إلى التربتوفان بنسبة ٣٠٠ جزء في المليون.

الكلمات المفتاحية: سماد الدجاج، التربتوفان، مستخلص الأعشاب البحرية والثيامين