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INFLUENCE OF SOME NATURAL SUBSTANCES ON CARAWAY PLANTS

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ABSTRACT

This study was carried out during the two successive growing seasons of 2019/2020 and 2020/2021 in the farm of Agricultural Experiment and Research Center, Minia University at Shosha, West Samalout City, Minia, to examine the effects of sheep manure (0.0, 2.5, 5.0 and 7.5 ton/fed.) and some vitamins (vit. B_1 and vit. E, each at 25 and 50 ppm), as well as, active yeast (5.0 and 10 g/l), as well as, their interaction on caraway plants grown in sandy soil under drip irrigation system.

The results showed that all test parameters of plant height, number of branches/plant, number of umbels/plant, fruit yield/plant and /fed., essential oil %, essential oil yield/plant and /fed. and photosynthetic pigments were significantly increased by use sheep manure treatments. Generally, sheep manure at 7.5 ton/fed. was more effective than other treatments. Also, all used six treatments of some vitamins and active yeast led to significant enhancement of all previous parameters relatively to control. Vitamin B_1 at 50 ppm was superior than other treatments. The best interaction treatments were recorded with plants received 7.5 or 5.0 ton/fed, sheep manure and sprayed with vit. B_1, followed by vit. E, then active yeast, each at the high concentration.

INTRODUCTION

Medicinal and aromatic plants are the most important crops playing a vigorous role in people's life universal because of their great importance in herbal medicine as they offer safe, cost-effective and preventive therapies **(Mittal and Singh, 2007)**. Caraway plant (*Carum carvi,* L.) is an aromatic plant belonging to the Apiaceae family. As any medicinal plant, caraway plant is used widely as a traditional medicine or in foods as a cooking spice**, as** well as, industrial pharmacology **(Aćimović, 2013)**.

Sheep manure as organic fertilizer is considers as a necessary fertilizer to reclaimed sandy soils and producing a good yield of plants **(Mengel and Kirkby, 2001; Al-Mosuly, 2008 and AL-mohammedi and Al-amfarje, 2017)**.

Antioxidants substances (vitamins, like vitamin E and vitamin B_1) playing a

vital role in plant protection **(Abdou *et al.*, 2013)**. Vitamins acting as antioxidants are natural growth regulators and in subtle amount have profound influence on biochemical and physiological processes of plants **(El Bassiouny *et al.*, 2005)**. Exogenous application of antioxidants on plants can minimize the negative effect of salinity and water stress on plant growth, yield quality and quantity **(Kosar *et al.*, 2015)**. Vitamins are considered as natural bioregulators, and various chemical activities may be affected even by their very small concentrations **(Sadak and Abdelhamid, 2015)**.

The positive effects of applying active dry yeast as a newly used biofertilizer were due to its content of various nutrients, higher percentage of proteins, large amount of vitamin B and natural plant growth regulators such as cytokinins and auxin **(Ferguson *et al.*, 1987)**.

The aim of this study was to examine the effect of sheep manure and some plant stimulants (active yeast, vitamin B_1 and vitamin E) on growth, yield and yield components, as well as essential oil production and some chemical constituents of caraway (*Carum carvi*, L.) plants.

MATERIALS AND METHODS

This work was conducted in the farm of Agricultural Experiment and Research Center, Minia University at Shosha, West Samalout City, Minia, during the two successive growing seasons of 2019/2020 and 2020/2021. A split plot design with three replicates in a randomized complete block design (RCBD) was followed, where organic fertilization (sheep manure) was in the main plot (A), while vit. B_1, vit. E and active yeast occupied the sub-plots (B). The main plots (A) including four levels of sheep manure [0.0, 2.5, 5.0 and 7.5 ton/fed.], while seven treatments of stimulants [control, vitamin B_1 and vit. E, each at 25 and 50 ppm as well as active yeast at 5 and 10 g/l] occupied the sub-plot. Therefore, the interaction treatments (A x B) were 28 treatments.

The experimental site was prepared and divided to terraces, 70 cm width with 30 cm apart. Each terrace includes 2.0 irrigation lines, with 40 cm apart. Seeds of caraway plant were sown on 15th October in both seasons on hill (3-4 seeds/hill) spaced at 25 cm (the dripper distances were 25 cm, with 4 l/hour) beside the drippers on the drip irrigation lines. So, the unit area was 2 m length x 1.0 width (2 m^2 = 1/2100 fed.), containing two irrigation lines with 16 plants (33600 plants/fed.). After 45 days from sowing (29th November), the plants were thinned to one plant/hill.

The soil analysis were performed according to the procedure of **Jackson (1973)** and the obtained data was presented in Table (a).

Sheep manure was obtained from a private sheep farm. The sheep manure fertilizer was added during preparing the soil for cultivation in both seasons. The chemical analysis of sheep manure was done according to **Black *et al.* (1965)** and is shown in Table (b).

Each of α – tocopherol and thiamine (vit. B_1 and vit. E) were applied by hand sprayer two times, the first dose was added after 60 days from sowing (14th December), while the second one was applied one month from the first dose (13th January).

Active yeast suspension was applied at 5.0 or 10 g/l as foliar spray twice at the same schedule of vitamins (vit. B_1 and vit. E). The plants were sprayed till runoff. All agricultural practices were carried out as usual in the two growing seasons.

Table (a): Physical and chemical analysis of the used soil during the two seasons of 2019/2020 and 2020/2021.

Soil character	Values		Soil character	Values	
	2019/2020	2020/2021		2019/2020	2020/2021
Physical properties:			**Soluble nutrients:**		
Sand (%)	89.21	88.09	Ca^{++} (ppm)	134.0	139.0
Silt (%)	3.36	4.71	Mg^{++} (ppm)	61.1	63.6
Clay (%)	7.43	7.20	Na^{+} (ppm)	80.5	87.0
Soil type	sandy	sandy	K^{+} (ppm)	14.7	20.3
Chemical properties:			DTPA-Extractable nutrients:		
pH (1:2.5)	8.15	8.19	Fe (ppm)	0.87	0.96
E.C. (dS/m)	1.39	1.24	Cu (ppm)	0.41	0.45
O.M.	0.18	0.15	Zn (ppm)	0.32	0.35
$CaCO_3$	13.92	13.98	Mn (ppm)	0.55	0.61

Table (b): Chemical analysis of sheep manure that used during the two growth seasons of 2019/2020 and 2020/2021.

Character	Values		Character	Values	
	2019/2020	2020/2021		2019/2020	2020/2021
pH (1:1)	7.33	7.39	C/N ratio	7.74 : 1	7.95 : 1
E.C. (dS/m)	5.93	5.99	Total N (%)	2.21	2.17
O.M. (%)	29.49	29.75	Total P (%)	1.11	1.09
O.C. (%)	17.11	17.26	Total K (%)	1.42	1.44

The plants were harvested on the third week of April in both experimental seasons.

Data recorded:

- Vegetative growth traits (plant height "cm" and number of branches/plant).
- Yield and yield components (number of umbels/plant and fruit yield/plant and /fed.).
- Oil production [essential oil (%) and oil yield/plant (ml) and /fed, (l)] according to **Egyptian Pharmacopoeia (1984)**.
- Photosynthetic pigments (chlorophyll a, b and carotenoids as (mg/g. F.W.) according to **Moran (1982)**.

The obtained data were tabulated and statistically analyzed according to **MSTAT–C (1986)**, and LSD test at 5 % was followed to compare between the means of treatments.

RESULTS AND DISCUSSION

3.1. Vegetative growth:

Data presented in Table (1) showed that plant height (cm) and number of branches/plant were significantly increased due to application of sheep manure at the three levels (2.5, 5.0 and 7.5 ton/fed.) as compared with control in both

seasons. The highest values were obtained with 7.5 ton/fed. sheep manure.

Similar results were reported by many workers such as **Aćimović (2013), Abdel-Latef and Hassanein (2016)**, **El-Banna and Fouda (2018)** and **Khater *et al*. (2020)** on caraway plant**.**

As can be seen from data presented in Table (1), all six used treatments of vitamins and active yeast significantly increased both of plant height and number of branches/plant as compared to control in both seasons. The treatment of vit. B_1 at 50 ppm produced the highest values of plant height (175.8 and 179.3 cm, in the first and second seasons, respectively) and number of branches/plant (14.7 and 15.0 in both seasons, respectively).

These results which recorded that vitamin B_1 has stimulating effect on plant height and number of branches of caraway are in agreement with those of **Botros (2013) and El-gohary *et al*. (2020)** on caraway plant. While, the beneficial effects of vitamin E were detected by **Abdou *et al*. (2013)** on caraway plants. Moreover, our results of active yeast are in agreement with those obtained by **Botros (2013), Matter and El Sayed (2015), Medani and Taha (2015) and Youssef *et al*. (2020)** on caraway plants.

The interaction between the main and sub-plots treatments (A x B) was significant for plant height and number of branches/plant in both seasons. The highest values of plant height and number of branches/plant were recorded with the treatments of sheep manure at 7.5 ton/fed. with vitamin B_1 at 50 ppm in both seasons.

3.2. Yield and yield components:

Data presented in Table (2) indicated that the influence of sheep manure fertilization treatments on number of umbels/plant and fruit yield/plant and /fed. were significant in both seasons. Fertilizing caraway plants with 2.5, 5.0 and 7.5 ton/fed. sheep manure increased the previous parameters as compared to untreated plants. The highest values of number of umbels/plant (32.10 and 32.70 in the first and second seasons, respectively), fruit yield/plant (43.25 and 44.11 g/plant in both seasons, respectively) and fruit yield/fed. (1453.6 and 1482.7 kg/fed. in both seasons, respectively) were obtained with high level of sheep manure (7.5 ton/fed.).

Our results are in harmony with those recorded by **Awad (2016), El-Tarawy *et al*. (2017), El-Banna and Fouda (2018) and Khater *et al*. (2020)** on caraway plants.

Concerning the effect of some vitamins and active yeast, data in Table (2) showed that number of umbels/plant and fruit yield/plant and /fed. were significantly increased in both seasons relatively to control due to spraying plants with vitamin B_1 and vitamin E, each at 25 and 50 ppm as well as active yeast at 5.0 and 10 g/l. In this regard, vitamin B_1 at 50 ppm was superior than other used treatments.

The increase in number of umbels/plant as well as fruit yield/plant and /fed. were emphasized by **Botros (2013)** and **El-gohary *et al*. (2020)** on caraway plant, regarding vitamin B_1. The role of vitamin E in increasing number of umbels/plant and fruit yield were explained by **Botros (2013)** on caraway plants and **Ayyat *et al*. (2021)** on black cumin plant. While, **Botros (2013), Matter and El Sayed (2015), Medani and Taha (2015)** and **Youssef *et al*. (2020)** on caraway plants. who indicated that fruit yield/plant and /fed. were

significantly augmented with application of active yeast at 5.0 or 10 g/l.

The interaction between sheep manure, some vitamins and active yeast treatments was significant for number of umbels/plant as well as fruit yield/plant and /fed. as clearly shown in Table (2). The highest values were obtained from plants received 7.5 ton/fed. sheep manure and sprayed with vitamin B_1 at 50 ppm.

3.3. Essential oil production:

Data presented in Table (3) indicated that the influence of sheep manure fertilization treatments on essential oil (%), essential oil yield/plant and /fed. was significant in both seasons. Application plants with sheep manure at 7.5 ton/fed. recorded the best results in this concern.

These results are in agreement with those obtained by **Abdel-Latef and Hassanein (2016), Awad (2016)**, **El-Tarawy *et al.* (2017)** and **Khater *et al.* (2020)** on caraway plants.

Concerning the effect of some vitamins (vitamin B_1 at 25 and 50 ppm and vitamin E at 25 and 50 ppm) as well as active yeast at 5 and 10 g/l on essential oil percent and essential oil yield/plant and /fed., data presented in Table (3) revealed that all used six treatments significantly enhanced essential oil percent and essential oil yield/plant and /fed. comparing with control in both seasons. The treatment of vitamin B_1 at 50 ppm recorded the first order, followed by vitamin E at 50 ppm in the second order, then active yeast at 10 g/l in the third order in both seasons.

Regarding the effect of vitamins as well as active yeast, our results in the line with those obtained by **Abdou *et al.* (2013)** on caraway plants and **Abdou *et al.* (2017)** on sweet basil plant, regarding the effect of vitamin B_1, also, **Abdou *et al.* (2013)** on caraway plants and **Abdou *et al.* (2015)**, on coriander plant, regarding vitamin E. The role of active yeast was reported by **Abdou *et al.* (2013), Matter and El Sayed (2015)** and **Youssef *et al.* (2020)** on caraway plants.

The interaction between main and sub plots treatments was significant for essential oil percent and essential oil yield/plant and /fed. in the two experimental seasons as clearly shown in Table (3). In the first season, the best overall interaction which resulted the highest percentage was 7.5 ton/fed. sheep manure plus 50 ppm vitamin B_1. In the second season, the interaction treatments of 7.5 or 5.0 ton/fed. sheep manure in combination with 50 ppm vitamin B_1 recorded the best results

3.4. Photosynthetic pigments (mg/g F.W.)

Data presented in Table (4) proved that the all-sheep manure levels (2.5, 5.0 and 7.5 ton/fed.) increased photosynthetic pigments (chlorophyll a, b and carotenoids). Moreover, it was noticed that the contents of pigments were sloping upward by the gradual increase of the applied sheep manure till 7.5 ton/fed.

In accordance with these results are those mentioned by **Abd El-Naeem (2008) and Abdou *et al.* (2009)** on caraway plants **and Badran *et al.* (2017)** on fennel plant.

The contents of pigments in the fresh leaves of caraway were significantly increased by some vitamins and active yeast, each at two concentrations. Among such six treatments, vitamin B_1 resulted the first order for chlorophyll a, b and carotenoids.

In harmony with our results concerning vitamins were those obtained by **Abdou *et al.* (2013)** on caraway plants and **AbdelKader *et al.* (2018)** on *Nigella sativa* for vitamin B_1. While, **Abdou *et al.* (2013)** on caraway plants and **Ayyat *et al.* (2021)** on black cumin, for vitamin E.

Moreover, **Abdou *et al*. (2013) Medani and Taha (2015)** and **Youssef *et al*. (2020)** on caraway plants, indicated that active yeast at 10 g/l enhanced photosynthetic pigments content of fresh leaves of plants.

The interaction treatments (A x B) were significant in the two growing seasons for only chlorophyll a. Generally, sheep manure at 7.5 ton/fed. with the highest concentration of vitamins and active yeast produced the highest values as clearly shown in Table (4).

Our results indicated that fertilizing caraway plants with sheep manure significantly enhanced plant height, number of branches/plant, number of umbels/plant, fruit yield/plant and /fed., essential oil % and essential oil yield/plant and /fed. and photosynthetic pigments. Such enhancement in all previous parameters of caraway plant due to sheep manure fertilization treatments reflected the positive biological and physiological roles of the sheep manure on the aforementioned parameters **(Badran, 2002; Soumare *et al*., 2003; Yousef and Abu El-Leel, 2014 and AL-mohammedi and Al-amfarje, 2017)**.

Also, data showed that all six treatments of vitamins and active yeast significantly improved all tested parameters of caraway plants and high concentration either for vitamins or active yeast was superior than low concentration. The positive effect of vitamins on caraway plants could be attributed due the biological and physiological roles of these compounds. All forms of tocopherols play an important role in plant growth, phytohormonal balance, signal transduction, senescence and abscission, as well as in many other metabolic processes **(Desel *et al*., 2007 and Arrom and Munné-Bosch, 2010)**.

Vitamin B_1 as antioxidant used as natural and safety and enhanced growth and productivity of several crops. Vitamin B1 has synergistic effects on growth, flowering, yield of seeds and oil and chemical constituents under favorable and unfavorable condition **(Matter, 2009)**.

Active yeast is a natural safety material biofertilizer causes various primitive effects on plants. It is considered as a natural source of cytokinins which stimulates cell division and enlargement as well as the synthesis of protein, nucleic acid, lipid and B-vitamin and nutritional elements (P, K, S, Na, Ca and Mg) **(Amer, 2004 and Matter and El Sayed, 2015)**.

From the previous physical and biological discussion, it could be summarized that the beneficial and unique roles of sheep manure and vitamin B_1, vitamin E and active yeast were responsible for enhancing the different physiological processes consequently, stimulating various vegetative growth, yield, oil production and some chemical constituents of caraway plants.

Table 1: Effect of organic fertilization, some vitamins and active yeast, as well as, their interactions treatments on plant height (cm) and number of branches/plant of caraway, (*Carum carvi,* L.), plant during the first and second seasons.

Active yeast and vitamins treatments (B)	sheep manure treatments (ton/fed.) (A)									
	0.0	**2.5**	**5.0**	**7.5**	**Mean (B)**	**0.0**	**2.5**	**5.0**	**7.5**	**Mean (B)**
	1st season (2019/2020)					2nd season (2020/2021)				
Plant height (cm)										
Control	140.9	149.9	156.2	167.7	153.7	143.7	152.8	159.4	171.0	165.7
Vit. E at 25 ppm	151.9	161.6	165.5	175.5	163.6	155.0	164.9	168.8	179.0	166.9
Vit. E at 50 ppm	156.1	166.1	172.8	176.7	167.9	159.2	169.4	176.2	180.2	171.3
Vit. B1 at 25 ppm	152.3	162.0	166.1	173.5	163.5	155.6	165.2	169.5	177.0	166.8
Vit. B1 at 50 ppm	160.8	171.1	181.8	189.5	175.8	164.1	174.5	185.4	193.1	179.3
Active yeast at 5 g/l	146.7	156.1	162.7	174.7	160.1	149.7	159.2	165.9	178.2	163.3
Active yeast at 10 g/l	154.5	164.9	169.7	176.0	166.1	157.4	167.4	173.1	179.6	169.4
Mean (A)	151.9	161.6	167.8	176.2		155.0	164.8	171.2	179.7	
L.S.D. at 5 %	A: 6.1		B: 3.8		AB: 7.6	A: 6.3		B: 3.7		AB: 7.4
Number of branches/plant										
Control	11.0	11.7	12.3	12.7	11.9	11.2	11.9	12.5	12.9	12.1
Vit. E at 25 ppm	11.7	12.4	12.9	13.4	12.6	11.9	12.6	13.2	13.7	12.8
Vit. E at 50 ppm	12.2	13.0	13.5	13.9	13.1	12.4	13.3	13.8	14.2	14.3
Vit. B1 at 25 ppm	11.8	12.6	13.0	13.6	12.7	12.0	12.8	13.3	13.9	12.9
Vit. B1 at 50 ppm	13.2	14.1	14.9	15.7	14.7	13.5	14.4	15.2	16.0	15.0
Active yeast at 5 g/l	11.5	12.2	12.8	13.2	12.4	11.7	12.4	13.1	13.5	12.6
Active yeast at 10 g/l	11.6	12.3	13.2	13.7	12.7	11.8	12.5	13.5	14.0	12.9
Mean (A)	11.9	12.8	13.2	13.7		11.1	13.1	13.5	14.0	
L.S.D. at 5 %	A: 0.4		B: 0.5		AB: 1.0	A: 0.4		B: 0.5		AB: 1.0

Table 2: Effect of organic fertilization, some vitamins and active yeast, as well as, their interactions treatments on number of umbels/plant, fruits yield/plant and /fed. of caraway, (*Carum carvi,* L.), plant during the first and second seasons.

Active yeast and vitamins treatments (B)	sheep manure treatments (ton/fed.) (A)									
	0.0	2.5	5.0	7.5	Mean (B)	0.0	2.5	5.0	7.5	Mean (B)
	1st season (2019/2020)					2nd season (2020/2021)				
Number of umbels/plant										
Control	23.29	24.78	26.30	26.40	25.40	23.76	25.28	26.83	28.97	26.20
Vit. E at 25 ppm	24.91	26.50	28.00	31.00	27.60	25.41	27.00	28.56	31.62	28.15
Vit. E at 50 ppm	28.95	30.80	32.50	34.50	31.69	29.53	31.42	33.15	35.19	32.32
Vit. B1 at 25 ppm	26.69	28.40	29.20	32.00	29.07	27.22	28.97	29.78	32.64	29.65
Vit. B1 at 50 ppm	30.93	32.90	34.30	35.40	33.38	31.55	33.59	35.00	36.11	34.00
Active yeast at 5 g/l	24.26	25.81	27.40	29.58	26.76	24.74	26.33	27.95	30.17	27.29
Active yeast at 10 g/l	28.86	30.70	32.30	34.00	31.36	29.44	31.31	32.95	34.68	32.09
Mean (A)	26.80	28.80	30.00	32.10		27.34	29.38	30.60	32.70	
L.S.D. at 5 %	A: 1.11		B: 1.05		AB: 2.10	A: 1.12		B: 1.06		AB: 2.12
Fruit yield/plant (g)										
Control	32.49	34.56	36.48	37.44	35.24	33.14	35.25	37.21	38.19	35.94
Vit. E at 25 ppm	34.97	37.20	39.00	40.60	37.94	35.67	37.94	39.78	41.41	38.70
Vit. E at 50 ppm	40.23	42.80	45.30	47.00	43.83	41.03	43.66	46.21	47.94	44.71
Vit. B1 at 25 ppm	37.60	40.00	43.20	44.50	41.32	38.35	40.80	44.06	45.39	42.15
Vit. B1 at 50 ppm	42.11	44.80	46.00	48.00	45.22	42.95	45.70	46.92	48.96	46.12
Active yeast at 5 g/l	33.84	36.00	38.00	39.00	36.71	34.52	36.72	38.76	39.78	37.44
Active yeast at 10 g/l	40.40	43.00	44.70	46.30	43.60	41.21	43.86	45.59	47.23	44.47
Mean (A)	37.38	39.76	40.95	43.25		38.13	40.55	41.77	44.11	
L.S.D. at 5 %	A: 1.15		B: 1.11		AB: 2.22	A: 1.20		B: 1.18		AB: 2.36
Fruit yield/fed. (kg)										
Control	1091.7	1161.2	1225.7	1258.0	1184.1	1113.5	1184.4	1250.3	1283.2	1207.8
Vit. E at 25 ppm	1175.0	1249.9	1310.4	1364.2	1274.9	1198.5	1274.8	1336.6	1391.4	1300.3
Vit. E at 50 ppm	1351.7	1438.1	1522.1	1579.2	1472.8	1378.6	1467.0	1552.7	1610.8	1502.3
Vit. B1 at 25 ppm	1263.4	1344.0	1451.5	1495.2	1388.5	1288.6	1370.9	1480.4	1525.1	1416.2
Vit. B1 at 50 ppm	1414.9	1505.3	1545.6	1612.8	1519.6	1443.1	1535.5	1576.5	1645.1	1550.1
Active yeast at 5 g/l	1137.0	1209.6	1276.8	1310.4	1233.5	1159.9	1233.8	1302.3	1336.6	1258.2
Active yeast at 10 g/l	1357.4	1444.8	1501.9	1555.7	1465.0	1384.7	1473.7	1531.8	1586.9	1494.3
Mean (A)	1255.9	1336.1	1404.9	1453.6		1281.0	1362.9	1432.9	1482.7	
L.S.D. at 5 %	**A: 45.8**		**B: 33.6**		**AB: 67.2**	**A: 48.8**		**B: 34.3**		**AB: 68.6**

Table 3: Effect of organic fertilization, some vitamins and active yeast, as well as, their interactions treatments on **essential oil (%) and yield/plant and /fed.** of caraway, (*Carum carvi*, L.), plant during the first and second seasons.

Active yeast and vitamins treatments (B)	sheep manure treatments (ton/fed.) (A)									
	0.0	2.5	5.0	7.5	Mean (B)	0.0	2.5	5.0	7.5	Mean (B)
	1st season (2019/2020)					2nd season (2020/2021)				
Essential oil (%)										
Control	3.03	3.23	3.32	3.35	**3.23**	3.09	3.29	3.39	3.42	**3.29**
Vit. E at 25 ppm	3.22	3.43	3.49	3.53	**3.42**	3.28	3.50	3.56	3.60	**3.49**
Vit. E at 50 ppm	3.31	3.52	3.82	3.92	**3.64**	3.38	3.59	3.90	4.00	**3.71**
Vit. B1 at 25 ppm	3.24	3.45	3.51	3.55	**3.44**	3.30	3.52	3.58	3.62	**3.51**
Vit. B1 at 50 ppm	3.51	3.73	4.03	4.19	**3.86**	3.58	3.80	4.11	4.27	**3.94**
Active yeast at 5 g/l	3.16	3.36	3.46	3.49	**3.37**	3.22	3.43	3.53	3.56	**3.44**
Active yeast at 10 g/l	3.19	3.39	3.54	3.63	**3.44**	3.25	3.46	3.61	3.70	**3.51**
Mean (A)	**3.24**	**3.44**	**3.59**	**3.66**		**3.30**	**3.51**	**3.66**	**3.73**	
L.S.D. at 5 %	**A: 0.07**		**B: 0.05**		**AB: 0.10**	**A: 0.06**		**B: 0.09**		**AB: 0.18**
Essential oil yield/plant (ml)										
Control	1.15	1.23	1.27	1.35	**1.25**	1.17	1.25	1.29	1.38	**1.27**
Vit. E at 25 ppm	1.22	1.30	1.34	1.43	**1.32**	1.24	1.33	1.37	1.46	**1.35**
Vit. E at 50 ppm	1.32	1.40	1.49	1.51	**1.43**	1.35	1.43	1.52	1.54	**1.46**
Vit. B1 at 25 ppm	1.23	1.31	1.35	1.44	**1.33**	1.25	1.34	1.38	1.47	**1.36**
Vit. B1 at 50 ppm	1.48	1.58	1.62	1.64	**1.58**	1.51	1.61	1.65	1.67	**1.61**
Active yeast at 5 g/l	1.20	1.28	1.32	1.41	**1.30**	1.22	1.31	1.35	1.44	**1.33**
Active yeast at 10 g/l	1.30	1.38	1.46	1.49	**1.41**	1.33	1.41	1.49	1.52	**1.44**
Mean (A)	**1.27**	**1.35**	**1.41**	**1.47**		**1.29**	**1.38**	**1.44**	**1.50**	
L.S.D. at 5 %	**A: 0.05**		**B: 0.04**		**AB: 0.08**	**A: 0.06**		**B: 0.05**		**AB: 0.10**
Essential oil yield/fed. (l)										
Control	38.6	41.3	42.7	45.4	**42.0**	39.3	42.0	43.3	46.4	**42.8**
Vit. E at 25 ppm	41.0	43.7	45.0	48.0	**44.4**	41.7	44.7	46.0	49.1	**45.4**
Vit. E at 50 ppm	44.4	47.0	50.1	50.7	**48.0**	45.4	48.0	51.1	51.7	**49.1**
Vit. B1 at 25 ppm	41.3	44.0	45.4	48.4	**44.8**	42.0	45.0	46.4	49.4	**45.7**
Vit. B1 at 50 ppm	49.7	53.1	54.4	55.1	**53.1**	50.7	54.1	55.4	56.1	**54.1**
Active yeast at 5 g/l	40.3	43.0	44.4	47.4	**43.8**	41.0	44.0	45.4	48.4	**44.7**
Active yeast at 10 g/l	43.7	46.4	49.1	50.1	**47.3**	44.7	47.4	50.1	51.1	**48.3**
Mean (A)	**42.7**	**45.5**	**47.3**	**49.3**		**43.5**	**46.5**	**48.2**	**50.3**	
L.S.D. at 5 %	**A: 1.6**		**B: 0.4**		**AB: 0.8**	**A: 1.7**		**B: 0.4**		**AB: 0.8**

Table 4: Effect of organic fertilization, some vitamins and active yeast, as well as, their interactions treatments on chlorophyll a, b and carotenoids (mg/g f.wt.) of caraway, (*Carum carvi,* L.), plant during the first and second seasons.

Active yeast and vitamins treatments (B)	sheep manure treatments (ton/fed.) (A)									
	0.0	2.5	5.0	7.5	Mean (B)	0.0	2.5	5.0	7.5	Mean (B)
	1st season (2019/2020)					2nd season (2020/2021)				
Chlorophyll a (mg/g F.W.)										
Control	2.139	2.276	2.436	2.471	**2.330**	2.182	2.321	2.485	2.520	**2.377**
Vit. E at 25 ppm	2.285	2.431	2.570	2.631	**2.479**	2.331	2.480	2.621	2.684	**2.529**
Vit. E at 50 ppm	2.680	2.851	2.974	3.108	**2.903**	2.734	2.908	3.033	3.170	**2.961**
Vit. B1 at 25 ppm	2.291	2.437	2.604	3.063	**2.599**	2.337	2.486	2.656	3.124	**2.691**
Vit. B1 at 50 ppm	2.692	2.864	2.936	3.201	**2.923**	2.746	2.921	2.995	3.265	**2.981**
Active yeast at 5 g/l	2.228	2.371	2.538	2.574	**2.428**	2.273	2.418	2.589	2.625	**2.477**
Active yeast at 10 g/l	2.693	2.865	2.901	3.083	**2.885**	2.747	2.922	2.959	2.125	**2.943**
Mean (A)	**2.394**	**2.585**	**2.708**	**2.875**		**2.442**	**2.637**	**2.762**	**2.932**	
L.S.D. at 5 %	**A: 0.118**		**B: 0.085**		**AB: 0.170**	**A: 0.121**		**B: 0.095**		**AB: 0.190**
Chlorophyll b (mg/g F.W.)										
Control	0.746	0.794	0.807	0.820	**0.792**	0.761	0.810	0.823	0.836	**0.808**
Vit. E at 25 ppm	0.782	0.832	0.863	0.882	**0.840**	0.798	0.849	0.880	0.900	**0.857**
Vit. E at 50 ppm	0.913	0.972	0.979	0.981	**0.961**	0.931	0.991	0.999	1.001	**0.980**
Vit. B1 at 25 ppm	0.819	0.872	0.874	0.884	**0.862**	0.835	0.889	0.891	0.902	**0.879**
Vit. B1 at 50 ppm	0.924	0.984	0.987	0.993	**0.972**	0.942	1.004	1.007	1.013	**0.991**
Active yeast at 5 g/l	0.777	0.827	0.841	0.854	**0.825**	0.792	0.843	0.858	0.871	**0.841**
Active yeast at 10 g/l	0.903	0.961	0.963	0.966	**0.948**	0.921	0.980	0.982	0.985	**0.967**
Mean (A)	**0.838**	**0.892**	**0.902**	**0.912**		**0.855**	**0.910**	**0.920**	**0.930**	
L.S.D. at 5 %	**A: 0.008**		**B: 0.006**		**AB: N.S.**	**A: 0.007**		**B: 0.005**		**AB: N.S.**
Carotenoids content (mg/g F.W.)										
Control	0.764	0.813	0.892	0.899	**0.842**	0.779	0.829	0.910	0.917	**0.859**
Vit. E at 25 ppm	0.858	0.913	0.933	0.951	**0.914**	0.875	0.931	0.952	0.970	**0.932**
Vit. E at 50 ppm	0.925	0.984	1.019	1.029	**0.989**	0.943	1.004	1.039	1.050	**1.009**
Vit. B1 at 25 ppm	0.874	0.930	0.941	0.971	**0.929**	0.891	0.949	0.960	0.990	**0.948**
Vit. B1 at 50 ppm	0.936	0.996	1.027	1.031	**0.997**	0.955	1.016	1.047	1.052	**1.017**
Active yeast at 5 g/l	0.796	0.847	0.929	0.936	**0.877**	0.812	0.864	0.948	0.955	**0.894**
Active yeast at 10 g/l	0.859	0.914	0.955	0.965	**0.923**	0.876	0.932	0.974	0.984	**0.941**
Mean (A)	**0.859**	**0.913**	**0.957**	**0.968**		**0.876**	**0.931**	**0.974**	**0.987**	
L.S.D. at 5 %	**A: 0.009**		**B: 0.006**		**AB: N.S.**	**A: 0.008**		**B: 0.004**		**AB: N.S.**

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الملخص العربي

تأثير بعض المواد الطبيعية علي نباتات الكراوية.

محمود عبدالهادي حسن عبده – محمد عادل بدر
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أُجريت هذه التجربة في مزرعة مركز التجارب والبحوث الزراعية – جامعة المنيا، قرية شوشة – غرب سمالوط، المنيا، خلال موسمي النمو (2020/2019) و (2021/2020) لاختبار تأثير التسميد بسماد الأغنام (صفر – 2.5 – 5.0 – 7.5 طن/فدان) وبعض الفيتامينات (فيتامين ب1 وفيتامين هـ، كل منهما عند تركيز 25 و 50 جزء في المليون) والخميرة النشطة عند تركيز 5.0 و 10 جم/لتر والتفاعل بينهما علي نباتات الكراوية النامية في أرض رملية.

أشارت النتائج إلى أن التسميد بسماد الأغنام أدي إلي زيادة معنوية في ارتفاع النبات ، عدد الأفرع/نبات ، عدد النورات/نبات ، محصول الثمار/النبات والفدان ، النسبة المئوية للزيت الطيار ، محصول الزيت الطيار/النبات والفدان ، صبغات البناء الضوئي مقارنة بمعاملة الكنترول. وكانت معاملة 7.5 طن/فدان سماد أغنام أكثر فاعلية مقارنة بالمعاملات الأخري. أيضاً، أدت جميع المعاملات المستخدمة من فيتامين ب1 وفيتامين هـ، كل منهما عند 25 و 50 جزء في المليون والخميرة النشطة عند 5.0 و 10 جم/لتر إلي زيادة معنوية لكل الصفات السابقة مقارنة بمعاملة الكنترول. وكانت معاملة فيتامين ب1 عند تركيز 50 جزء في المليون أفضل المعاملات في هذا الشأن. بينما كانت أفضل معاملة تداخل هي التسميد بسماد الأغنام عند مستوي 5 او 7.5 طن/فدان ورش النباتات بفيتامين ب1 ثم فيتامين هـ ثم الخميرة النشطة، عند التركيزات العالية لكلٍ منهم.