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Effect of organic and bio-fertilization treatments on Fennel plant under drip irrigation system in Bahria Oases.

II- Oil productivity and some chemical compounds

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ABSTRACT

This experiment was carried out at the farm of Royal Herbs Company - Bahria Oases - Giza in a newly reclaimed desert land under the drip irrigation system during two successive seasons 2018/2019 and 2019/2020 with the aim of studying the effect of organic fertilizer (compost) and bio fertilization treatments {phosphorein (PHOS) – Effective microorganisms (EM) - Minia azoteine (MA) and their combinations} and their interaction on oil production and some chemical compounds, namely, photosynthetic pigments (chlorophyll a, b and carotenoids) and nutrients percentage (N, P and K %) on fennel plants. The obtained results indicated that the application of compost significantly increased oil productivity in the seeds (oil%, oil yield per plant and per feddan) and the studied chemical components (chlorophyll a, b and carotenoids; and N, P and K%), the best treatment was 20-ton compost/fed.

All studied parameters were significantly affected by bio-fertilization; the best treatment was PHOS + EM + MAAslo, the interaction effect between the two factors was significant and . the best interaction treatment was compost at 15 or 20 ton/fed. with (PHOS + EM + MA) of bio-fertilization in the two seasons.

KEYWORDS: Compost, Bio-fertilization, Fennel, Oil productivity and Chemical composition**.**

1. INTRODUCTION

Even though herbs had been priced for their medicinal, flavoring and aromatic qualities for centuries, the imitation products of the modern age surpassed their value for a while. However, the unsighted dependence on synthetics was trouncing all the barricades and incite people to come again to the naturals with optimism of safety and sanctuary (Mahmoud *et al*., 2016).

Medicinal plants are used to cure many ailments that either non-curable or seldomly cured through modern systems of medicine. Approximately 80% of the world population depends on medicinal plants for their health and healing (Aliyu, 2003).

Fennel (*Foeniculum vulgare*, Miller) plant is one of the most common and widely cultivated aromatic and medicinal plants in middle Egypt Governorates such as BeniSuef, Minia and Assuit. It is a 120-180 cm long winter annual herb belonging to Fam. Apiaceae. Fennel is originally native to Mediterranean Sea region from where its cultivation spread out to Europe and Latin America Countries. The fruits which are the used part of fennel plant contain 3.5 - 5% volatile oil with the most important components being anethole and fenchone. The fruits are commonly used in medicinal folklore and bakery and the volatile oil is involved in many pharmaceutical purposes and food industry (Badran *et al*., 2016).

The essential oil is used in cosmetics and pharmaceutical products (Lawrence, 1984; Braun and Franz, 1990).

Organic manures are important for medicinal and aromatic plants to produce the best product in both quantity and quality and it is also very safe for human health and environment. This is made by recycling organic material as plant and animals waste and food scraps in a controlled process. Continuous usage of inorganic fertilizer affects soil structure. Hence, organic manures can serve as alternative to mineral fertilizers for improving soil structure (Dauda *et al*., 2008) and microbial biomass (Suresh *et al*., 2004).

Bio-fertilizers are considered to be low cost, eco-friendly and renewable sources of plant nutrients supplementing chemical fertilizers in sustainable agricultural system. This refers to microorganism, which increase crop growth through different mechanisms, i.e. biological nitrogen fixation, phosphate-dissolving, growth promoting or hormonal substances, as well as, increasing availability of soil nutrients (Hedge *et al*., 1999).

Therefore, the aim of the present work was to study the effect of compost and bio-fertilization

treatments, as well as, their interactions on essential oil productivity and chemical composition of fennel (*Foeniculum vulgare*, Mill.) plants.

2. MATERIALS AND METHODS

The present study was carried out for two seasons (2018/2019 and 2019/2020) at Bahria Oases (Gizza) – in Royal Herbs farm.

The fruits of fennel (*Foeniculum vulgare*, Mill.) plants were obtained from Royal Herbs company, Gizza, Shabramant. The experiment was arranged in a randomized complete block design in a split plot design with three replicates. The main plots (A) included four levels of compost, (0, 10,15 and 20 ton/fed.) while seven treatments of bio-fertilization: Phosphorein (PHOS), Effective microorganisms (EM), Minia azotein (MA), (PHOS + EM), (PHOS + MA), (PHOS + EM + MA) and control treatments occupied the sub-plots (B).

Therefore, the interaction treatments (A*B) were 28 treatments. Fennel fruits were sown in October 21st in the two growth seasons in plots. Each plot consists of 4 m width x 7 m length and it contains 7 terraces (2 line/terrace) with 1 m separation to prevent water seepage from each plot to adjacent plot. Planting rate was 5 kg seeds/fed. in hills with 50 cm apart between hills. Therefore, each experimental unit contained 224 plants (which were thinned into two plants per hill). Thus, the number of plants/fed. was 32,000 plants. Two weeks before planting date, compost was added during preparation of the soil for planting in the two experimental seasons at the Royal Herbs Farm. The physical and chemical analysis of the used soil in both seasons were determined according to Page *et al*. (1982) and shown in Table (1).

Table 1. Physical and chemical properties of the used soil.

Soil character	Values	Soil character	Values
Chemical properties:		**Available nutrients:**	
pH 1:2.5	7.80	Ca^{++} (ppm)	116.69
E.C. (dS/m)	0.77	Mg^{++} (ppm)	3.77
O.M.	0.13	Na^{+} (ppm)	35.50
$CaCO_3$	3.35	K^{+} (ppm)	15.56
Exchangeable nutrients:		**Physical properties:**	
Ca^{++} **(mg/100 g soil)**	3.5	Sand (%)	93.70
Mg^{++} **(mg/100 g soil)**	2.5	Silt (%)	3.85
Na^{+} **(mg/100 g soil)**	0.8	Clay (%)	2.45
K^{+} **(mg/100 g soil)**	0.2	Soil type	Sandy

Fresh and active bio-fertilizers, Minia azotein and effective microorganisms E.M. (containing N-fixing bacteria) and Phosphorein (containing phosphate dissolving bacteria) were obtained from the Laboratory of Bio-fertilizers, Department of Genetic, Fac. of Agric., Minia University. Bio-fertilizers were applied three times to the soil beside the plants at the rate of 50 cm^3/hill (1 ml=10^7 cells of bacteria). The first dose; for Phosphorein, Effective microorganism and Minia azotein was added 40 days from sowing date, 20 days interval between the three doses and then plants were irrigated immediately. The Compost was obtained from El-Sharqia company. The physical and chemical properties of the used compost are shown in Table (2).

Table (2): Physical and chemical properties of the used compost:

Properties	First season	Second season
Organic matter (%)	15.00	13.80
Humidity (%)	7.90	9.00
Ca (ppm)	1405.10	1295.00
Mg (ppm)	46.60	47.40
Na (ppm)	644.00	613.00
K (ppm)	476.20	485.10
P (ppm)	4.30	4.70
E.C. (dS/m)	6.21	6.65
pH	8.10	7.97

The sub plot treatments (B) were as follows: **b_1**, Control; **b_2**, Phosphorien; **b_3**, Effective microorganism; **b_4**, Minia azotein; **b_5**, biofertilizers (Phosphorien+ Effective microorganism); **b_6**, biofertilizers (Phosphorien + Minia Azotein); **b_7**, biofertilizers (Phosphorien + Effective microorganism + Minia azotein).

The following data were recorded at the harvesting time except chlorophyll a, b and

carotenoids were recorded after 20 days from the last experimental treatments (bio-fertilization).

2.1. The essential oil productivity:

Essential oil percentage (%), essential oil yield/plant (ml) and essential oil yield/fed. (liter).

Essential oil percentage was determined in dried samples in both seasons by subjecting to hydro distillation in Clevenger apparatus according to method described by the Egyptian Pharmacopoeia (1984), the resulted oil was dried over anhydrous-soduim sulphate and kept at refrigerator until Gas Liquid Chromatography Analyses. Then the essential oil yield per plant and per feddan was calculated.

2.2. Chemical composition:

2.2.1. Chlorophyll a, b and carotenoids (mg/g fresh wight of herbs).

Chlorophyll a, b and carotenoids were determined in fresh herbs samples (mg/g f.w.) according to the method cited from Fadl and Sari El–Deen (1978).

2.2.2. Elements percentages (N, P and K).

To determine N, P and K% in plant tissues, 0.2 g crude dried herbs powder from each sample was wet digested with a mixture of concentrated sulphoric (H_2SO_4) and perchloric ($HClPO_4$) acids, then heated until become clear solution. This solution was quantitavely transferred into 100 ml measuring flask and kept for determinations. (Cottenie, 1982).

2.3. Statistical analysis:

All obtained data in the first and second seasons were tabulated and statistically analyzed according to MSTAT-C (1986) and the L.S.D. test at 5% was followed to compare between the means.

3. RESULTS AND DISCUSSIONS

3.1. The essential oil productivity

It is clearly noticed from data presented in Tables (3 and 4) that plants of fennel which received compost at 20 ton/fed. showed the highest significant increase of essential oil (%), oil yield/plant (ml/plant) and oil yield/fed. (liter) followed by compost at 15 ton/fed. then 10 ton/fed. in both seasons.

These results are in accordance with those obtained by Badran and Safwat (2004), Abdou *et al*. (2009b), Azzaz *et al*. (2009), Moradi *et al*. (2011), Abdou *et al*. (2012), Jamshidi *et al*. (2012), Younesian *et al*. (2013), Abarghouei (2014), Eisa (2016) and Abd El-Aleem *et al*. (2017) on fennel plants.

Table 3. Effect of compost and bio-fertilization, as well as, their combination treatments on oil (%) and oil yield/plant (ml) of *Foeniculum vulgare*, Mill. plants during the first and second seasons.

Bio-fertilization treatments (B)	Compost levels ton/fed. (A)									
	0	10	15	20	Mean (B)	0	10	15	20	Mean (B)
	The 1st season (2018/2019)					The 2nd season (2019/2020)				
	Oil (%)									
Control	1.45	2.01	2.24	2.45	2.04	1.52	2.10	2.34	2.57	2.13
PHOS	1.53	2.07	2.53	2.62	2.19	1.60	2.17	2.65	2.74	2.29
EM	1.69	2.30	2.85	2.90	2.44	1.77	2.41	2.98	3.03	2.55
MA	1.60	2.17	2.70	2.77	2.31	1.67	2.27	2.82	2.89	2.41
PHOS+EM	1.86	3.08	3.33	**3.43**	2.92	1.94	3.22	3.49	**3.59**	3.06
PHOS+MA	1.76	2.39	3.00	3.14	2.57	1.84	2.49	3.13	3.29	2.69
PHOS+EM+MA	1.92	3.23	**3.51**	**3.61**	**3.07**	2.01	3.37	**3.67**	**3.77**	**3.21**
Mean (A)	1.69	2.46	2.88	**2.99**		1.77	2.58	3.01	**3.12**	
L.S.D. at 5 %	**A: 0.05**		**B: 0.09**		**AB: 0.18**	**A: 0.09**		**B: 0.12**		**AB: 0.24**
	Oil yield/plant (ml/plant)									
Control	0.32	0.49	0.60	0.82	0.56	0.35	0.54	0.65	0.90	0.61
PHOS	0.34	0.53	0.86	0.95	0.67	0.37	0.58	0.94	1.05	0.74
EM	0.39	0.67	1.13	1.18	0.84	0.43	0.74	1.24	1.29	0.93
MA	0.36	0.57	0.99	1.07	0.75	0.39	0.63	1.09	1.18	0.82
PHOS+EM	0.44	1.33	1.68	1.76	1.30	0.48	1.46	1.85	1.93	1.43
PHOS+MA	0.41	0.70	1.27	1.49	0.97	0.45	0.77	1.39	1.64	1.06
PHOS+EM+MA	0.46	1.58	**1.86**	**1.93**	**1.46**	0.51	1.73	**2.04**	**2.12**	**1.60**
Mean (A)	0.39	0.84	1.20	1.31		0.43	0.92	1.32	1.44	
L.S.D. at 5 %	**A:0.08**		**B:0.09**		**AB:0.18**	**A:0.11**		**B:0.10**		**AB:0.20**

PHOS: Phosphorein
EM: Effective microorganisms
MA: Minia azotein

Table 4. Effect of compost and bio-fertilization, as well as, their combination treatments on oil yield/fed. (liter) of *Foeniculum vulgare,* Mill. plants during the first and second seasons.

Bio-fertilization treatments (B)	Compost levels ton/fed. (A)									
	0	10	15	20	Mean (B)	0	10	15	20	Mean (B)
	The 1st season (2018/2019)					The 2nd season (2019/2020)				
	Oil yield/fed. (liter)									
Control	10.24	15.68	19.20	26.24	17.92	11.20	17.28	20.80	28.80	19.52
PHOS	10.88	16.96	27.52	30.40	21.44	11.84	18.56	30.08	33.60	23.68
EM	12.48	21.44	36.16	37.76	26.88	13.76	23.68	39.68	41.28	29.76
MA	11.52	18.24	31.68	34.24	24.00	12.48	20.16	34.88	37.76	26.24
PHOS+EM	14.08	42.56	53.76	56.32	41.60	15.36	46.72	59.20	61.76	45.76
PHOS+MA	13.12	22.40	40.64	47.68	31.04	14.40	24.64	44.48	52.48	33.92
PHOS+EM+MA	14.72	50.56	59.52	61.76	46.72	16.32	55.36	65.28	67.84	51.20
Mean (A)	12.48	26.88	38.40	41.92		13.76	29.44	42.24	46.08	
L.S.D. at 5 %	**A: 2.80**		**B: 2.30**		**AB: 4.60**	**A: 2.80**		**B: 2.38**		**AB: 4.67**

PHOS: Phosphorein
EM: Effective microorganisms
MA: Minia azotein

The data presented in tables (3 and 4) indicated that essential oil (%), oil yield/plant (ml/plant) and oil yield/fed. (liter) in the fruits of fennel plants was improved as a result of inoculating the growing soil with any commercial product of bio-fertilizers either separately or collectively used. Inoculating soil with Phosphorein plus Effective microorganisms plus Minia azotein gave significantly higher oil (%) and oil yield (ml/plant and liter/fed.) compared with all used treatments. The lowest essential oil percentage was obtained by the control treatment in both seasons.

Similar results were obtained by Sharaf and Khattab (2004), Abdou *et al*. (2009b) and Gamar *et al*. (2018) on fennel plants, Abd El-Latif (2002), Al-Shareif (2006) and Abdou *et al*. (2009a) on caraway plants, Badran *et al*. (2003), Hemdan (2008) and Zand *et al*. (2013) on anise plants, Hellal *et al*. (2011) on dill, Rekaby (2013) and Mounika *et al*. (2018) on coriander plants.

The interaction between compost and bio-fertilization treatments was significant for oil (%), oil yield/plant (ml/plant) and oil yield/fed (liter/fed.) of fennel in both seasons as clearly shown in tables (3 and 4).

The best interaction treatments were obtained by adding compost at 20 ton/fed. in combination with (PHOS + EM + MA) or adding compost at 20 ton/fed. plus (PHOS + EM).

3.2. Chemical composition:

Data presents in Tables (5, 6 and 7) indicated that, the content of chlorophyll a, b and carotenoids in the fresh weight of herbs and N, P and K% in dry weight of herbs of fennel plants were greatly affected by compost treatments as compared to control treatment in both seasons. The high contents were obtained with 20 ton/fed. compost.

Similar results were obtained by Tanious (2008) and Abdou *et al*. (2012) on fennel plants, Ahmed (2017), Hassan (2008) and Mahmoud (2009) on black cumin.

According to data tabulated in Tables (5, 6 and 7), it could be concluded that the bio-fertilizers compound progressively increased contents of chlorophyll a, b, carotenoids, N, P and K% as compared with control treatment in both seasons. So, the highest contents of the three photosynthetic pigments and N, P and K were obtained with treatments (PHOS + EM + MA).

The above results of contents of pigments are in paralled with those obtained by Muthaura *et al*. (2010) on pigweed plants, Patil (2010) on *Stevia rebaudiana* var. Bertoni, Ibrahim (2014) on Khilla and Ahmed (2017) on black cumin plants.

The interaction between compost and bio-fertilization treatments was significant for chlorophyll a, b, carotenoids, N, P and K % in both seasons as shown in Tables (5, 6 and 7).

The best interaction effects between compost and bio-fertilization treatments were obtained by supplying fennel plants with compost at 20 ton/fed. and inoculation with (PHOS + EM + MA) or plus (PHOS + EM in some cases), also by adding compost at 15 ton/fed. + (PHOS + EM + MA).

Table 5. Effect of compost and bio-fertilization, as well as, their combination treatments on chlorophyll a and b (mg/ g F.W.) of *Foeniculum vulgare,* Mill. plants during the first and second seasons.

Bio-fertilization treatments (B)	Compost levels, ton/fed. (A)									
	0	10	15	20	Mean (B)	0	10	15	20	Mean (B)
	The 1st season (2018/2019)					The 2nd season (2019/2020)				
Chlorophyll a (mg/ g F.W.)										
Control	1.569	1.810	1.897	1.978	1.813	1.612	1.862	1.952	2.036	1.865
PHOS	1.612	1.813	1.981	2.016	1.855	1.662	1.865	2.039	2.074	1.910
EM	1.624	1.905	2.265	2.268	2.016	1.670	1.960	2.329	2.332	2.073
MA	1.621	1.833	2.236	2.250	1.985	1.668	1.885	2.300	2.317	2.042
PHOS+EM	1.778	2.340	2.448	**2.477**	2.261	1.827	2.407	2.517	**2.549**	2.325
PHOS+MA	1.673	1.943	2.271	2.342	2.057	1.720	1.998	2.337	2.410	2.116
PHOS+EM+MA	1.807	2.393	**2.480**	**2.509**	**2.297**	1.859	2.459	**2.552**	**2.581**	**2.363**
Mean (A)	1.669	2.005	2.225	**2.263**		1.717	2.062	2.289	**2.328**	
L.S.D. at 5 %	**A: 0.033**		**B: 0.025**		**AB: 0.050**	**A: 0.037**		**B: 0.028**		**AB: 0.056**
Chlorophyll b (mg/ g F.W.)										
Control	0.541	0.624	0.654	0.682	0.625	0.556	0.642	0.673	0.702	0.643
PHOS	0.556	0.625	0.683	0.695	0.640	0.573	0.643	0.703	0.715	0.658
EM	0.560	0.657	0.781	0.781	0.695	0.576	0.676	0.803	0.804	0.715
MA	0.559	0.632	0.771	0.776	0.685	0.575	0.650	0.793	0.799	0.705
PHOS+EM	0.613	0.807	0.844	**0.854**	0.779	0.630	0.830	0.868	**0.879**	0.802
PHOS+MA	0.577	0.670	0.783	0.807	0.709	0.593	0.689	0.806	0.831	0.730
PHOS+EM+MA	0.623	0.825	**0.855**	**0.865**	**0.792**	0.641	0.848	**0.880**	**0.890**	**0.815**
Control	0.576	0.691	0.767	**0.780**		0.592	0.711	0.790	**0.803**	
L.S.D. at 5 %	**A: 0.009**		**B: 0.008**		**AB: 0.016**	**A: 0.013**		**B: 0.010**		**AB: 0.020**

PHOS: Phosphorein
EM: Effective microorganisms
MA: Minia azotein

Table 6. Effect of compost and bio-fertilization, as well as, their combination treatments on carotenoids (mg/g F.W.) and nitrogen percentage of Foeniculum vulgare, Mill. **plants during the first and second seasons.**

Bio-fertilization treatments (B)	Compost levels ton/fed. (A)									
	0	10	15	20	Mean (B)	0	10	15	20	Mean (B)
	The 1st season (2018/2019)					The 2nd season (2019/2020)				
Carotenoids (mg/g F.W.)										
Control	0.661	0.763	0.799	0.834	0.764	0.680	0.785	0.823	0.858	0.786
PHOS	0.680	0.764	0.835	0.849	0.782	0.700	0.786	0.859	0.874	0.805
EM	0.684	0.803	0.955	0.957	0.850	0.704	0.826	0.981	0.983	0.874
MA	0.683	0.772	0.942	0.948	0.837	0.703	0.794	0.969	0.977	0.861
PHOS+EM	0.749	0.986	1.032	**1.044**	0.953	0.770	1.014	1.061	**1.074**	0.980
PHOS+MA	0.705	0.819	0.983	0.990	0.874	0.725	0.842	0.985	1.016	0.892
PHOS+EM+MA	0.761	1.008	**1.045**	**1.057**	**0.968**	0.783	1.036	**1.076**	**1.088**	**0.996**
Mean (A)	0.703	0.845	0.942	**0.954**		0.724	0.869	0.965	**0.981**	
L.S.D. at 5 %	**A: 0.008**		**B: 0.011**		**AB: 0.022**	**A: 0.010**		**B: 0.012**		**AB: 0.024**
Nitrogen (%)										
Control	2.21	2.70	2.86	3.05	2.71	2.40	2.88	3.01	3.24	2.88
PHOS	2.27	2.75	3.12	3.19	2.83	2.49	2.94	3.30	3.36	3.02
EM	2.42	2.93	3.37	3.44	3.04	2.63	3.11	3.54	3.60	3.22
MA	2.35	2.81	3.25	3.31	2.93	2.56	2.99	3.42	3.47	3.11
PHOS+EM	2.56	3.58	3.78	3.86	3.45	2.74	3.71	3.90	**3.98**	3.58
PHOS+MA	2.50	2.98	3.51	3.65	3.16	2.68	3.22	3.64	3.77	3.33
PHOS+EM+MA	2.64	3.72	**3.91**	**3.98**	**3.56**	2.80	3.83	**4.02**	**4.08**	**3.68**
Mean (A)	2.42	3.07	3.40	**3.50**		2.61	3.24	3.55	**3.64**	
L.S.D. at 5 %	**A: 0.07**		**B: 0.05**		**AB: 0.10**	**A: 0.08**		**B: 0.07**		**AB: 0.14**

PHOS: Phosphorein
EM: Effective microorganisms
MA: Minia azotein

Table 7. Effect of compost and bio-fertilization, as well as, their combination treatments on phosphorus and potassium percentages of *Foeniculum vulgare,* Mill. plants during the first and second seasons.

Bio-fertilization treatments (B)	Compost levels ton/fed. (A)									
	0	10	15	20	Mean (B)	0	10	15	20	Mean (B)
	The 1st season (2018/2019)					The 2nd season (2019/2020)				
	Phosphorus (%)									
Control	0.216	0.276	0.301	0.327	0.280	0.241	0.307	0.335	0.361	0.311
PHOS	0.225	0.284	0.338	0.348	0.299	0.257	0.315	0.364	0.377	0.328
EM	0.242	0.311	0.375	0.384	0.328	0.277	0.343	0.405	0.412	0.359
MA	0.234	0.292	0.357	0.366	0.312	0.268	0.324	0.388	0.395	0.344
PHOS+EM	0.259	0.399	0.428	0.439	0.381	0.293	0.429	0.450	0.455	0.407
PHOS+MA	0.250	0.320	0.393	0.410	0.343	0.284	0.352	0.423	0.439	0.375
PHOS+EM+MA	0.268	0.419	0.448	**0.460**	**0.399**	0.301	0.444	0.466	**0.475**	**0.422**
Mean (A)	0.242	0.329	0.377	**0.391**		0.274	0.359	0.404	**0.416**	
L.S.D. at 5 %	**A: 0.009**		**B: 0.006**		**AB: 0.012**	**A: 0.011**		**B: 0.008**		**AB: 0.016**
	Potassium (%)									
Control	1.98	2.32	2.50	2.61	2.35	2.08	2.41	2.55	2.73	2.44
PHOS	2.03	2.38	2.66	2.70	2.44	2.12	2.46	2.75	2.79	2.53
EM	2.14	2.53	2.84	2.88	2.60	2.20	2.60	2.95	2.99	2.69
MA	2.10	2.44	2.75	2.81	2.53	2.17	2.50	2.86	2.89	2.61
PHOS+EM	2.24	2.97	3.12	**3.20**	2.88	2.31	3.06	3.21	**3.26**	2.96
PHOS+MA	2.19	2.56	2.92	3.03	2.68	2.26	2.68	3.02	3.12	2.77
PHOS+EM+MA	2.27	3.06	**3.25**	**3.28**	**2.97**	2.35	3.16	**3.36**	**3.41**	**3.07**
Mean (A)	2.14	2.61	2.86	**2.93**		2.21	2.70	2.96	**3.03**	
L.S.D. at 5 %	**A: 0.04**		**B: 0.07**		**AB: 0.14**	**A: 0.06**		**B: 0.08**		**AB: 0.16**

PHOS: Phosphorein
EM: Effective microorganisms
MA: Minia azotein

4. CONCLUSION

It can be concluded that to obtain the best oil production and chemical compounds, namely, photosynthetic pigments (chlorophyll a, b and carotenoids) and nutrients percentage (N, P and K%) of fennel, must be supplying plants combined with compost at 20 or 15 ton/fed. with Phosphoren + Effective microorganisms + Minia Azotein.

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الملخص العربي

تأثير التسميد العضوى والحيوى على نبات الشمر البلدى تحت نظام الرى بالتنقيط فى الواحات البحرية.

II- إنتاجية الزيت وبعض الصفات الكيميائية

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أُجرِيَ هذا البحث في مزرعة شركة رويال للأعشاب بالواحات البحرية موسمي (٢٠١٨/٢٠١٩) و (٢٠١٩/٢٠٢٠) لدراسة كيفية تحسين النمو والإنتاجية لنباتات الشمر البلدى فى الأراضى الرملية تحت نظام الرى بالتنقيط فى الواحات البحرية وذلك بدراسة تأثير التسميد العضوى (الكمبوست) بمعدلات (١٠، ١٥ و ٢٠ طن/فدان وكذلك الكنترول) كعامل رئيسي، والتسميد الحيوي باستخدام بكتريا، كعامل ثانوي، وتشمل: (الفسفورين – الميكروبات الدقيقة النشطة – المنيا أزوتين) والتداخل بين العاملين.

وبعد التجربة لموسمين زراعيين متتاليين، تم الحصول على تأثيرات إيجابية فى جميع معاملات الكمبوست والتسميد الحيوي علي صفات النسبة المئوية للزيت ومحصول الزيت للنبات والفدان وصبغات البناء الضوئى والنسبة المئوية لكل من النيتروجين والفوسفور والبوتاسيوم، خلال موسمي النمو.

أفضل النتائج كانت عند إستخدام معدل ٢٠ طن/فدان من الكمبوست بالإضافة إلى التسميد الحيوى باستخدام بكتريا (منيا أزوتين + الميكروبات الدقيقة النشطة + الفوسفورين)، ثم تلاها معدل ٢٠ طن/فدان كمبوست بالإضافة إلى التسميد الحيوى باستخدام بكتريا (الميكروبات الدقيقة النشطة + الفوسفورين).