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The Effect of Organic and Bio-Fertilization on Vegetative Growth and Yield of Thyme (*Thymus vulgaris*, L.)"

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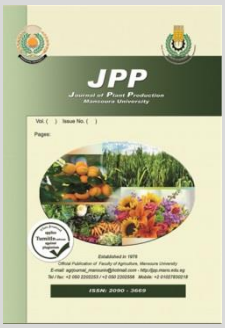

ABSTRACT

Nutritional field trials were applied at the agricultural reclamation farms of the Third Field Army, Suez Governorate, Egypt, during the seasons of 2016 to 2017 and 2017 to 2018 aiming to investigate the different sources of organic fertilization (farmyard, goats and compost) also some bio-fertilization (active dry yeast, microbein, Potassumag, NPK natural, and biohyomean) effect as well as the effect of their combinations on vegetative product, herb yield, essential oil production also chemical composition of Thyme plants [*Thymus vulgaris*, L].The obtained results exhibited that all fertilizer treatments in general improved the studied vegetative growth and yield characters as well as chemical composition of plants compared to the control treatment in two seasons. The organic fertilizers application achieved the highest values of measurements in both seasons with compost application at rate of 20 m^3/fed. while FYM at rate of 20 m^3/fed gave the lowest ones in comparison with control plants in both seasons. It is evident that the application of organic fertilization from different sources at the rate of 20 m^3/fed., in combinations with the studied bio-fertilizers improved the most vegetative growth characters, essential oil production and chemical composition of thyme plants compared with control treatment. The highest values in this regard were realized with combination of compost at the rate of 20 m^3/fed. plus microbein, potassumag, yeast and biohyomean in addition to the recommended chemical NPK. This treatment can be recommended for thyme plants in order to obtain a higher herb yield and essential oil production with better specifications.

Keywords: Thyme, organic, fertilization, bio-fertilization, reclamation

INTRODUCTION

Demand and utilization for medicinal, aromatic plants and spices are interest demand for herbal plant medicine applications. Other purposes included food flavorings, cosmetics such as skin, fragrances, oral and hair care preparations and industrial chemicals.

Thyme (*Thymus vulgaris*, L.) plant belongs to family Lamiaceae (Labiateae) and it has been used since eighteenth century on account of its aromatic compound contents, especially thymol. Thyme herb is using extensively in the kitchen, fresh or dried herbs as one of the most important culinary herb .As a medicinal herb it can be used to treat bronchitis, colic, rheumatic fever and other intestine and stomach disorder (Piccaglia and Marott, 1990). Essential oil of thyme is used in pharmaceutical industry, i.e. antiseptic, anti fungal and anti-parasitic. Deans *et al*. (1993) report about other effects of thyme volatile phenolic oil as antimicrobial, anti-oxidative, natural food preservative mammalian age-delaying. Thyme is widely used as a flavoring in the confectionery industry, (Kruger,1992).

Chemical nutrients especially phosphorus, nitrogen and potassium are very important for plants, because nitrogen, phosphor and potassium partake in structure of several components of the whole plants (protein, hormones, amino acids, enzymes, nucleic acids, fats and regulation of water conditions). However, using intense chemical fertilization cause serious problems on human health by pollution of the whole environmental conditions (soil, air and drainage water).

The organic fertilizers are utilized for the change of soil texture, supplying nutrients and they are considered save for human health. Organic matter improves the aeration and drainage of compacted soils, the water holding capacity and increases the soil exchange capacity i.e. its ability to absorb nutrients (Bryan and Lance, 1991).

EL-Ghawwas (2002) on *Nigella sativa*, reported that fertilization with farmyard 18 m^3/fed. Improved number of fruits, plant height, seed weight per plant significantlyalso the yield each offixed and volatile oils per plot and of course per plant in both seasons.

Younis *et al.* (2004) reported aboutincreasing vegetative yield by fertilization with FYM significantly. Seed weight per plot and of course per plant increased by treating plants with different rats of farmyard manure. Active ingredient of *Ammivisnaga*plants (visnagin&khlein) increased linearly by increasing the rate of farmyard manure significantly.

The significant effect of bio-fertilizers may be due to the effect of different strain groups and nutrients mobilizing microorganisms which help in availability of metals and their forms in the composted material and increased levels of extractable minerals(EL-Kramany*et al*. 2000). Massoud *et al*. (2004) showed that nitrobein

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bio-fertilizer plus phosphorein bio-fertilizer gave increase intheheight of plant also the number of branches and each of plant fresh and dry weight significantly of thyme plants.

Yeast as a natural bio-stimulator is very safe to human, animals and environments (EL-Araby, 2004). It is also good natural source of most growth substances such as (riboflavin,thiamine, cholin, pyridoxine, niacin, folic acid and vitamin B_{12}) as well as most of nutrient elements (Ca, Na, K, Fe, P, Zn, S, and Si), as well as, organic compounds such ascarbohydrate, i.e. protein, nucleic acids and lipids(Nagodawithana, 1991). The significant effects of active dry yeast are attributed to its high content of protein percentage, different nutrients, high content of natural growth hormones percentage such as cytokinins, also content high percentage of vitamin B. In addition, application of yeast is more effective in releasing CO_2 which improved photosynthesis(Idso *et al*., 1995). Each of plant height, number of branches also NPK contents as well as the volatile oil component of black cumin were highest as affected by the treatment of 2 mg yeast(Naguib and Khalil, 2002). The vegetative growth, essential oil content and composition were increased in the sprayed plants with dry yeast(EL-Hindi and EL-Boraie, 2004 on marigold). Bio-fertilization with active dry yeast at 1 g/L and calcium super phosphate at 150 kg/fed.gave highest percentage of volatile oil of coriander seeds(Eid, 2001).

Combinations between each of bio-fertilizer and active dry yeast as a bio-fertilizer increased the vegetative growth also carbohydrates contents as well as NPK percentages of *Vigna radiate*, L. plants(Fouda, 2005).

The final goal of this research was to study the effect of individual applications of different nutrition sources like organic manure (e.g. FYM, Goats, Compost) and bio-fertilizers (e.g. potassumag, microbein, yeast and biohyomean) and their combinations on growth, essential oil productivity and chemical components of Thyme plants fertilized by natural or chemical NPK under reclaimed lands.

MATERIALS AND METHODS

This study was conducted at the Third Field Army reclaiming Farm, Suez Governorate, Egypt during the two seasons of 2016/2017 and 2017 /2018 aiming to study the effect of chemical NPK or natural NPK as a natural source of NPK with different sources of organic fertilization (farmyard, goats and compost) as well as different sources of bio-fertilization such as active dry yeast, microbien (as a nitrogen fixation bacteria), potassumage (as a potassium dissolving bacteria), biohyomean (as a natural source of nitrogen fixation bacteria, phosphate dissolving bacteria, and potassium dissolving bacteria) and their combinations on vegetative growth, herb yield and essential oil production as well as chemical composition of Thyme plants (*Thymus vulgaris*, L). Seeds of *Thymus vulgaris*, L (Thyme) were planted in the nursery under shaded conditions for germination on November, 15th 2016 and 2017 seasons. The growing seedlings were transplanted in an irrigated soil after 80 days from sawing and planted 30 cm apart on each ridge. The soil of the experimental location was sand texture.

Randomized soil samples were obtained from the field to determine the physical and chemical properties according to the standard method described by Wilde *et al*. (1985). Some soil characteristics are presented in Table (1).

Table 1.Chemical and physical characteristics of the soil in the two seasons

Season	Sand (%)	Silt mm (%)	Clay mm (%)	$CaCO_3$ mm (%)	pH mm	Available nutrients (ppm)		
						N	P	K
2016-2017	42.60	29.60	24.60	3.20	8.80	11.90	8.16	80.00
2017-2018	40.12	31.46	25.23	3.10	8.75	11.10	9.90	80.60

All plots received chemical NPK fertilizers consists of mixture of ammonium sulphat (20.5%), phosphoric acid (85%) and potassium sulphate (48.5%) at the recommended rate of Agriculture Ministry of Egypt (300 –150 – 75) respectively, throughout both season, except those which applied with NPK natural . The used natural NPK fertilization was liquid organic ammonium nitrate (33.5 % N), phosphate ore (20% P_2O_5) and potassium ore (12% K_2O) and it was added at the rate of 300, 200 and 200 kg/fed., respectively. The previous quantities of both of chemical and natural NPK were divided to three equal doses and used three times during every growing season in drip irrigation water. The first one was done after one week from transplanting, and the second one after one month from the first while the third after one month from the second. The previous applications were repeated for every cute in the two seasons.

The organic fertilization from different sources (FYM, Goats and Compost) was added to the experimental field during preparation the soil for planting the seedlings at the rate of 20 m^3/fed.The different sources of organic fertilization were analyzed at the Water and Soil Laboratory in both seasons (Tabels 2, 3 and 4).

Table 2.Analytical data of farmyard manure before adding to the experimental soil for two seasons (2016 / 2017) and (2017 / 2018)

Properties	2016/2017	2017/2018
Organic matter	65.45	68.90
Total carbon	37.06	32.51
Total nitrogen	1.76	1.80
C/N ratio	1:21.25	1:21.50
Total phosphate	1.04	0.89
Total potassium	0.98	0.87
pH (in 1:5)	8.20	8.15

Table 3.Analytical data of goats manure before adding to the experimental soil in both seasons (2016/2017 and 2017/2018)

Properties	2016/2017	2017/2018
Organic matter	69.02	68.45
Total carbon	39.32	36.59
Total nitrogen	2.68	2.41
C/N ratio	1:20.30	1:21.80
Total phosphate	1.33	1.04
Total potassium	0.88	0.87
pH (in 1:5)	8.18	8.10

Table 4. Analytical data of compost before adding to the experimental soil in both seasons (2016/2017 and 2017/2018)

Properties	2016/2017	2017/2018
Organic matter %	47.83	49.68
Total carbon %	27.74	30.51
Total nitrogen %	1.91	1.97
C/N ratio	1:15	1:17
Total phosphate %	0.85	0.88
Total potassium %	1.42	1.21
pH (in 1:5)	8.41	8.43
EC (ds/m)	4.33	4.37
Wetness %	41	44

Bio-fertilizers were provided by the (G.O.A.E.F.), Ministry of Agriculture, Egypt. The applied bio-fertilizers were microbein which contains live cells of efficient bacteria strains for N-fixation and phosphate solubilizing (*Azotobacter* sp., *Azospirillum* sp., *Pseudomonas* sp., *Rhizobium* sp. and *Bacillus megatherium*),potassumag which contains live cells of efficient bacteria strains as potassium solubilizing bacteria (*Bacillus silicate*) and biohyomean which contains live cells of different efficient bacteria strains as N-fixation bacteria, phosphate solubilizing bacteria and potassium solubilizing bacteria.

Bacterial growth media were added to the soil with the drip irrigation water and used three times at the rate of 4 l/fed. during every growing season. The first one was done after one week from transplanting, and the second one after one month from the first while the third one after one month from the second. One week after finishing the first cut, this procedure was repeated for the second cut in each season. The application of active dry yeast (*Saccharomyces cerevisiae*) was done as foliar spray with concentration of 3 g/L., three times during every growing season.The first foliar spraying was done after one week from planting, and the second one after one month from the first while the third after one month from the second and all these applications repeated for every cute. The composition of utilized dry yeast is presented in table (5) according to Khedr and Farid (2000).

Table 5.Showedactive dry yeast chemical analysis.

Minerals						
Macro (g/100g d.w)	**Micro (mg/100g d.w)**	**Amino acids (mg/100g d.w)**	**Carbohydrates (mg/100g d.w)**	**Enzymes (mg/100g d.w)**	**Vitamins (mg/100g d.w)**	
	B 175.6	Histidine2.66				
	Al 650.2	Arginine 1.95			VitaminB2	1.32
	Co 67.8	Lysine 2.94			VitaminB1	2.25
	Sn 223.9	Isoleucine 2.30			Nicotinic acid	39.89
	Pb 438.6	Leucine 3.07			Riboflavin	4.98
	NaO 0.35	Phenylalanine 2.07			Biotin	0.08
P_2O_5 7.23	Mn 81.3	Methionine 0.70			Panthothenic acid	19.55
K_2O 51.68	Cao 3.05	Thereonine 2.08	Glucose 13.32	Oxidase 0.28	P-amino benzoic acid	9.25
N 34.39	Zn 335.6	Tryptophan 0.44	Carbohydrate 23.1	Cytochrome 0.32	Folic acid	4.37
	Mg 5.76	Aspartic acid 1.35			VitaminB6	1.26
	SiO_2 1.55	Valine2.17			Thiamine	2.72
	Cl 0.06	Glutamic acid 1.01			Vitamin B_{12}159	
	SO_2 0.49	Proline 1.53			Pyridoxine	2.95
	FeO 0.92	Serine 1.59			Inositol 204	
	NaCl 0.30	Cystine0.23				
		Tyrosine 1.49				

The experimental design:

Complete randomized block design with three replicates was applied as a design of the experiment.

The treatments were as following:

1- Control (NPK) recommended doses.
2- (NPK) recommended doses + FYM 20 m^3/fed.
3- (NPK) recommended doses + Goats 20 m^3/fed.
4- (NPK) recommended doses + compost 20 m^3/fed.
5- (NPK) recommended doses + Microbein + potassumag + yeast.
6- (NPK) recommended doses + Microbein + potassumag + yeast + FYM 20 m^3/fed.
7- (NPK) recommended doses + Microbein + potassumag + yeast + Goats 20m^3/fed.
8- (NPK) recommended doses + Microbein + potassumag + yeast + compost 20 m^3/fed.
9- (NPK) natural recommended doses + Microbein + potassumag + yeast .
10- (NPK) natural recommended doses + Microbein + potassumag + yeast + FYM 20 m^3/fed.
11- (NPK) natural recommended doses + Microbein + potassumag + yeast + Goats 20 m^3/fed.
12- (NPK) natural recommended doses + Microbein + potassumag + yeast + compost 20 m^3/fed.
13- (NPK) recommended doses + Microbein + potassumag + yeast + Biohyomean.
14- (NPK) recommended doses + Microbein + potassumag + yeast + Biohyomean + FYM 20 m^3/fed.
15- (NPK) recommended doses + Microbein + potassumag + yeast + Biohyomean + Goats 20 m^3/fed.
16- (NPK) recommended doses + Microbein + potassumag + yeast + Biohyomean + Compost 20 m^3/fed.

Harvesting:

The plants were harvested twice yearlyin both seasons by cutting the aerial parts of plant 10 cm above the soil surface. The first cut of aerial parts was carried out in the mid of June and the second cut was in the mid of October.

Three plants were chosen randomly in each cut from each treatment in two seasons. The vegetative growth measurements (plant height, number of plant branches, each of plant fresh and dry weight) were recorded.

The essential oil percentages were determined from dry leaves using 100 gm, samples for each cut. The distillation of essential oil and the determination were

described in the Britich Pharmacopoeia (1963). The oil content was calculated by multiplying oil percentage by weight of dry plants (ml/plant) and per feddan (Liter/fed.). The essential oil production from the second cut of the second season was analyzed using Gas Liquid Chromatography technique (GLC), which carried out at the Laboratory of Aromatic and Medicinal plants search section, Cairo, Egypt.

The use of GLC in the quantitative determination was performed using the methods described by Hoftman (1967) and Bunzen *et al*. (1969).

Mineral elements was carried out in the Laboratory of Chemical Dept., Fac. Agric., Mansoura Univ. Plant samples were dried in an electric oven at 70 ºC for 48 hour then finely ground for chemical determination according to A.O.A.C. (1970). Nitrogen percentage was determined according to method of Kjeldahl as described by Jackson (1973). Phosphorus percentage was determined according to Murphy and Reily (1962). Potassium percentage was determined according to Wilde *et al*. (1985).

The complete randomized block design with 3 replicates was used in both growing seasons. Obtained data was subjected to the statistical analysis of variance (ANOVA) the mean values of the treatments were compared using L.S.D at probability level 0.05 as mentioned by Steel and Torrie (1980).

RESULTS AND DISCUSSION

1- Plant growth characters :

Data presented in Tables (6, 7, 8 and 9) indicated that providing thyme plants with different sources of organic fertilization(FYM, Goats, Compost) at rat of 20 m^3/fed., (microbein + potassumag + yeast), (microbein + potassumag + yeast + NPK natural), (microbein + potassumag + yeast + biohyomean) and their combinations improve in most cases the vegetative growth characters expressed as plant height, number of branches, herb fresh and dry weights compared with control. The highest values of vegetative growth characters resulted from the plants fertilized with recommended chemical NPK and 20 m^3/fed. Compost in combination with microbien + potassumag + yeast + biohyomean in both cuts of the two seasons.

The pre-mentioned increases may be due to the essential and vital role of organic fertilization, bio-fertilizers potassumag, microbein and yeast as well as biohyomean, every of them fertilized solely or in combinations. The stimulatory effect of (FYM) as a result of improving physical, chemical, biological, texture and drainage of the soil which in turn, positively influence the growth (Salem, 1986). The increases in vegetative growth characters owing to yeast may be due to its content of tryptophan (Moor, 1979). Increments resulted from bio-fertilized treatments may be due to the supplements of bio-fertilizers to plants with nitrogen which is considered a precursor of protein synthesis and a vascular osmoticum. The osmotic compounds in the cell sap are important in order to allow cell enlargement. These results are supported by Hamza *et al*. (2007) on *Plantago ovate*, Forsk plants and Massoud (2007) on marjoram plants. On other hand, Kononova (1966) and Fortun*et al*. (1989) performed that humic acids are known to posses many beneficial agricultural properties, they participate actively in the decomposition of organic matter, improve soil texture, enhancement of photosynthesis which resulted in greater plant growth. The results of this study are in harmony of those obtained with Massoud *et al*. (2010) on marjoram plants.

The combination treatments showed also that there were many significant differences in plant growth characters in between and in comparison with control treatment for both cuts during the two seasons.

Table 6. Effect of organic fertilization, bio fertilization and their combinations on Plant height (cm) of thymeplants during two successive seasons 2016 / 2017 and 2017 / 2018 for two cuts

Treatment	Plant height (cm)			
	Season 2017		Season 2018	
	First cut	Second cut	First cut	Second cut
Control recommended dose of NPK	32.66	34.00	31.33	30.66
FYM 20m^3/fed	34.66	35.33	33.00	34.33
Goats20m^3/fed	34.66	33.66	32.66	33.00
Compst20m^3/fed	36.00	36.33	32.66	30.66
Microbien+potassumag +yeast	32.66	35.66	29.66	29.33
Microbien+ potassumag + yeast + FYM	38.00	38.33	34.66	34.33
Microbien + potassumag + yeast + Goats	37.66	38.00	38.66	36.66
Microbien + potassumag + yeast + Compost	38.33	39.33	37.00	35.33
Microbien + potassumag + yeast + NPK natural	39.00	39.33	37.66	36.66
Microbien + potassumag + yeast + NPK natural + FYM	39.66	41.33	38.33	36.33
Microbien + potassumag + yeast + NPK natural + Goats	39.33	40.33	40.66	40.00
Microbien + potassumag + yeast + NPK natural + Compost	38.66	41.33	44.33	37.66
Microbien + potassumag + yeast +Biohyomean	42.66	43.33	38.66	37.33
Microbien + potassumag + yeast + Biohyomean+ FYM	34.66	44.33	42.00	41.66
Microbien + potassumag + yeast + Biohyomean + Goats	45.66	45.66	41.22	41.00
Microbien + potassumag + yeast + Biohyomean +Compost	47.33	46.66	41.33	41.33
LSD 5 %	1.87	2.10	4.72	2.54

Table 7. Effect of organic fertilization, bio fertilization and their combinations on number of branches/plant of thyme plants during two successive seasons2016 / 2017 and 2017 / 2018 for two cuts

Treatment	number of branches			
	Season 2017		Season 2018	
	First cut	Secondcut	First cut	Second cut
Control recommended dose of NPK	24.00	24.00	24.33	25.00
FYM 20m^3/fed	24.66	23.66	24.66	25.66
Goats20m^3/fed	24.00	25.00	22.66	22.33
Compst20m^3/fed	24.33	24.66	23.00	24.00
Microbien + potassumag + yeast	24.33	25.00	25.00	25.00
Microbien + potassumag + yeast + FYM	25.33	26.00	25.66	25.66
Microbien + potassumag + yeast + Goats	25.66	26.00	26.00	24.66
Microbien + potassumag + yeast + Compost	25.33	25.66	25.66	24.66
Microbien + potassumag + yeast + NPK natural	26.00	25.33	25.66	26.00
Microbien + potassumag + yeast + NPK natural + FYM	26.33	26.33	25.66	26.00
Microbien + potassumag + yeast + NPK natural + Goats	26.66	27.00	26.66	27.33
Microbien + potassumag + yeast + NPK natural + Compost	27.33	27.66	27.00	27.00
Microbien + potassumag + yeast + Biohyomean	27.33	27.00	27.66	27.00
Microbien + potassumag + yeast + Biohyomean + FYM	27.66	28.00	28.00	28.00
Microbien + potassumag + yeast + Biohyomean + Goats	30.00	30.66	29.66	30.66
Microbien + potassumag + yeast + Biohyomean +Compost	30.33	31.00	32.00	31.33
LSD 5 %	2.12	2.05	2.33	2.07

Table 8.Herb fresh weight/plant (g) of thyme as affected by different sources of organicfertilization, bio-fertilization and their combinations during 2016 / 2017 and 2017 / 2018 seasons for two cuts

Treatment	Fresh weight			
	Season 2017		Season 2018	
	First cut	Second cut	First cut	Second cut
Control recommended dose of NPK	433.33	375.33	388.00	392.33
FYM 20m^3/fed	353.33	405.33	345.00	407.66
Goats20m^3/fed	426.66	391.66	365.66	377.33
Compst20m^3/fed	450.00	448.33	391.66	487.00
Microbien + potassumag + yeast	408.33	404.33	385.33	383.00
Microbien + potassumag + yeast + FYM	452.66	459.33	417.00	420.00
Microbien + potassumag + yeast + Goats	453.66	444.00	440.33	409.00
Microbien + potassumag + yeast + Compost	487.00	498.00	442.66	442.66
Microbien + potassumag + yeast + NPK natural	491.66	517.33	429.33	414.66
Microbien + potassumag + yeast + NPK natural + FYM	518.66	525.00	483.66	500.00
Microbien + potassumag + yeast + NPK natural + Goats	498.00	528.66	507.33	523.00
Microbien + potassumag + yeast + NPK natural + Compost	532.00	540.66	518.33	523.33
Microbien + potassumag + yeast + Biohyomean	628.00	606.00	508.66	508.33
Microbien + potassumag + yeast + Biohyomean + FYM	625.00	647.66	537.00	554.33
Microbien + potassumag + yeast + Biohyomean + Goats	664.00	662.33	590.33	622.33
Microbien + potassumag + yeast + Biohyomean +Compost	699.66	712.66	643.66	722.66
LSD 5 %	42.39	42.93	54.07	38.62

Table 9.Herb dry weight/plant (g) of thyme as affected by different sources of organic fertilization, bio-fertilization and their combinations during 2017 and 2018 seasons for two cuts.

Treatment	Dry weight			
	Season 2017		Season 2018	
	First cut	Second cut	First cut	Second cut
Control recommended dose of NPK	123.72	120.35	125.52	123.15
FYM 20m^3/fed	157.83	163.57	131.58	133.24
Goats20m^3/fed	135.31	138.49	137.64	137.54
Compst20m^3/fed	140.33	143.42	149.21	148.85
Microbien + potassumag + yeast	144.22	143.78	153.43	155.22
Microbien + potassumag + yeast + FYM	148.86	147.66	154.25	153.41
Microbien + potassumag + yeast + Goats	150.45	149.86	153.35	151.65
Microbien + potassumag + yeast + Compost	147.83	149.73	155.84	156.99
Microbien + potassumag + yeast + NPK natural	148.87	147.14	152.99	154.28
Microbien + potassumag + yeast + NPK natural + FYM	149.20	149.71	155.40	157.20
Microbien + potassumag + yeast + NPK natural + Goats	154.90	156.18	156.91	160.49
Microbien + potassumag + yeast + NPK natural + Compost	160.86	157.90	163.39	162.29
Microbien + potassumag + yeast + Biohyomean	191.81	196.43	173.98	173.00
Microbien + potassumag + yeast + Biohyomean + FYM	205.06	205.35	193.70	195.91
Microbien + potassumag + yeast + Biohyomean + Goats	207.11	201.73	195.81	194.14
Microbien + potassumag + yeast + Biohyomean +Compost	209.54	211.12	204.62	212.66
LSD 5 %	10.52	10.18	7.84	8.09

2- Essential oil productivity:

The essential oil percentage and content in the dried leaves of thyme plants varied from one treatment to other (Tables10 and 11). The highest increasing in oil percentage were obtained from fertilized plants with compost 20 m^3/fed. combined with (microbien + potassumag + yeast +

biohyomean) which were (15.33, 15.33 and 15.33, 15.33 %) for two cuts during the two seasons, respectively, whereas same treatment achieved the most increments of essential oil content cc/plant in the two cuts for two seasons and the differences were significant in comparison with those obtained by control plants, (32.12, 32.41 cc/plant in the first season and 31.41, 32.56 cc/plant in the second season).

Similar results of positive effect of both FYM or bio-fertilizers (phosphorien and microbien) on the essential oil productivity were obtained by Shalan et al. (2001) on chamomile, Massoud (2007) on marjoram.

These increases might be attributed to the enhancing effect of organic and bio-fertilizers on vegetative growth, in terms of fresh yield besides increasing uptake of nutrients especially phosphorus element which linked by phosphate bounds which is adenosine tri-phosphate (ATP). In this form, the energy can be undergoing processes such activation uptake and the synthesis of various organic compounds such as essential oil, (EL-Ghadban et al. 2003)

Table 10.Essential oil percentage of thyme as affected by different sources of organic fertilization, bio-fertilization and their combinations during 2016 / 2017 and 2017 / 2018 seasons for two cuts

Treatment	Essential oil percentage			
	Season 2017		Season 2018	
	First cut	Second cut	First cut	Second cut
Control recommended dose of NPK	4.666	3.333	4.666	3.333
FYM 20m^3/fed	5.333	4.666	5.333	4.666
Goats20m^3/fed	6.000	4.666	6.000	4.666
Compst20m^3/fed	6.666	7.333	6.666	7.333
Microbien + potassumag + yeast	6.000	5.333	6.000	5.333
Microbien + potassumag + yeast + FYM	7.333	8.000	7.333	8.000
Microbien + potassumag + yeast + Goats	8.666	8.666	8.666	8.666
Microbien + potassumag + yeast + Compost	8.000	8.666	8.000	8.666
Microbien + potassumag + yeast + NPK natural	8.666	9.333	8.666	9.333
Microbien + potassumag + yeast + NPK natural + FYM	8.666	8.666	8.666	8.666
Microbien + potassumag + yeast + NPK natural + Goats	9.333	10.666	9.333	10.666
Microbien + potassumag + yeast + NPK natural + Compost	10.666	11.333	10.666	11.333
Microbien + potassumag + yeast + Biohyomean	11.333	11.333	11.333	11.333
Microbien + potassumag + yeast + Biohyomean + FYM	12.666	12.666	12.666	12.666
Microbien + potassumag + yeast + Biohyomean + Goats	14.000	14.000	14.000	14.000
Microbien + potassumag + yeast + Biohyomean +Compost	15.333	15.333	15.333	15.333
LSD 5 %	2.76	2.30	2.76	2.30

Table 11.Oil content of thyme cc/plantas affected by different sources of organic fertilization, bio-fertilization and their combinations during 2016 / 2017 and 2017 / 2018 seasons for two cuts

Treatment	Oil content			
	Season 2017		Season 2018	
	First cut	Second cut	First cut	Second cut
Control recommended dose of NPK	5.750	4.080	5.900	4.180
FYM 20m^3/fed	8.4000	7.526	7.033	6.223
Goats20m^3/fed	8.093	6.466	8.290	6.370
Compst20m^3/fed	9.363	10.516	9.886	10.903
Microbien + potassumag + yeast	8.673	7.743	9.170	8.290
Microbien + potassumag + yeast + FYM	10.933	11.813	11.333	12.273
Microbien + potassumag + yeast + Goats	13.200	12.986	11.273	13.133
Microbien + potassumag + yeast + Compost	11.450	13.010	11.166	13.620
Microbien + potassumag + yeast + NPK natural	12.876	13.780	13.210	14.456
Microbien + potassumag + yeast + NPK natural + FYM	12.993	12.980	13.506	13.636
Microbien + potassumag + yeast + NPK natural + Goats	14.440	16.646	14.636	17.173
Microbien + potassumag + yeast + NPK natural + Compost	17.133	17.906	17.430	18.893
Microbien + potassumag + yeast + Biohyomean	21.750	22.306	19.730	20.216
Microbien + potassumag + yeast + Biohyomean + FYM	27.366	25.980	24.533	24.850
Microbien + potassumag + yeast + Biohyomean + Goats	23.750	28.206	27.386	28.563
Microbien + potassumag + yeast + Biohyomean +Compost	32.123	32.410	31.410	32.560
LSD 5 %	4.53	4.09	4.35	4.36

3- Chromatographic analysis of essential oil components :

Data showed in Table (12) as well as in Figure (1) identified (10) compounds separated from thyme herb oil samples produced from plants fertilized with organic fertilization or inoculated with potassumag, microbien, yeast, biohyomean and their combinations. The obtained chromatograms revealed the presence of (22) components from which (10) components were identified by the retention times obtained from pure authentic substances. The (10) main components are presented in Table (12).

It is evident from these results that the compound of thymol recorded the highest values (48.52%) when the plants treated with 20 m^3/fed. compost combination with microbien + potassumag + yeast + NPK natural, whereas the lowest value (23.37%) was recorded in plants of the treatment chemical NPK with FYM 20 m^3/fed. The same data showed also that the plants of the treatment microbien plus potassumag plus yeast and NPK natural gave the highest value (35.70%) in comparison with control and other treatments. It is clear that cooperation between both of bio-fertilizers and organic manure activated biosynthesis reactions of thyme plants resulting the highest value of main components.

Table 12. GLC (%) of thyme plants oil as affected by different sources of organic fertilization, bio-fertilization and their combinationsfor the second cut during the second season.

Main components Treatments	α-pinene	camphene	β-pinene	Limonene	1,8 cineole	p-cymene	Thymol	Linalool	Carvacrol	Borneol
Control recommended dose of NPK	0.97	0.98	0.57	1.75	2.98	32.89	35.80	0.55	3.14	2.10
FYM 20m^3/fed	0.73	7.96	3.06	2.47	6.69	14.85	23.37	13.74	10.08	4.03
Goats20m^3/fed	0.85	1.96	0.43	2.04	4.96	28.97	40.90	3.40	4.96	2.30
Compst20m^3/fed	0.89	2.05	0.19	0.26	7.02	33.60	42.81	0.83	2.69	2.08
Microbien + potassumag + yeast	0.73	2.20	0.71	1.40	7.15	33.29	42.20	2.22	4.97	2.44
Microbien + potassumag + yeast + FYM	0.67	2.13	0.64	0.75	6.69	30.24	44.30	3.81	4.72	2.30
Microbien + potassumag + yeast + Goats	0.76	2.26	0.18	0.78	6.67	28.45	44.41	2.75	4.33	2.17
Microbien + potassumag + yeast + Compost	1.14	0.21	0.04	0.70	7.51	31.36	40.77	1.61	4.06	2.37
Microbien + potassumag + yeast + NPK natural	1.36	0.41	1.09	1.03	5.54	35.70	36.83	2.02	2.60	5.01
Microbien + potassumag + yeast + NPK natural + FYM	0.82	0.23	2.25	0.50	1.05	27.50	45.62	1.21	3.55	1.66
Microbien + potassumag + yeast + NPK natural + Goats	0.85	2.03	0.17	0.55	7.13	28.23	45.01	1.09	3.58	2.46
Microbien + potassumag + yeast + NPK natural + Compost	0.28	0.42	0.67	1.73	3.70	24.22	48.52	0.98	4.00	2.36
Microbien + potassumag + yeast + Biohyomean	0.68	1.76	0.16	0.16	5.92	34.81	41.17	3.50	4.19	2.15
Microbien + potassumag + yeast + Biohyomean + FYM	0.80	1.97	0.31	0.79	7.92	28.84	41.34	1.33	4.92	2.61
Microbien + potassumag + yeast + Biohyomean + Goats	0.76	2.19	0.21	0.77	7.29	29.53	46.01	0.94	3.22	2.24
Microbien + potassumag + yeast + Biohyomean +Compost	4.32	5.08	0.81	1.23	5.77	22.71	27.97	2.47	21.80	2.71

Farmyard manure = FYM, potassumage = Po. , Microbein = Mi. , yeast =ye. , biohyomean = Bi. , Feddan = Fed.

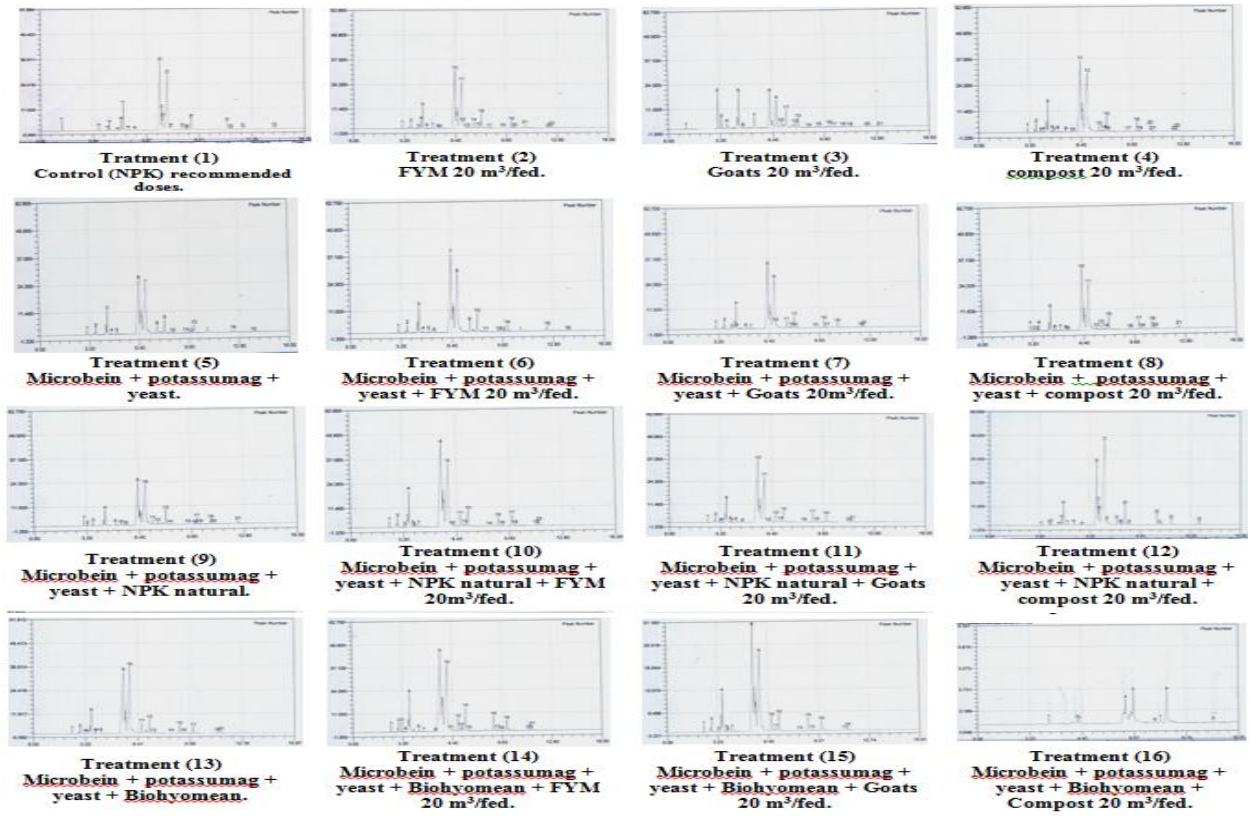

Figure 1. Effect of treatment by different sources of organic fertilization, bio-fertilization also their combinations during the last cut in the last season 2017 - 2018 on the essential oil components (%) of thyme plants.
(1) α-pinene / (2) camphene / (3) β-pinene / (4) Limonene / (5) 1,8 cineole / (6) p-thymene / (7) thymol / (8) linalool / (9) carvacrol / (10) borneol.

5- Chemical analysis :

Data of the effect of organic, bio-fertilizers and their combinations on pigments content and minerals percentages in leaves of thyme plants in two cuts during the two seasons are illustrated in Tables (13, 14, 15, 16, 17, 18 and 19) and all treatments cleared significant differences between them in comparison with control.

The obtained data revealed that the fertilized plants with different sources of organic fertilization at rate of 20 m^3/fed. achieved better increments concerning all measurements, but the highest rate of them compost at rate of 20 m^3/fed. was the best over remain rates of organic fertilization, solely compared with control, while the compost 20 m^3/fed. in combination with micronien + potassumag + yeast + NPK natural resulted the highest values of chlorophyll A content, phosphorus and potassium percentages, while the combinations of compost20 m^3/fed. + microbien + potassumag + yeast + biohyomean caused the best results of chlorophyll B and carotenoids in leaves compared with control plants and other treatments in this respect for both cuts in the two seasons.

These results are in harmony with those obtained by Abd-EL-Fattah and Sorial (2000) on squash, Massoud (2006) on *Salvia officinalis*.

Table 13.Chlorophyll (A) (mg) in the fresh leaves of thyme plants during two successive seasons 2016 / 2017 and 2017 / 2018 for two cuts

Treatment	Chlopophyll (A) (mg/gm)			
	Season 2017		Season 2018	
	First cut	Second cut	First cut	Second cut
Control recommended dose of NPK	1.010	0.780	1.160	0.800
FYM 20m^3/fed	1.170	1.210	1.174	1.216
Goats20m^3/fed	1.231	1.271	1.239	1.239
Compst20m^3/fed	1.255	1.297	1.267	1.299
Microbien + potassumag + yeast	1.171	1.175	1.176	1.181
Microbien + potassumag + yeast + FYM	1.250	1.260	1.258	1.265
Microbien + potassumag + yeast + Goats	1.295	1.291	1.291	1.291
Microbien + potassumag + yeast + Compost	1.310	1.356	1.313	1.300
Microbien + potassumag + yeast + NPK natural	1.326	1.321	1.330	1.328
Microbien + potassumag + yeast + NPK natural + FYM	1.460	1.463	1.465	1.460
Microbien + potassumag + yeast + NPK natural + Goats	1.477	1.479	1.478	1.483
Microbien + potassumag + yeast + NPK natural + Compost	1.497	1.490	1.493	1.498
Microbien + potassumag + yeast + Biohyomean	1.352	1.357	1.356	1.360
Microbien + potassumag + yeast + Biohyomean + FYM	1.359	1.365	1.360	1.370
Microbien + potassumag + yeast + Biohyomean + Goats	1.366	1.378	1.366	1.385
Microbien + potassumag + yeast + Biohyomean +Compost	1.381	1.392	1.375	1.395
LSD 5 %	0.115	0.073	0.065	0.076

Table 14.Chlorophyll (B) (mg) in the fresh leaves of thyme plants during two successive seasons 2016 / 2017 and 2017 / 2018 for two cuts

Treatment	Chlorophyll (B) (mg/gm)			
	Season 2017		Season 2018	
	First cut	Second cut	First cut	Second cut
Control recommended dose of NPK	0.410	0.440	0.421	0.456
FYM 20m^3/fed	0.548	0.593	0.499	0.561
Goats20m^3/fed	0.563	0.599	0.591	0.576
Compst20m^3/fed	0.499	0.605	0.598	0.610
Microbien + potassumag + yeast	0.545	0.580	0.563	0.564
Microbien + potassumag + yeast + FYM	0.572	0.610	0.601	0.625
Microbien + potassumag + yeast + Goats	0.591	0.630	0.606	0.642
Microbien + potassumag + yeast + Compost	0.597	0.642	0.620	0.651
Microbien + potassumag + yeast + NPK natural	0.620	0.641	0.684	0.646
Microbien + potassumag + yeast + NPK natural + FYM	0.710	0.748	0.708	0.752
Microbien + potassumag + yeast + NPK natural + Goats	0.763	0.821	0.767	0.821
Microbien + potassumag + yeast + NPK natural + Compost	0.803	0.799	0.821	0.871
Microbien + potassumag + yeast + Biohyomean	0.632	0.652	0.690	0.670
Microbien + potassumag + yeast + Biohyomean + FYM	0.720	0.756	0.720	0.765
Microbien + potassumag + yeast + Biohyomean + Goats	0.772	0.823	0.781	0.836
Microbien + potassumag + yeast + Biohyomean +Compost	0.811	0.878	0.831	0.886
LSD 5 %	0.046	0.036	0.036	0.064

Table 15.Carotenoids content (mg) in the fresh leaves of thyme plants during two successive seasons 2016 / 2017 and 2017 / 2018 for two cuts

Treatment	Carotenoids content (mg/gm)			
	Season 2017		Season 2018	
	First cut	Second cut	First cut	Second cut
Control recommended dose of NPK	0.491	0.495	0.530	0.540
FYM 20m^3/fed	0.670	0.675	0.691	0.695
Goats20m^3/fed	0.739	0.748	0.720	0.731
Compst20m^3/fed	0.757	0.781	0.763	0.787
Microbien + potassumag + yeast	0.703	0.710	0.715	0.718
Microbien + potassumag + yeast + FYM	0.778	0.790	0.798	0.809
Microbien + potassumag + yeast + Goats	0.794	0.799	0.811	0.816
Microbien + potassumag + yeast + Compost	0.820	0.825	0.829	0.835
Microbien + potassumag + yeast + NPK natural	0.830	0.835	0.836	0.840
Microbien + potassumag + yeast + NPK natural + FYM	0.878	0.823	0.889	0.856
Microbien + potassumag + yeast + NPK natural + Goats	0.892	0.894	0.899	0.868
Microbien + potassumag + yeast + NPK natural + Compost	0.901	0.912	0.910	0.912
Microbien + potassumag + yeast + Biohyomean	0.870	0.876	0.875	0.885
Microbien + potassumag + yeast + Biohyomean + FYM	0.882	0.890	0.897	0.899
Microbien + potassumag + yeast + Biohyomean + Goats	0.898	0.901	0.903	0.899
Microbien + potassumag + yeast + Biohyomean +Compost	0.910	0.929	0.920	0.930
LSD 5 %	0.038	0.037	0.048	0.058

Table 16.Effect of organic fertilization, bio-fertilization and their combinations on total carbohydrate percentage in the dried herb (g/100 g dry weight) of thyme plants during two successive seasons 2016 / 2017 and 2017 / 2018 for two cuts

Treatment	Total carbohydrate percentage			
	Season 2017		Season 2018	
	First cut	Second cut	First cut	Second cut
Control recommended dose of NPK	15.85	15.88	15.91	15.98
FYM 20m^3/fed	16.34	16.47	16.39	16.55
Goats20m^3/fed	16.64	16.67	16.60	16.72
Compst20m^3/fed	16.70	16.75	16.72	16.80
Microbien + potassumag + yeast	15.89	15.93	15.96	16.02
Microbien + potassumag + yeast + FYM	16.40	16.52	16.46	16.59
Microbien + potassumag + yeast + Goats	16.70	16.71	16.66	16.81
Microbien + potassumag + yeast + Compost	16.75	16.83	16.78	16.85
Microbien + potassumag + yeast + NPK natural	15.93	15.98	16.00	16.09
Microbien + potassumag + yeast + NPK natural + FYM	16.51	16.57	16.53	16.64
Microbien + potassumag + yeast + NPK natural + Goats	16.74	16.78	16.72	16.85
Microbien + potassumag + yeast + NPK natural + Compost	16.82	16.87	16.83	16.93
Microbien + potassumag + yeast + Biohyomean	15.99	16.04	16.07	16.14
Microbien + potassumag + yeast + Biohyomean + FYM	16.58	16.64	16.67	16.70
Microbien + potassumag + yeast + Biohyomean + Goats	16.80	16.84	16.78	16.91
Microbien + potassumag + yeast + Biohyomean +Compost	16.92	16.99	16.91	16.99
LSD 5 %	0.610	0.630	0.430	0.432

Table 17.Effect of organic fertilization, bio-fertilization and their combinations on nitrogen percentage in dried leaves of thyme plants duringtwo successive seasons 2016 / 2017 and 2017 / 2018 for two cuts

Treatment	Nitrogen percentage			
	Season 2017		Season 2018	
	First cut	Second cut	First cut	Second cut
Control recommended dose of NPK	1.20	1.32	1.25	1.38
FYM 20m^3/fed	1.55	1.63	1.60	1.89
Goats20m^3/fed	1.71	1.81	1.78	1.88
Compst20m^3/fed	1.93	2.05	2.19	2.11
Microbien + potassumag + yeast	1.60	1.81	1.60	1.70
Microbien + potassumag + yeast + FYM	1.77	1.89	1.90	1.83
Microbien + potassumag + yeast + Goats	2.88	2.97	3.00	3.08
Microbien + potassumag + yeast + Compost	2.96	3.10	3.11	3.17
Microbien + potassumag + yeast + NPK natural	2.64	2.30	2.68	2.60
Microbien + potassumag + yeast + NPK natural + FYM	2.76	2.80	2.79	2.86
Microbien + potassumag + yeast + NPK natural + Goats	2.85	2.90	2.91	2.96
Microbien + potassumag + yeast + NPK natural + Compost	3.06	3.15	3.19	3.31
Microbien + potassumag + yeast + Biohyomean	2.41	2.16	2.35	2.41
Microbien + potassumag + yeast + Biohyomean + FYM	2.46	2.27	2.43	2.45
Microbien + potassumag + yeast + Biohyomean + Goats	2.53	2.40	2.55	2.60
Microbien + potassumag + yeast + Biohyomean +Compost	2.59	2.63	2.66	2.68
LSD 5 %	0.099	0.096	0.036	0.065

Table 18.Effect of organic fertilization, bio-fertilization and their combinations onphosphorus percentage in dried leaves of thyme plants duringtwo successive seasons 2016 / 2017 and 2017 / 2018 for two cuts

Treatment	Phosphorus percentage			
	Season 2017		Season 2018	
	First cut	Second cut	First cut	Second cut
Control recommended dose of NPK	0.480	0.450	0.540	0.471
FYM 20m^3/fed	0.511	0.501	0.550	0.531
Goats20m^3/fed	0.550	0.539	0.590	0.569
Compst20m^3/fed	0.579	0.580	0.630	0.600
Microbien + potassumag + yeast	1.450	1.412	1.487	1.456
Microbien + potassumag + yeast + FYM	1.480	1.460	1.533	1.529
Microbien + potassumag + yeast + Goats	1.495	1.486	1.580	1.558
Microbien + potassumag + yeast + Compost	1.500	1.496	1.594	1.570
Microbien + potassumag + yeast + NPK natural	1.500	1.521	1.589	1.611
Microbien + potassumag + yeast + NPK natural + FYM	1.751	1.774	1.781	1.768
Microbien + potassumag + yeast + NPK natural + Goats	1.780	1.788	1.796	1.804
Microbien + potassumag + yeast + NPK natural + Compost	1.792	1.796	1.799	1.890
Microbien + potassumag + yeast + Biohyomean	1.491	1.482	1.590	1.632
Microbien + potassumag + yeast + Biohyomean + FYM	1.745	1.751	1.775	1.766
Microbien + potassumag + yeast + Biohyomean + Goats	1.776	1.784	1.783	1.784
Microbien + potassumag + yeast + Biohyomean +Compost	1.780	1.792	1.701	1.793
LSD 5 %	0.098	0.045	0.039	0.065

Table 19.Effect of organic fertilization, bio-fertilization and their combinations on Potassium percentage in dried leaves of thyme plants during two successive seasons 2016 / 2017 and 2017 / 2018 for two cuts

Treatment	Potassium percentage			
	Season 2017		Season 2018	
	First cut	Second cut	First cut	Second cut
Control recommended dose of NPK	2.740	2.930	2.950	3.110
FYM 20m^3/fed	2.966	3.137	3.163	3.210
Goats20m^3/fed	3.142	3.190	3.179	3.271
Compst20m^3/fed	3.157	3.198	3.190	3.298
Microbien + potassumag + yeast	2.900	3.079	3.057	3.141
Microbien + potassumag + yeast + FYM	3.465	3.600	3.551	3.690
Microbien + potassumag + yeast + Goats	3.614	3.629	3.565	3.701
Microbien + potassumag + yeast + Compost	3.624	3.643	3.577	3.747
Microbien + potassumag + yeast + NPK natural	3.701	3.664	3.553	3.874
Microbien + potassumag + yeast + NPK natural + FYM	3.872	3.910	3.932	3.960
Microbien + potassumag + yeast + NPK natural + Goats	3.901	3.931	3.940	3.970
Microbien + potassumag + yeast + NPK natural + Compost	3.939	3.944	3.957	3.956
Microbien + potassumag + yeast + Biohyomean	3.658	3.645	3.557	3.861
Microbien + potassumag + yeast + Biohyomean + FYM	3.875	3.890	3.905	3.900
Microbien + potassumag + yeast + Biohyomean + Goats	3.910	3.910	3.932	3.961
Microbien + potassumag + yeast + Biohyomean +Compost	3.932	3.922	3.945	3.985
LSD 5 %	0.086	0.039	0.059	0.049

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تأثير التسميد العضوي و الحيوي على النمو الخضري و المحصول في نبات الزعتر

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أجريت هذه الدراسة خلال موسمين ٢٠١٧ ، ٢٠١٨ فى مزرعة جنيفة – الفوج الزراعى للجيش الثالث الميدانى – السويس –لدراسة تأثير الاسمدة العضوية الفارم يارد وسماد الاغنام و الكومبوست وبعض الأسمدة الحيوية مثل الخميرة الجافة والبوتاسيوماج والميكروبين و البيوهيومين و NPKالطبيعي والخليط بين هذه العناصر على النموالخضري وإنتاج الزيت الطيار ومكوناته فى نبات الزعتر.تم معاملة نباتات الزعترمصادر السماد العضوى المختلفة الفارم يارد و سماد الاغنام و الكومبوست بمعدل ٢٠ م٣/الفدان و كذلك تم معاملة النباتات بالاسمدة الحيوية المختلفة بالتركيزات المقررة منفردة و مخلوطة مع الأسمدة العضوية فى موسمى الزراعة المتتابعين كما سمدت نباتات الكنترول و كذلك كل المعاملات عدا التى استقبلت NPK الطبيعي بالجرعات الموصى بها من السماد الكيماوى لوزارة الزراعة بجمهورية مصر العربية.وأظهرت النتائج تحسن وتفوق الصفات الخضرية المختلفة لنباتات الزعتر عن نباتات الكنترول مثل إرتفاع النبات وعدد الأفرع الجانبية والوزن الطازج والجاف للنبات والنسبة المئوية للزيت في النبات ومكوناته نتيجة لكل المعاملات وكانت أفضل المعاملات هي السماد الكيماوي بالجرعات الموصي بها من وزارة الزراعة مع الكومبوست ٢٠ م٣/الفدان متداخلا مع الميكروبين + البوتاسيوماج + الخميرة + البيوهيومين على الصفات المختلفة تحت الدراسة وكانت الزيادات جميعها معنوية.أظهر التحليل الكروماتوجرافى للزيت أنه يحتوى على عدد (٢٢) من المكونات الرئيسية تم التعرف على عدد (١٠) مركبات منها وكان مركب الثيمول هو الرئيسى على الإطلاق وقد أدت المعاملات المذكورة كلها إلى زيادات واضحة عن الكنترول.تبعا لنتائج هذا البحث يمكن التوصية بالتسميد بالكومبوست بمعدل ٢٠ م٣/الفدان بالإضافةللأسمدة الحيوية (الميكروبين + البوتاسيوماج + الخميرة + البيوهيومين) بالجرعات المقررة مع السماد الكيماويNPK الموصى به للحصول على محصول وافر من عشب و زيت الزعتر ذو مواصفات أفضل.