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Effect of Organic Fertilization on Yield and Active Constituents of *Thymus Vulgaris* L. under North Sinai Conditions

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Abstract: In two successive seasons 2003/2004 and 2004/2005 the present work was carried out at El-Shiekh Zowaied Research Station, Desert Research Center, North Sinai Governorate, Egypt in sandy soil to study the effect of some organic fertilizers (Compost, Chicken and Sheep manures) on both growth and yields of *Thymus vulgaris* L. Results revealed that ($20m^3$ compost combined with $10m^3$ chicken or sheep manure) were superior in most cases of growth characters and yields. Moreover, they are leading in oil percentage and oil yield. The main components of thyme essential oil were thymol, limonene and methyl chavicol. The highest value for oxygenated compounds especially thymol was obtained from $30m^3$ Compost combined with $10m^3$ Sheep manure treatment (82.84%) compared to the control (42.69%). Also, both treatments gave the highest profits per feddan (4655.95 and 538.67 LE/Feddan respectively).

Key words: Thyme – *Thymus vulgaris* L. – Organic farming – Compost – Chicken manure – Sheep manure – essential oil – Thymol – Sandy soil.

INTRODUCTION

Since long time Ancient Egyptians used thyme in embalming. The ancient Greeks used it in their baths and burnt it as incense in their temples, believing that thyme was a source of courage. In the European middle Ages, the herb was placed beneath pillows to aid sleep and ward off nightmares [1].Thyme is the common name of *Thymus vulgaris* L. It is belongs to Family Lamiaceae (Labiateae) or mint family. Thyme plant is a gray dwarf perennial shrub rarely exceeds 40 cm height. It is native to Europe and the Mediterranean region. The stems are quadrangular erect, numerous, hard, branched, and usually from 20 to 30 cm high. Leaves are small oval, rolled margin and downy under surface, narrow and elliptical, greenish-grey in color, reflexed at the margins, and set in pairs upon very small foot-stalks. The flowers terminate the branches in whorls, small white or pink and arranged in a corymbs. The seeds are roundish and very small they retain their germinating power for three years [2,3]. The cultivated area in Egypt is about 30–50 feddans according to the Ministry of Agriculture. It has many uses, some of them were recorded as a folklore uses such culinary [4,5]. Turkish or in Arabic kitchen cooking thyme have many uses such as an accompaniment to grilled lamb or to make Dokka (ground thyme, sesame, somak and nuts), Also it has multiple uses in food industry and in kitchicken; i.e., spice, poultry soups, sausages[6,7,8,9]. Thyme is considered as a spice due to terpenic compounds isolated from its leaves volatile oil [10].

Thyme also well know as medicinal herb, it have many uses such carminative, stimulant, toothpastes and antifungal [11,12,13,14,15,16,17]. Antispasmodic, diaphoretic, diuretic, antioxidant, tonic, rheumatism and employed in the treatment of cancer [18] Antiviral activities [19,20]. Thyme oil has been reported to be nonirritating and non-sensitizing to human skin [21]. Moreover, the oil constituents themselves have medicinal effects. The essential oil of common thyme (*Thymus vulgaris* L.) is made up of 20-54% thymol. Thymol, an antiseptic, is the main active ingredient in Listerine mouthwash.[22] Before the advent of modern antibiotics, it was used to medicate bandages [23].

Thyme also, have both antiviral and antimicrobial effects [24,25,56,27]. Also it has multiple uses in pesticide as nematicide and insecticide [28].

The pervious uses can be explain that, thyme is one of the important plants which need more researches specially in the new reclaimed lands such North Sinai which has a favorable environmental condition for producing it. Moreover, studying the agricultural practices and their effect on the herbage and the volatile oil yield must take consideration.

Recently in Egypt large areas of newly reclaimed and desert lands have been cultivated with medicinal and aromatic plants during the last few years [29]. The intensive farming on Nile valley soils in Egypt and agriculture practices have forced the farmers to use more fertilizers to get the high benefit. The intensive use of manufactured nitrogen fertilizers increased the crops productivity but with low quality which is not acceptable for export [30,31].

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Concern with the modern direction to reduce using chemicals and follow organic or biodynamic techniques in agriculture to mitigate the pollution harmful effects on man health, this work has been done. The aim of this work is to study the effect of different organic fertilizers from different resources (compost, chicken and sheep manures) on some growth characters and both essential oil production and constituents as well as some chemical composition of thyme plants (nitrogen, phosphorus, potassium and carbohydrates contents).

MATERIALS AND METHODS

The present work was conducted in the Experimental scientific Station of North Sinai, El-Sheikh Zwaied, Egypt during two successive seasons of 2003/2004 – 2004/2005. Seeds of thyme plants were kindly provided from Sekem Company of medicinal and aromatic plants. It were sown in a well prepared soil in nursery in 15th of September for both seasons, seedlings about 12 – 15 cm length were transplanted at the 1st of November in the experimental plots. The distance between seedlings was 30cm and 50 cm between lines. Nine fertilization treatments were done as follows:

1. Control.
2. $10m^3$ chicken manure.
3. $10m^3$ sheep manure.
4. $20m^3$ compost.
5. $20m^3$ compost + $10m^3$ chicken manure.
6. $20m^3$ compost + $10m^3$ sheep manure.
7. $30m^3$ compost.
8. $30m^3$ compost + $10m^3$ chicken manure.
9. $30m^3$ compost + $10m^3$ sheep manure.

Data were recorded on some growth characters (plant height, and both fresh and dry herb weights per plant and per feddan) and essential oil percentage, oil yield per plant and per feddan was determined in the fresh herb, NPK and carbohydrate. Essential oil constituents were fractionated and identified using Gas chromatography technique (GC) analyses for the fresh herb using the column (HP-5 capillary 30m × 0.320mm × 0.5 µm film thicknesses) in the GC HP5890 Series Gas Chromatograph. The injection conditions were as follows: Nitrogen was used as the carrier gas with a flow rate of 2.00 ml/min. Air and hydrogen flow rates were 330 and 30 ml/min, respectively. Temperature program was as follows: Injection temperature at 50ºC was held for 5 min, increased from 50º to 200ºC at a rate of 5ºC/min. The maximum temperature was maintained for a further 10 min before cooling. A set of standard compounds representing different chemical groups with a stated purity of 99% by GLC, was obtained from Drugago Company (Holzmiden, Germany).

Nitrogen content was determined according to [32], potassium content [33], phosphorus content [34] and carbohydrate content according to [35]. Oil percentage in the fresh herb was determined according to [36].

Complete randomized block design was used, with three replicates for each treatment and mean comparisons were made using Duncan's Multiple Range test at 5% significant level according to [37].

Harvesting was carried out in two cuts every season. The first cut was done on 15th May (after 90 days from transplanting date) and the second cut was done on 15th August (after 180 days from transplanting date) by cutting the vegetative parts of plants (5 cm above the soil surface) leaving 2 branches for re growth.

Table A: The chemical and physical properties of compost (El Khalil Compost):

Weight of m^3 (kg)	Wet. (%)	pH	EC	Total N (%)	O.M. (%)	Total carbon (%)	Ash	C/N ratio	Total P (%)	Total K (%)
580.5	35	7.5	4.5	1.69	1.5	28.6	29.5	20.5	0.8	1.0

Table B: The chemical and physical properties of sheep manure:

Weight of m^3 (kg)	Wet. (%)	pH	EC	Total N (%)	O.M. (%)	Total carbon (%)	Ash	C/N ratio	Total P (%)	Total K (%)
580.5	58	7.4	2.03	0.75	3.6	28.6	6.00	4:1	0.6	0.2

Table C: The chemical and physical properties of chicken manure:

Weight of m^3 (kg)	Wet. (%)	pH	EC	Total N (%)	O.M. (%)	Total carbon (%)	Ash	C/N ratio	Total P (%)	Total K (%)
262	75%	7.4	2.03	3.7	5.5	28.6	6.1	5:1	0.55	2.03

Table D: Mechanical properties of the experimental soil

Coarse sand %	Fine sand %	Silt %	Clay %	Soil texture
58.36	31.96	7.43	2.25	Sandy

Table E: Chemical properties of the experimental soil:

pH	E.C (m mhos/cm)	OM %	Soluble cations (meq./L.)			Soluble anions (meq./L.)				
			K^+	Na^+	Mg^{++}	Ca^{++}	$CO3^{--}$	HCO_3^-	Cl^-	SO_4^{--}
8.7	0.76	0.47	0.09	2.43	0.8	3.20	-	3.00	1.38	2.14

Table F: Water analysis:

pH	E.C(m mhos/cm)	Soluble cations (ppm)				Soluble anions (meq./L.)			
		K^+	Na^+	Mg^{++}	Ca^{++}	$CO3^{--}$	HCO_3^-	Cl^-	SO_4^{--}
8.3	6.2	2.00	55.00	24.92	41.02	23.22	86.55	85.5	89.00

RESULTS AND DISCUSSIONS

Plant height (cm): Data in Table (1) showed significant differences in plant height among different treatments. Generally, the first cut plants were higher than the second one. The tallest plants were obtained from $20m^3$ compost + $10m^3$ chicken manure treatment (22.71 and 22.10 cm) compared to (11.71 and 12.75 cm) for control, respectively for the means of the first and second seasons. These results were in line with those obtained by [38,39,40,41].

Thyme Fresh Weight: Results of fresh weight/plant (Table, 2) revealed that kinds of manure separately or combined with compost led to significant differences in plant fresh weight. Generally, in most cases, the second cut was superior in fresh weight comparing with the first one. The heaviest fresh weight was obtained from $20m^3$ compost combined with $10m^3$ chicken flowed by from $20m^3$ compost combined with $10m^3$ sheep manure. (These results were in agreement with those obtained by [42,43].

The same trend was found to be true for fresh weight/feddan (Table 3).

Plant Dry Weight: Concerning results of dry weight per plant, it could be noticed that, a harmony trend like that observed in fresh weight per plant. Table (4) showed significant differences in dry weight. Furthermore, a similar trend like plant fresh weight was observed. These results were in harmony of those mentioned by Ali (2002) [40,41,43,44,45]. Also, similar trend was noticed in dry weight of thyme per feddan (Table 5).

Essential Oil Percentage: Taking essential oil percentage into consideration, Table (6) revealed that among different treatments, 10 m^3 sheep manure (0.56 and 0.61%) was superior in oil percentage in most cases during both seasons, followed by $20m^3$ compost + $10m^3$ chicken manure (0.54 and 0.56%). It also resulted in significant differences compared to other treatments, especially the control (0.26 and 0.46%). These results were in agreement with those obtained by [40,42,43]

Oil Yield per Plant: Taking oil yield/plant into consideration, Table (6) showed that among different treatments, $20m^3$ compost combined with 10 m^3 sheep manure was superior in oil yield in the first season, while the same level of compost combined with $10m^3$ chicken manure gave the highest oil yield/plant for the second season compared to other treatments, especially the control (0.04 and 0.08ml). Concerning to oil yield/feddan, the same trend was observed (Table 7).

Essential Oil Constituents: In concern to the thyme oil constituents, the second cut for the second season was chosen. The recorded data tabulated in Table (6) present thyme oil components which were identified and divided into three main groups; namely, hydrocarbons, oxygenated and unidentified ones. It showed that, the highest total of oxygenated compounds (82.84% and 80.29% respectively) was resulted from $30m^3$ Compost + $10m^3$ sheep and $20m^3$ Compost + $10m^3$ Chicken treatments**.** While the lowest one 42.69% resulted from control plants. Generally, the main constituents of volatile oil of the studied treatments were thymol (71.12-34.50%), limonene (30.30-0.69%) and methyl chavicol (2.18-4.2%). These results were agreed [13] who reported that thyme plants have active constituents as volatile oil especially thymol, carvacorol, cineole, borneol.

Nitrogen Content: Results of nitrogen content (%) were presented in Table (7). It cleared that among different treatments, $20m^3$ Compost + $10m^3$ Chicken and $10m^3$ Chicken manure treatments gave the highest contents of nitrogen (%) (3.09 – 2.62%) and (3.06 – 2.15%), respectively. Contrarily, control treatment had the lowest nitrogen content (0.2 – 0.2%) compared to other studied treatments during both cuts and seasons. These results were in agreement with those obtained by [40,42].

Phosphorus Content: Data on phosphorus content (%) presented in Table (8) showed that among different treatments, the first compost rate ($20m^3$) combined with 10 m^3 chicken manure gave the highest content of phosphorus (%) in most cases especially in the second cut (0.64 - 0.64% respectively). While, the lowest content (0.04 – 0.04%) was resulted from control treatment during both seasons. These results were in agreement with those obtained by [40,42].

Potassium content:

Concerning of potassium content (%), results presented in Table (9) cleared that the addition of $20m^3$ compost combined with $10m^3$ chicken manure resulted in the highest content of potassium content (%) in most cases especially in the second cut (1.73%). However, $20m^3$ compost alone exhibited the lowest potassium content (0.73 and 0.81%) compared to other studied cultivars during both seasons. These results were in agreement with those obtained by [40,42].

Table 1: Effect of fertilization on plant height of thyme

Treatments	Plant height (cm)					
	1st season			2nd season		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Control	12.92	10.50	11.71	*12.92*	*12.58*	12.75
10m³ Chicken	21.85	16.00	18.93	*18.92*	*16.67*	17.80
10m³ Sheep	18.00	15.00	16.50	*17.83*	*15.75*	16.79
20m³ Compost	20.00	15.75	17.88	*18.39*	*16.00*	17.20
20m³ Compost+10m³ Chicken	24.17	21.25	22.71	*22.94*	*21.25*	22.10
20m³ Compost+10 m³ Sheep	23.42	18.25	20.84	*21.86*	*18.25*	20.06
30m³ Compost	23.17	17.00	20.09	*20.92*	*18.00*	19.46
30m³ Compost+10m³ Sheep	23.33	18.50	20.92	*21.89*	*18.50*	20.20
30m³ Compost+10m³ Chicken	24.17	21.25	22.71	*22.25*	*20.25*	21.25
LSD 5%	2.96	2.18		2.39	1.75	

Table 2: Fresh weight per plant (gm/plant) of thyme

Treatments	Fresh weight (gm/plant)					
	1st season			2nd season		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Control	12.89	15.99	14.44	17.17	17.82	17.50
10m³ Chicken	36.93	38.83	37.88	40.93	42.28	41.61
10m³ Sheep	28.53	41.22	34.88	31.06	44.48	37.77
20m³ Compost	34.81	44.70	39.76	24.61	31.38	28.00
20m³ Compost+10m³ Chicken	42.63	74.50	58.57	33.76	50.30	42.03
20m³ Compost+10 m³ Sheep	33.77	100.33	67.05	23.18	52.43	37.81
30m³ Compost	30.10	83.77	56.94	25.35	46.41	35.88
30m³ Compost+10m³ Sheep	28.67	88.83	58.75	32.32	49.94	41.13
30m³ Compost+10m³ Chicken	26.52	77.33	51.93	26.79	36.10	31.45
LSD 5%	8.38	16.05		8.26	15.63	

Table 3: Fresh weight per feddan (kg/feddan) of thyme

Treatments	Fresh weight (kg/feddan)					
	1st season			2nd season		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Control	361.01	447.72	404.37	480.76	498.96	489.86
10m³ Chicken	1120.37	1087.15	1103.76	1146.04	1183.93	1164.99
10m³ Sheep	798.93	1154.16	976.55	869.77	1245.53	1057.65
20m³ Compost	974.68	1251.60	1113.14	689.17	878.73	783.95
20m³ Compost+10m³ Chicken	1193.64	2086.00	1639.82	945.19	1408.40	1176.80
20m³ Compost+10 m³ Sheep	945.47	2809.33	1877.40	649.04	1467.95	1058.50
30m³ Compost	842.89	2345.47	1594.18	658.67	1299.48	979.08
30m³ Compost+10m³ Sheep	802.67	2487.33	1645.00	840.67	1398.41	1119.54
30m³ Compost+10m³ Chicken	742.56	2165.33	1453.95	696.33	1010.80	853.57
LSD 5%	234.00	433.70		231.40	430.40	

Table 4 : Dry weight of thyme/plant

Treatments	Dry weight (gm/plant)					
	1st season			2nd season		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Control	5.05	5.69	5.37	7.02	7.16	7.09
10m³ Chicken	10.80	14.61	12.71	11.96	17.46	14.71
10m³ Sheep	9.78	16.34	13.06	11.64	19.41	15.53
20m³ Compost	13.94	21.35	17.65	8.58	14.63	11.61
20m³ Compost+10m³ Chicken	18.66	33.17	25.92	13.73	20.74	17.24
20m³ Compost+10 m³ Sheep	21.80	21.80	21.80	21.80	21.80	21.80
30m³ Compost	17.83	39.67	28.75	11.42	22.96	17.19
30m³ Compost+10m³ Sheep	17.70	37.67	27.69	10.43	21.93	16.18
30m³ Compost+10m³ Chicken	15.03	40.50	27.77	10.65	22.06	16.36
LSD 5%	6.86	6.05		7.45	4.64	

Table 5: Dry weight of Thyme per feddan (kg/feddan)

Treatments	Dry weight (kg/feddan)					
	1st season			2nd season		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Control	141.49	161.60	151.55	196.47	200.48	198.48
10m³ Chicken	302.49	446.08	374.29	334.79	488.97	411.88
10m³ Sheep	273.84	312.96	293.40	325.83	543.48	434.66
20m³ Compost	390.41	345.60	368.01	240.24	409.55	324.90
20m³ Compost+10m³ Chicken	522.39	697.60	610.00	384.35	580.72	482.54
20m³ Compost+10 m³ Sheep	610.40	566.40	588.40	441.56	616.37	528.97
30m³ Compost	499.33	480.96	490.15	296.67	642.88	469.78
30m³ Compost+10m³ Sheep	495.69	570.56	533.13	271.00	614.04	442.52
30m³ Compost+10m³ Chicken	420.93	597.12	509.03	277.00	617.68	447.34
LSD 5%	168.30	192.20		129.90	208.30	

Table 6 A: Essential oil percentage of thyme

Treatments	Essential oil percentage (%)					
	1st season			2nd season		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Control	0.23	0.28	0.26	0.46	0.46	0.46
10m³ Chicken	0.47	0.40	0.44	0.49	0.49	0.49
10m³ Sheep	0.57	0.55	0.56	0.61	0.61	0.61
20m³ Compost	0.36	0.39	0.38	0.42	0.39	0.41
20m³ Compost+10m³ Chicken	0.40	0.67	0.54	0.45	0.67	0.56
20m³ Compost+10 m³ Sheep	0.49	0.52	0.51	0.53	0.52	0.53
30m³ Compost	0.45	0.53	0.49	0.58	0.53	0.56
30m³ Compost+10m³ Sheep	0.34	0.57	0.46	0.53	0.57	0.55
30m³ Compost+10m³ Chicken	0.40	0.44	0.42	0.60	0.36	0.48
LSD 5%	0.10	0.16		0.12	0.10	

Table 6 B: Chemical composition of thyme essential oil fractionated by GC technique

	% Area in oil								
	1	2	3	4	5	6	7	8	9
Hydrocarbons									
α-Pinene	1.19	0.57	1.09	1.31	0.05	0.06	1.63	0.06	0
β-Pinene	1.81	0.54	0.52	1.17	0.00	0.60	1.08	0.01	0.64
Limonene	23.01	20.68	22.00	28.78	0.69	30.30	25.78	0.69	28.64
Cineol	0.37	0.19	0.17	1.09	2.32	0.39	1.99	2.47	0.40
Total	26.39	21.98	23.79	32.36	3.06	31.34	30.48	3.22	29.68
2) Oxygenated compounds									
Camphor	1.68	0.71	0.91	0.81	0.91	1.23	0.93	1.59	1.50
Linalool	1.68	2.55	5.47	0.81	0.20	0.11	0.91	2.60	0.00
Methyl chavicol	2.81	2.49	2.89	4.02	4.20	2.18	2.22	4.62	2.68
α-Terpineole	0.37	1.57	0.17	2.09	3.01	2.00	2.19	0.30	2.47
Boreniol	0.83	0.57	1.97	0.20	0.25	0.41	0.30	1.30	0.44
Thymol	34.50	64.76	34.85	58.42	69.25	60.21	55.54	71.12	59.29
Carvacrol	0.83	1.57	1.97	1.09	2.47	1.03	2.20	1.30	1.30
Total	42.69	74.22	48.22	67.43	80.29	67.17	64.28	82.84	67.67
3) Unknown	30.92	3.79	27.99	0.21	16.65	1.49	5.25	13.94	2.65

1- Control
2- 10 m3 Chicken
3- 10 m3 Sheep
4- 20 m3 Compost
5- 20 m3Compost + 10 m3Chicken
6- 20 m3Compost + 10 m3Sheep
7- 30 m3 Compost
8- 30 m3Compost + 10 m3Sheep
9- 30 m3Compost + 10 m3Chicken

Table 7A : Oil yield per plant of thyme/plant (ml)

Treatments	Oil yield per plant (ml)					
	1st season			2nd season		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Control	0.03	0.04	0.04	0.08	0.08	0.08
10m^3 Chicken	0.18	0.15	0.17	0.21	0.20	0.21
10m^3 Sheep	0.16	0.23	0.19	0.18	0.27	0.23
20m^3 Compost	0.13	0.17	0.15	0.10	0.12	0.11
20m^3 Compost+10m^3 Chicken	0.17	0.50	0.33	0.15	0.34	0.24
20m^3 Compost+10 m^3 Sheep	0.17	0.52	0.34	0.12	0.27	0.20
30m^3 Compost	0.14	0.44	0.29	0.15	0.25	0.20
30m^3 Compost+10m^3 Sheep	0.10	0.51	0.30	0.17	0.28	0.23
30m^3 Compost+10m^3 Chicken	0.11	0.31	0.21	0.16	0.12	0.14
LSD 5%	0.10	0.06		0.12	0.07	

Table 7 B: Oil yield per feddan of thyme

Treatments	Oil yield per feddan (L)					
	1st season			2nd season		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Control	0.83	1.25	1.04	2.21	2.30	2.25
10m³ Chicken	5.11	4.48	4.80	5.80	5.62	5.71
10m³ Sheep	4.55	6.35	5.45	5.31	7.60	6.45
20m³ Compost	3.51	4.88	4.20	2.89	3.43	3.16
20m³ Compost+10m³ Chicken	4.77	13.98	9.38	4.25	9.44	6.84
20m³ Compost+10 m³ Sheep	4.63	14.61	9.62	3.44	7.63	5.54
30m³ Compost	3.79	12.43	8.11	3.82	6.89	5.35
30m³ Compost+10m³ Sheep	2.73	14.18	8.45	4.46	7.97	6.21
30m³ Compost+10m³ Chicken	2.97	8.66	5.82	4.18	3.44	3.81
LSD 5%	*1.65*	*2.5*		*1.81*	*3.38*	

Table 7C: Nitrogen content of thyme

Treatments	Nitrogen content (%)					
	1st season			2nd season		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Control	0.19	0.20	0.20	0.19	0.21	0.20
10 m³ Chicken	3.40	2.71	3.06	2.30	2.00	2.15
10 m³ Sheep	2.32	2.63	2.47	0.23	2.38	1.31
20 m³ Compost	1.21	1.35	1.28	1.32	1.23	1.28
20 m³ Compost + 10 Chicken	3.22	2.95	3.09	2.02	3.22	2.62
20 m³ Compost + 10 Sheep	1.47	2.33	1.90	2.22	1.47	1.85
30 m³ Compost	1.76	1.94	1.85	2.08	1.94	2.01
30 m³ Compost + 10 Sheep	1.43	2.04	1.73	1.76	2.04	1.90
30 m³ Compost + 10 Chicken	2.24	1.35	1.79	2.15	1.15	1.65

Table 8: Phosphorus content of thyme

Treatments	Phosphorus content (%)					
	1st season			2nd season		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Control	0.04	0.04	0.04	0.04	0.04	0.04
10m³ Chicken	0.77	0.54	0.66	0.45	0.40	0.43
10m³ Sheep	0.46	0.53	0.50	0.48	0.48	0.48
20m³ Compost	0.24	0.27	0.26	0.26	0.25	0.25
20m³ Compost+10m³ Chicken	0.42	0.64	0.53	0.40	0.64	0.52
20m³ Compost+10 m³ Sheep	0.33	0.47	0.40	0.45	0.30	0.37
30m³ Compost	0.35	0.39	0.37	0.42	0.39	0.40
30m³ Compost+10m³ Sheep	0.29	0.41	0.35	0.35	0.41	0.38
30m³ Compost+10m³ Chicken	0.45	0.27	0.36	0.43	0.23	0.33

Table 9 : Potassium content of thyme

Treatments	Potassium content (%)					
	1st season			2nd season		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Control	1.02	0.90	0.96	1.10	1.02	1.06
10m^3 Chicken	1.80	1.46	1.63	1.07	1.07	1.07
10m^3 Sheep	1.25	1.41	1.33	1.28	1.50	1.39
20m^3 Compost	0.65	0.80	0.73	0.71	0.90	0.81
20m^3 Compost+10m^3 Chicken	1.12	1.73	1.43	1.08	1.73	1.41
20m^3 Compost+10 m^3 Sheep	1.25	0.79	1.02	1.19	0.79	0.99
30m^3 Compost	0.94	1.04	0.99	1.12	1.04	1.08
30m^3 Compost+10m^3 Sheep	0.77	1.10	0.94	0.94	1.10	1.02
30m^3 Compost+10m^3 Chicken	1.20	1.00	1.10	1.15	0.80	0.98

Carbohydrate Content: Taking carbohydrate content (%) into consideration, Table (10) concluded that generally the second cut was higher in carbohydrate content in most cases compared with the first one. Among different treatments the highest carbohydrate content was obtained from 20m^3 Compost + 10m^3 chicken treatment as it gave (19.55 - 14.48%) compared to other studied treatments during both cuts and seasons. These results were in agreement with those obtained by [40,42].

The Income from Thyme: The recorded data in Table (11) showed the, total coasts which resulted from using different treatments. It indicates that, the lowest coast (3250L.E./fed.) was recorded in control treatment. On contrary, the highest one (8450 L.E./fed.) was resulted from using the high compost rate combined with 10m^3 Chicken manure (30m^3 Compost + 10m^3 Chicken).

Consider to the income and retail from feddan (4200 m^2), it estimated considering the price of dry herb of thyme as 18500 L.E./ton [47]. Table (12) cleared that, control treatment only; don't make any profit. Moreover, it led to a real loss (12.27 LE/Fed.). On the other side the highest profit was obtained from using 20 m^3 Compost+10 Sheep which gave both highest income and profit (10335.67 and 5385.67L.E./fed. respectively). It is well known that prices are differing according to both time and place so; this study can be conceded just a guide line.

Discussion: The recorded results exhibit that, generally the second cut was higher than the first one in most studied parameters. Specially in case of single application of compost and sheep manure, this may be due to sheep manure (act as slow release fertilizer) and compost need long time to decompose and its nutrient constituents become more available to uptake by the plants. Contrarily, chicken manure increase growth and increase the efficiency of compost when it is combined with it, this may be due to the richness of organic acids and mineral nutrients in chicken manure particularly nitrogen (Table B). But this effect was not continuous due to the soil type (Tables D and E), which is sandy soil, that mean it is well drained soil and the nutrients in compost are easy to be leached. So, the effect of chicken manure in most cases, if added separately, can be observed clearly in the first cut. A synergistic effect was observed between compost and sheep manure combination than single application of each one. A same trend was observed with combined treatment of compost and chicken manure. It could be concluded that, the increment in fresh and dry weights of thyme herb may be due to the effect of combined fertilizers which enhanced growth of the herb resulting from cell division and elongation in the meristimatic zones. These increments in herb have also positive effect on oil yield. In general the total yield of herb was lower than in other places in Egypt this my be due to increase salinity in irrigation water (6.2 m.mohs/cm or 3968 ppm) (Table F)

Recommendations: From the aforementioned results it is recommended to perform the following treatments:
To obtain the highest thyme fresh or dry herb yields and oil yields, and thymol content the plants are suggest to be fertilize s with 20m^3 compost combined with 10 sheep or Chicken manure.

Table 10: Carbohydrate content of thyme

Treatments	Carbohydrate content (%)					
	1st season			2nd season		
	1st cut	2nd cut	Mean	1st cut	2nd cut	Mean
Control	10.50	14.00	12.25	10.50	12.50	11.50
10m^3 Chicken	11.50	15.00	13.25	11.03	14.20	12.61
10m^3 Sheep	12.75	14.53	13.64	13.15	13.15	13.15
20m^3 Compost	8.75	9.48	9.12	7.28	6.78	7.03
20m^3 Compost+10m^3 Chicken	21.30	17.80	19.55	11.15	17.80	14.48
20m^3 Compost+10 m^3 Sheep	13.00	12.15	12.58	14.30	10.15	12.23
30m^3 Compost	10.75	12.70	11.73	12.50	14.70	13.60
30m^3 Compost+10m^3 Sheep	10.50	14.00	12.25	10.50	12.50	11.50
30m^3 Compost+10m^3 Chicken	11.50	15.00	13.25	11.03	14.20	12.61

Table 11: Production coast of thyme per feddan

Coast Items	Land rent	Seedling	Fertilizers	Irrigation	Energy	Tillage	Labor	Transport.	Processing	Total coast
1	500.00	1000.00	0.00	500.00	100.00	50.00	500.00	100.00	500.00	3250.00
2	500.00	1000.00	700.00	500.00	100.00	50.00	500.00	100.00	500.00	3950.00
3	500.00	1000.00	200.00	500.00	100.00	50.00	500.00	100.00	500.00	3450.00
4	500.00	1000.00	1500.00	500.00	100.00	50.00	500.00	100.00	500.00	4750.00
5	500.00	1000.00	2200.00	500.00	100.00	50.00	500.00	100.00	500.00	5450.00
6	500.00	1000.00	1700.00	500.00	100.00	50.00	500.00	100.00	500.00	4950.00
7	500.00	1000.00	4500.00	500.00	100.00	50.00	500.00	100.00	500.00	7750.00
8	500.00	1000.00	4700.00	500.00	100.00	50.00	500.00	100.00	500.00	7950.00
9	500.00	1000.00	5200.00	500.00	100.00	50.00	500.00	100.00	500.00	8450.00

** All the prices was calculated according to average prices in 2003-2005*

1- Control
2- 10 m^3 Chicken
3- 10 m^3 Sheep
4- 20 m^3 Compost
5- 20 m^{3}Compost + 10 m^{3}Chicken
6- 20 m^{3}Compost + 10 m^{3}Sheep
7- 30 m^3 Compost
8- 30 m^{3}Compost + 10 m^{3}Sheep
9- 30 m^{3}Compost + 10 m^{3}Chicken

Table 12: Income and profit from thyme production per feddan

	Total Dry Herb			Retail		
	1st season	2nd season	Mean (kg/feddan)	Income (LE/Feddan)	Coast (LE/Feddan)	Profit (LE/Feddan)
1	151.55	198.48	175.01	3237.73	3250.00	-12.27
2	374.29	411.88	393.08	7272.03	3950.00	3322.03
3	293.40	434.66	364.03	6734.56	3450.00	3284.56
4	368.01	324.90	346.45	6409.37	4750.00	1659.37
5	610.00	482.54	546.27	10105.95	5450.00	4655.95
6	588.40	528.97	558.69	10335.67	4950.00	5385.67
7	490.15	469.78	479.96	8879.31	7750.00	1129.31
8	533.13	442.52	487.82	9024.72	7950.00	1074.72
9	509.03	447.34	478.18	8846.38	8450.00	396.38

** All the prices was calculated according to average prices in 2003-2005*

1- Control
2- 10 m^3 Chicken
3- 10 m^3 Sheep
4- 20 m^3 Compost
5- 20 m^{3}Compost + 10 m^{3}Chicken
6- 20 m^{3}Compost + 10 m^{3}Sheep
7- 30 m^3 Compost
8- 30 m^{3}Compost + 10 m^{3}Sheep
9- 30 m^{3}Compost + 10 m^{3}Chicken

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