Effect of Organic and Chemical Fertilizers on Vegetative Growth and Volatile Oil Content of *Thymus vulgaris* Plants

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ABSTRACT

Thyme plants are perennial herbaceous plants which are cultivated for its seeds and are classified as an edible plant. Two sources of fertilizers (Organic and Chemical fertilizer) were studied. Effects of these sources on the vegetative growth, percentage and the composition of volatile oil of Thyme plants. Using the organic fertilizer gave higher percentages of oil and main compounds of Thyme volatile oil than the chemical fertilizer. Data showed also, that the means of vegetative growth of Thyme plants increased with using the organic fertilization.

ADDITIONAL INDEX WORDS: *Thymus vulgaris*, organic and chemical fertilizer, vegetative growth, volatile oil, thymol, carvacrol.

INTRODUCTION

Thymus vulgaris or common thyme is a slow growing herbaceous plant, sometimes becoming somewhat woody. Thyme is a member of the Lamiaceae plant family; it is native to the Mediterranean region but is now found in Algeria, Turkey, Tunisia, the USA, Russia, central Europe, and China. It is much cultivated as a culinary herb. It typically grows as a sub-shrub, between 15 and 20 cm tall. It was a medicinal herb which was known to many ancient civilizations and known to Hippocrates, the 'father of medicine'. (Hedrick, 1972).

Thyme adds a distinctive aromatic flavoring to sauces, stews, stuffing's, meats, poultry - almost anything from soup to salad. In medieval times the plant symbolized courage, and to keep up their spirits, knights departing for the Crusades received scarves embroidered with a sprig of thyme from their ladies. There was a popular belief, too, that a leaf tea

prevented nightmares, while another held that tea made of thyme and other herbs enabled one to see nymphs and fairies. Herbalists of the middle ages regarded thyme as a stimulant and antispasmodic and recommended sleeping on thyme and inhaling it as a remedy for melancholy and epilepsy.

In 1725 a German apothecary discovered that the plant's essential oil contains a powerful disinfectant called Thymol that is effective against bacteria and fungi. Thymol, also acts as a expectorant, loosening phlegm in the respiratory tract so that it can be coughed up. Later herbalists listed thyme for these uses and as remedy for numerous other complaints, including diarrhoea and fever. They prescribed the oil externally as an antiseptic for fungal infections such as athlete's foot.

Za'atar is generally prepared using ground dried thyme, oregano, marjoram, or some combination thereof, mixed with toasted sesame seeds, and salt, though other spices might also be added. Traditionally, housewives throughout the Fertile Crescent, Iraq, and the Arabian Peninsula made their own variations of za'atar, which was unknown in North Africa. Recipes for such spice mixtures were often kept secret and not even shared with daughters and relatives. This general practice is cited by Western observers of Middle Eastern and North African culinary cultures as one reason for their difficulties in determining the names of the different spices used (Jennene, 2002)

Thyme oil is very potent oil and should not be used during pregnancy or in cases of high blood pressure. Because of the phenols (Carvacrol and Thymol), which can irritate mucus membranes and cause skin irritation, it should not be used for skin care products, and in general should be used in low concentrations. When it is used in massage therapy, it would be a good idea to do a skin patch test to determine if the person is sensitive to it (Davis, ,1999).

The important role of chemical fertilizers in increasing the medicinal and aromatic plants production is fully recognized. However, in the recent years, many constraints have been raised due to their adverse impacts on public health, environment and National income. To confront this problem, it is necessary to develop alternative methods of supplying nutrients to the growing plants. Many scientists consider the

utilization of bio-organic fertilizers today as a promising alternative technique particularly for maintaining the fertility and productivity of agricultural soils, in addition, to reducing the risk of environmental pollution (Nicholson *et al.*, 1999 and Galal and Ali, 2004).

Many authors studied the effect of organic manure treatments on growth, yield, volatile oil and chemical composition of aromatic seed crops as Osman (2000; Aly *et al.* (2007 a , b) , Abdalla (2009) on *Coriandnrm sativum*; Abd Ellatif (2002) ; Abd El-Naeem (2008) on *Carum carvi*; Badran and Saiwat (2004); Mohamed and Abdou (2004) and Tanious (2008) on *Foeniculum vulgare El Ghawas*,(2002)who demonstrated that organic fertilization treatments, significantly, increased vegetative growth traits, seed yield, volatile oil parameters, as well as, chemical constituents compared with the control treatment.

Likewise, Bio-fertilization technology has taken a part in minimizing production- costs and avoiding the environmental hazards (Galal and Ali, 2004). The beneficial effects of bio-fertilizer treatments on vegetative growth traits, yield, volatile oil and chemical composition of aromatic plants were obtained by Surendra *et al.* (2002) and Aly et al. (2007 a , b) on *Coriandrum* sativum; and Badran *et al.* (2003) on anise; Abdou and ElSayed (2002); Al-Shareif (2000) and Abd El-Naeem (2008) on caraway and Abdou *et al.* (2004 a and b) and Tanious (2008) on fennel. Since, they found that bio-fertilization treatments (N_2 fixing bacteria and/or phosphate dissolving bacteria) led to an increment in vegetative growth characters, yield, volatile oil (percent and yield) as well as chemical constituents (chlorophyll a, b and caroteniods contents and N, P and K% in the leaves of the plants).

The aim of present work is to study the effect of organic and chemical fertilization on vegetative growth and volatile oil of *Thymus vulgaris* plants.

MATERIALS AND METHODS

Research was carried out during the agricultural seasons 2006/2007 and 2007/2008 In the area of Sheikh Badr (Tartous, Syria) to

study the impact of recommended the rate of pickled compost 30 tons / ha and the rates of mineral fertilizers 450 kg ammonium sulfate / ha and 400 kg superphosphate / ha, 150 kg / ha sulphate of potash on the essential oil percentage and its majors components. A sample from surface soil was collected from the experimental area and analyzed for some chemical and physical properties as shown in Table (1).Also the chemical composition of organic fertilizer was determined and present in Table (2).

Table (1): Soil Chemical analysis:

Mechanical analysis of soil, %			Available NPK nutrients (Available absorption)			O.M %	$CaCO_3$ %	EC dsm^{-1}	PH
Loam	Silt	Sand	N%	P_2O_5 ppm	K_2O ppm				
28	50	22	0.021	8.5	350	1.02	22.22	1.28	8.11

Table (2): Chemical composition of organic fertilizer (Sheep manure):

Micro elements, ppm			Relationships of organic matter dry weight		Macro elements, %			Season
Zn	Fe	Mn	O.M %	Ash %	N	P_2O_5	K_2O	
31	6531	265	34.00	60.00	1.14	0.95	1.61	**2007**
32	6418	2.68	33.78	65.22	1.13	0.93	1.62	**2008**

Organic fertilizers were added before basic tillage on October 2006.Seedlings planted in the lines of the dimensions 40 cm × 40 cm × 1 plant to achieve agricultural density 62500 plants / ha. Length of the experimental piece (4 m x1.6 m) consist of 4 rows, then the experimental plot area 26.4 m2 and used three replicates. Then the overall experiment's area was 79.2 m2 except the corridors of service and scopes of the

experiment (50 cm) in all directions. Then a series of service operations for even the appearance of flowers and opening 50% of the plants. The layout of the experiment was randomized complete blocks design (Snedecor and Cochran, 1974).

The operations of irrigation depend on rainfall during the winter and spring and given supplementary irrigation in the summer during periods of drought. The Thyme plants grown without the use of any pesticides.

Essential oil analysis:

The essential oils (for second season 2008 only) were diluted in diethyl ether (20 ml in 1 ml) and analyzed with GC-MS (HP 8644) with flame ionization detector (FID) on a fused silica 132 capillary column DB-5, 25 m in length, 0.32 mm i.d., and 0.5 mm film thickness.133 Helium was used as the carrier gas with a flow rate of 1.6 ml/min; the detector 134 temperature was 260 °C, the oven temperature was programmed to increase from 130 to 260 °C at a rate of 4 °C/min. The split injector was heated at 250 °C, the split 136 ratio was 15:1. Data were processed on a DP 800 integrator.

The percentage of volatile oil and some physical properties (Refractive index, Iodine value, and Saponification value) were determined (Official Methods of the American oil Chemists Society,1989).Also the percentage of majors constituents were estimated by measuring the peak area of the different compounds of the chromatogram according to Heftman (1967) and Gunther and Joseph (1978).

RESULT AND DISCUTION

Generally, data represent in Tables 3,4,5 and Fig.(1) using organic fertilizer gave the heights mean value of vegetative growth (plant height, dry weight per plant, branches number per plant and the number of days until the start of flowering) compared with chemical fertilizer.

The effect of organic and chemical fertilizers on Thyme oil percentage, major's compounds percentage and physiocomercial properties of oil are shown in Tables (4 and 5) and illustrated in Fig. (1).The results indicated that using two sources of fertilizers had no significant effect on the studied physiocomercial properties. While Organic fertilizer gave the highest

percentage of essential oil and most of major compounds percentage (especially Carvacrol and Thymol).

The chromatographic fractionation (for organic fertilizer) shows that the major compound of essential oil is Carvacrol (82.04%) and Thymol (12.02%)

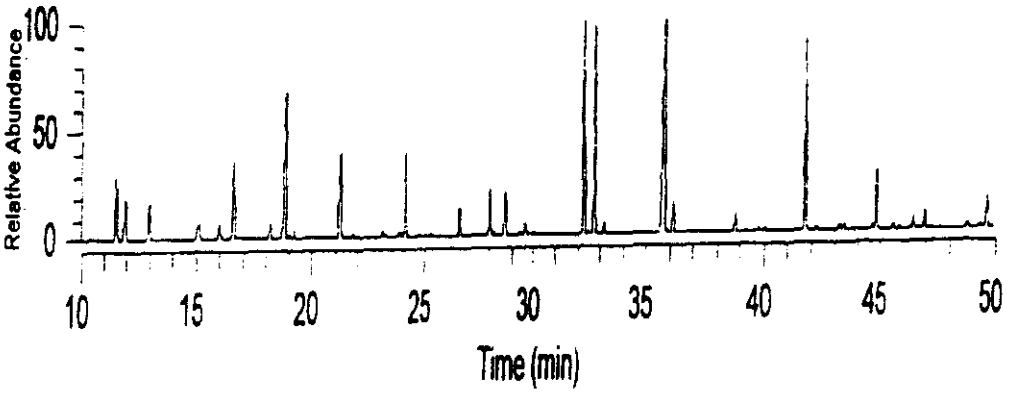

Fig. 1.Typical GC-MS chromatograms of Thyme oil

Table (3): Effect of organic and chemical fertilizers on vegetative growth

Treatments	Season	Plant height (cm)	Dry weight per Plant (gm)	Branches number per plant	The number of days until the start of flowering
Chemical Fertilizer	2007	37.27 b	28.86 b	135.81 b	58.00a
Organic Fertilizer	2007	42.95 a	37.07 a	137.59 a	56.89 b
L.S.D $_{0.05}$	2007	2.05	4.11	1.02	0.89
Chemical Fertilizer	2008	34.12 b	26.66 b	129.70 b	55.12 a
Organic Fertilizer	2008	38.79 a	34.86 a	132.47 a	53.91 b
L.S.D $_{0.05}$	2008	1.76	4.27	1.24	1.54

Table (4): Effect of organic and chemical fertilizers on some physical properties

Treatments	Density G/mL.20 °C	Iodine value	Refractive index 20 °C
Organic F.	0.892	106.4	1.4911
Chemical F.	0.890	106.4	1.4923
L,S.D $_{0.05}$	n.s	n.s	n.s

Table (5): Effect of organic and chemical fertilizers on volatile oil and major's compounds percentage.

Compounds,%	Organic Fertilizer	Chemical Fertilizer	L.S.D $_{0.05}$
Borneol	2.21 a	2.02 b	0.01
Camphene	1.05 a	0.06 b	0.02
Carvacrol	82.04 a	73.98 b	0.31
β-Caryophyllene	0.08 b	0.09 a	0.01
P-Cymene	5.91 b	6.24 a	0.12
Methyl thymol	1.04 a	1.01 b	0.01
α-Terpinene	9.10 a	6.08 b	0.03
Thymol	13.31 a	12.02 b	0.02
Linalool	4.07 a	3.87 b	0.11
Limonene	0.71 a	0.69 b	0.01
Volatile oil, %	1.92	1.56	0.03

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الملخص العربى

تأثيراتسميد العضوي والكيميائي علي النمو الخضري والزيت العطري لنبات الزعتر

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نباتات الزعتر أعشاب معمرة تزرع بالبذور وتصنف كنبات صالح للأكل. تم دراسة تأثير التسميد العضوي والكيميائي علي النمو الخضري و النسبة المئوية للزيت ومكوناتة لنباتات الزعتر.وقد لوحظ أن التسميد العضوي قد أعطي أعلي نسبه مئوية للزيت العطري ومكوناتة الرئيسية مقارنة بالتسميد الكيماوي.أظهرت النتائج أيضا زيادة في متوسطات النمو الخضري باستخدام التسميد العضوي مقارنة بالتسميد الكيماوي.