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Effect of Organic and Chemical Fertilizers on Dry Yield, Essential Oil and Compounds on Rosemary (*Rosemarinus officinalis* L.)

Seyede Roghaye Hosseini Valiki*, Sobhanall Ghanbari**, Mohammad Akbarzadeh, Majid Ghasempor Alamdari** and Sajedeh Golmohammadzadeh*******

**M.Sc. student of Agronomy Department, Faculty of Agriculture Sciences and Natural Resources, Qaemshahr branches, Islamic Azad University, Qaemshahr, IRAN.*
***Department of Agriculture, Faculty of Agriculture Sciences and Natural Resources, Qaemshahr branches, Islamic Azad University, Qaemshahr, IRAN.*
****Faculty of Medicinal Plants Research, Agricultural Research Center of Mazandaran, IRAN.*
*****M.Sc. student of Department of Agronomy, Faculty of Crop Sciences, Sari Agricultural Sciences and Natural Resources University, Sari, IRAN.*

(Corresponding author: Seyede Roghaye Hosseini Valiki)
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ABSTRACT: In order to examined the effect of manure and chemical fertilizers on the some agronomic characteristics, yield and the essential oil of rosemary. The experiment was carried out as randomized complete design with 9 treatments at 4 replications in Sari, 2013. Treatments were included witness (control), sheep and vermin-compost fertilizers and chemical fertilizers of nitrogen and phosphorus at 6 different amounts which were N150-P150, N150-P200, N150-P250, N200-P150, N200-P200 and N200-P250. The results showed that sheep manure had the highest dried yield (1344kg/ha), essential oil (3.72%) and essential oil yield (50 liters per hectare) that increased 2, 2.4 and 4.5times compared to the controls. In general, sheep manure compared to vermicompost and other chemical treatments increased the dry yield, essential oil yield and type and percentage of ingredients of Rosemary on local climatic condition of experimental site.

Key words: Rosemary, Manure and chemical fertilizer, Yield and Essence.

INTRODUCTION

Today, due to adverse effects of medication, the general approach to use of herbal medicines is increasing (Hecl & Sustrikova, 2006). Studies on medicinal plants in natural ecosystems and agricultural suggest that using sustainable farming system for adaptation to natural conditions and product quality, provide the best conditions for the production of plants and most active ingredient produce in such circumstances (Sharifi-Ashurabadi *et al*, 2002).For this reason global approach is to the production of medicinal plants, sustainable farming systems and their management techniques. One of the most important management techniques, increase the use of organic fertilizers and reducing chemical inputs in soils, especially in arable land under cultivation of medicinal plants. Sheep manure and vermicompost of organic fertilizers, due to characteristics such as high porosity, absorption and storage of mineral elements and their gradual liberalization, the water-holding capacity, growth and quality of horticultural crops and development of sustainable agriculture were important for agricultural specialists (Kocabas *et al.*, 2010).

In recent years research on application of organic manures especially vermicompost, has been increased. Various studies on some medicinal plants such as sweet basil (*Ocimum bacilicum*) and yarrow (*Achillea millefolium* L.) showed that organic fertilizers compared to chemical fertilizers had significant effect on yield and essential oil (El Gendy *et al.*, 2001). Among the medicinal plants, aromatic and essential oils plant, special place to have the terms of use and application of the various communities. Among the most important of these plants can be pointed Rosemary which is of great importance in the Iran and world. Rosemary (*Rosmarinus officinalis* L.) from Lamiaceae is a perennial plant, evergreen, shrub in the form of Mediterranean origin. The main component of Rosemary's leaves and branches is essential oil. The essential oil of this plant reported between 0.5 to 2.5percent over the world. The main components of essential oil of Rosemary are 1,8 cineol, borneol, Camphor, Burnylacetate, Alpha-pinene and Beta-pinene, that depending on the geographic location of the plant and the percentage of each of these materials is variable (Zargari, 1997).

According to universal tendency to produce and reproduce medicinal plants in a sustainable and low input farming systems, also, lack of studies about the response of rosemary plant to the manure and vermicompost fertilizer, this research was aimed to investigate the effects of chemical fertilizers and organic fertilizers as an important component of sustainable agriculture on dry yield, and essential oil yield and its compounds of the plant.

MATERIAL AND METHODS

This research was carried out at spring of 2013 on the farm in Sari (38N, 53 E and 705m above sea level), Iran. Experimental field has Caspian mild and wet climate, average rainfall during the growing season (spring and summer), 94.5 mm and the average daily temperature is 31.19°C. At first, the soil of experimental field with sheep manure and vermicompost samples analysed to determine the amount of nutrients and physical and chemical properties (Table 1). The experiment was carried out as randomized complete design with 9 treatments at 4 replications. Treatments were included witness (control), sheep and vermicompost fertilizers and chemical fertilizers of nitrogen and phosphorus at 6 different amounts which are N150-P150, N150-P200, N150-P250, N200-P150, N200-P200 and N200-P250. Nitrogen was chosen as Urea (45% pure nitrogen) and phosphorus was also chosen as triple superphosphate fertilizer (46% phosphorus as P_2O_5).

Table 1: Nutrients amount and physical and chemical properties of vermicompost, sheep manure and experimental soil.

Soil texture	Cu (ppm)	Zn (ppm)	Mn (ppm)	Fe (ppm)	Mg (%)	Ca (%)	N (%)	K (ppm)	P (ppm)	O.C (%)	O.M (%)	pH	Electrical conductivity EC*10 (ds m^{-2})	Base percentage	Depth (cm)	Characteristics
Silty loam	0.7	2.6	11.3	15.1	400	-	0.128	137	14.3	1.28	2.20	7.4	3.5	40	0-30	Soil
-	21	43	428	1205	0.41	2.32	1.10	0.28	0.44	14.2	-	7.42	5.25	-	-	Vermicompost
-	|19	25	290	1110	0.36	1.32	2.10	2.79	0.46	28.2	-	7.56	25.3	-	-	Sheep manure

The amount of chemical fertilizers, sheep manure and vermicompost were determined regarding to Rosemary plant fertilizer needs (Each one 10t/ha) (Zargari, 1997).About a month before transferring seedlings in plastic pots (15 of April 2013), the manure and vermicompost mixed with the soil in each pot to convert vermicompost organic matter and manure into absorbable mineral during a month before transferring seedling. Reticulated around pot to increase root growth by air conditioner, increase decomposition of organic matter by microorganisms in fertilizers and increased efficiency of uptake by plant roots. Due to the sudden absorption of minerals, nutritional shocks caused burn young seedling. On 15 May before planting rosemary seedlings, chemical fertilizers mixed with soil in pot, such as urea in 3 stages (early planted, early vegetative and early reproductive growth) and phosphorus fertilizer at planting time added to all pots soil. Each pot has the dimensions 40 × 35cm, that each containing 20 kg of soil.

The amount of nitrogen and phosphorus were added to each pot 20 kg consisted of 1.2 gr or 60 ppm for each of manures150kg/ha, 1.6gr or 80 ppm for each of manures 200 kg/ha and 2 gr or 100ppm to 250kg/ha fertilizer treatments. After fertilization, the seedlings were planted in each pot. Then all pots were placed outdoors in a field experimental. Growing stage such as irrigation and weed control was carried in the pots during the growing season.

Then all pots were placed outdoors in a field experimental. Growing stage such as irrigation and weed control was carried in the pots during the growing season. Measured traits were including dry yield (Total dry weight of stems and leaves), the amount of essence, yield essence, the type and the amount of the compounds. On 20 September, the plant was harvested 10 cm above soil surface of the pot, and to maintain the quantity and quality of shoots, the samples in the shade and at ambient temperature for 7 days were dried.

Then100 gr of each to determine the amount of oil transferred to the laboratory. In order to extract the oil from the dried aerial parts used steam distillation method by Clevenger apparatus about 3 hours.

To identify the composition of the oils after preparation, the samples injected in-GC / MS system. Agilent 6890 gas chromatograph was used of type column with a length of 30 m, internal diameter of 0.25 mm and a thickness of 0.25 mm of type HP-5MS. The column temperature program developed in this way: The initial temperature of 50°C of play and hold at this temperature for 5 min, Thermal gradient of 3°C per minute, increasing the temperature to 240°C at a rate of 15 degrees per minute, increasing the temperature to 300°C and hold for three minutes at this temperature. The injection chamber temperature was 290°C and helium used as the carrier gas flow rate 0.8 ml per minute. Mass spectrograph used Agilent 5973 model with ionization voltage with 70 electron volts, EI ionization method and ionization source temperature was 220°C. Spectra identified by their inhibition index and indices in comparison with the references books and articles and using the mass spectra standard components and using the information in the computed library were performed.

The obtained data were analyzed by MSTAT-C program. Data means were compared by Duncan's Multiple Range Test at P = 0.05. The EXCEL Microsoft word was used for drawing of diagram.

RESULTS

A. Dry yield, amount and yield of essential oils

According to table 2, effect of all treatments on dry yield, amount and yield of essential oil were significant at the1% level. This means that both organic and chemical fertilizers had a statistically significant effect on these traits. According to (Table 3), all organic fertilizers and chemical fertilizers increased dry yield, amount of essential oil and also essential oil yield of rosemary compared to control.

Table 2: Mean Square table effect of used treatment on yield and quality of the herb rosemary.

Essential oil yield	Essential oil	Dry yield	Degrees of freedom	Sources of variation
542.428**	1.738**	197820**	8	Treatment
7.295	0.047	2503.491	27	Error
9.919	8.671	4.927	--	CV

**High significant at 1%

Table 3: Comparison table of fertilizer treatments on yield and essential oil of rosemary herb.

Essential oil yield (L/ha)	Essential oil (%)	Dry yield (kg/ha)	Treatment
10.42^{i}	1.55^{hi}	673.25^{hi}	Control
35.93^{b}	3.02^{b}	1188^{b}	Vermicompost
50.07^{a}	3.72^{a}	1344^{a}	Sheep manure
33.7^{bc}	2.9^{bc}	1164.25^{bc}	N150+P150
26.23^{de}	2.45^{de}	1074^{de}	N150+P200
21.48^{fg}	2.2^{efg}	977^{f}	N150+P250
27.73^{d}	2.57^{d}	1076^{d}	N200+P150
22.60^{ef}	2.37^{def}	952^{fg}	N200+P200
16.88^{h}	1.77^{h}	689.75^{h}	N200+P250

* Numbers with at least one common letter are statistically significant at the 5% level, no significant differences.

Among all treatments, sheep manure treatments had statistically significant effect at highest level. So that the highest dry yield, amount essential oil and essential oil yield obtained by sheep manure were respectively 1344 kg per hectare, 3.72 percent and 50 liters per hectare that compared to the control increased respectively 2, 2.4 and 4.5 fold (Table 3). After sheep manure treatments, vermicompost fertilizer and chemical fertilizer had high effect on these traits. The results showed that organic fertilizers increased the average dry yield and essential oil yield respectively 20 and 75% compared to chemical fertilizers. Average electrical conductivity, total nitrogen, organic carbon content, potassium content and micronutrient (Fe, Zn, Cu, Mn) in the manure (sheep and vermicompost) were greater than chemical fertilizers (Table 1), which increased dry yield, essential oil amount and essential oil yield. Statistical differences in the traits measured by sheep manure vermicompost due to high levels of electrical conductivity, organic carbonand potassium in fertilizers. Increase dry weight and amount of essential oil of rosemary by consumption of vermicompost than chemical fertilizers because of positive changes in soil physical, chemical properties, providing nutrient to plant during the growing season by vermicompost that can provide optimum conditions for plant to increase plant weight.

According to high organic materials, increase water holding capacity of the soil and improve physical and chemical structure planting bed, application of vermicompost use for increasing plant yield (Arancon et al., 2004; Atiyeh *et al.,* 2002).Vermicompost have nitrogen, phosphorus and potassium more than their surrounding soil. The results of research on Roman chamomile (*Anthemis nobilis*) showed that the application of vermicompost improved the quality essential oil (Luic & Pank, 2005). Khalid and Shafei (2005) showed that 30 tons of manure animal was improvement amount 30 percent essential oil of (*Anethum graveolens*). In other research, the percentage of essential oil and essential oil yield of *Coriandrum sativum* herb increased by using20 tons manure fertilizer (Salem & Awad, 2005). The application of animal manure improved the oil amount about 41% in the herb *Salvia officinalis* (Kaplan *et al*., 2009). Adding animal manure to the soil improved soil physical and biological processes, created a proper grounds for root growth and provided nutrient for plants enhanced the growth and dry matter production. In relation to the findings of some researchers on medicinal plants, *Ocimum basilicum, Salvia officinalis* and *Achillea millefolium*, indicated that the application of appropriate amounts of animal manure increased, plant dry weight (Kaplan et al., 2009 & Biasi *et al.,* 2009).

The results showed among all treatments, manure treatment (N = 150, P = 150), had significant effect on essential oil and essential oil yield of rosemary compared to other fertilizers. Rahimzadeh *et al.* (2011) showed that chemical fertilizer increased dry matter yield of *Dracocephalum moldavica*. The results show that nitrogen plays a key role to increase of essential oil of Labiateae family plants. In this regard, positive effect of nitrogen on oil of *Mentha arvensis* (Saxena & Singh, 1996) and oil of *M. piperita* were indicated (Singh *et al.,* 1989). Ozegono *et al* (2008) concluded that increasing levels of nitrogen fertilizer, increased essential oil content of Artemisia. The positive effect of different fertilizer treatments on amount stated that essential oils are terpenoides compounds and biosynthesis of their manufacturer part (Isoprenoids) required the ATP and NADPH, due to that fact that the presence of elements such as nitrogen and phosphorus are essential for the formation of the latter compound, so can be concluded that the use of chemical fertilizers increase plant essential oil (Loomis & Corteau, 1972).

On the other hand, this research results showed that application of 200 kg nitrogen and 250 kg of phosphorus fertilizer (N200-P250) reduced dry yield, essential oil the and essential oil yield than other chemical treatments, that indicated this amount of nitrogen and phosphorus according to nutrients in the soil was in critical level for rosemary plant. Table 3 showed that the application of 200 kg/ha nitrogen (treatments N200-P150, N200-P200 and N200-P250) decreased dry yield, essential oil and essential oil yield of rosemary about 150 kg per hectare (treatments N150-P150, N150-P200 and N150-P250).

Generally use nitrogen more than this amount reduced yield and rosemary plants was in critical levels. The Tindal *et al* (2002) in research on (*Tanacetum parthenium*) plant observed that in chemical feed system, nitrogen at low level produced more biomass and increased the amount of nitrogen fertilizer reduced the biomass about 23%. Also gradual increase of phosphorus from 150 to 250 kg per hectare (treatments N150-P150, N150-P200, N150-P250 and N200-P150, N200-P200, N200-P250) decreased dry yield, essential oil and essential oil yield of rosemary. Therefore critical levels of phosphorus for rosemary plant due to weather conditions and soil physicochemical properties can be 150 kg per hectare. In other word, rosemary plant sensitive to high levels of phosphorus. Pourohit and Vyas (2004) stated that chamomile plant (*Chamaemelum nobile*) like rosemary had good response to NPK fertilizers, but was sensitive to large quantities of phosphorus.

Nitrogen and phosphorus are two elements that have interaction positive effect on uptake and impact of biochemical interplay. In other word, by increasing the nitrogen, phosphorus uptake by plant and its effect on plant metabolic activity increase and with increasing soil phosphorus, nitrogen uptake and physiological effects of the plant increase. Phosphorus element that is a major factor in the storage and transfer of energy within the plant can be used a major factor in the stored energy for the metabolic processes of the plant (Mahmoudi & Hakimian, 1379). So by adding phosphorus, photosynthesis and respiration increased, but when nitrogen is too much in the soil, excessive intake of phosphorus (or vice versa)increase respiration and the quantitative and qualitative of yield or essential oil had affected adversely. The most important issue of medicinal plants is naturalness of substance extracted from them. Therefore, the use of fertilizers for plants, especially herbs should act carefully, because the growth and yield of medicinal plants like other plants influence various factors, genetic and environmental. So according to the results obtained in this study, it can be concluded the nitrogen and phosphorus, each amount 150 kg per hectare compared to the rest of the amount chemical fertilizers applied to enhance the dry yield, essential oil and essential oil dry were more desirable.

B. Compounds of essential oil

Sustainable agricultural production systems, especially in the agricultural and medicinal plants, the product will be the ideal addition to quantitative increase, in terms of quality (type and amount of chemical compositions of the oils) is desirable. The plant rosemary essential oil obtained by treatments in this study, has been the 55/1(control) to 72/3 (sheep manure) variable percentage that 40 different types of compounds that have been identified, so that20type of these compounds have existed in most treatments that been shown in Table 4.

The results showed the20components of the essential oil of rosemary, some of the compounds have increased compared to control by treatments and some other have dropped or any percent of these compounds exist. Therefore it can be concluded that the type of components of rosemary essential oil was dependent on the conditions and the type of plant nutrition, so that in this experiment determined the effect of various fertilizer (organic and chemical) on components of essential oils. 20 types of compounds were in rosemary essential oil, the major and most compounds obtained in this experiment included Alpha-Pinene, 1,8-Cineole, Camphene, Camphor, Borneol, Bornyl acetate and Caryophyllene, which in some sources as the major compound were identified in the essential oil of rosemary(Zargari, 1997).

According to table 4, all the components of the rosemary essential oil by fertilizer treatments were different in terms of numerical, So that all treatments were including all the 20 compounds. Except treatment (N200-P250), which contains only a few types of compounds which their amount has been more or less than the controlor other treatments in other word, this treatment have been effective on some compounds and ineffective on the some other compounds. Therefore it can be concluded that treatments (N200-P250), the nitrogen fertilizer (200 and 250kg ha phosphorus), for rosemary plants was undesirable in terms of the dry yield and essential oil, yield essential oil and in terms of amount and type of components of the oil and nitrogen and phosphorus more than this amount will have detrimental effect on plant oils.

Results in accordance with Akbarnia *et al* (2003) research on (*Trachyspermum ammi*), the amounts of nitrogen and phosphorus higher than desirable reduced some oils of plant. They also suggested that the conventional fertilization system, the main composition (Parasymn, thy mol and Pamatrpynn) with low fertilizer (30 kg N and 20 kg Pha) compared to the control treatment had no significant difference with the application of 60kg Nand40kgPha, the compounds increased significantly. The other hand increasing amounts of fertilizer more than this amount, whereas no effect on the amount of thymol and Pamatrpynn percentage, dropped the amount of Parasymn.

Table 4: Effect of organic and chemical fertilizers on types of Rosemary plant compounds.

N200-p250	N200-p200	N200-p150	N150-p250	N150-p200	N150-p150	Sheep manure	Vermicompost	Control	Treatment
20.57	22.53	19.82	19.96	16.09	20.49	27.18	22	20.22	Alpha-Pinene
-	17.39	14.97	14.97	12.54	9.66	9.62	18.30	15.30	1,8-Cineole
7.65	11.93	8.73	9.42	10.11	10.24	13.23	9.45	7.97	Camphene
-	-	13.32	11.50	10.91	14.01	-	-	9.66	Camphor
-	6.03	9.46	10.03	6.61	7.31	7.71	5.73	6.64	Borneol
8.18	7.44	3.76	4.79	4.12	4.60	9.39	7.25	5.62	Caryophyllene
-	1.07	7.07	7.50	7.46	9.45	0.91	10.02	8.76	Bornyl acetate
11.49	4.51	4.09	3.30	4.05	4.5	5.72	3.96	3.42	Alpha-Terpinolene
3.65	4.67	3.70	3.62	3.99	4.34	5.13	3.90	3.60	Beta-Pinene
-	3.79	3.40	3.29	4.19	3.41	4.04	3.55	2.93	Beta.-Myrcene
7.18	3.34	1.63	1.94	1.81	2.04	3.64	2.88	2.40	Caryophyllene oxide
6.25	2.73	2.19	2.18	2.68	2.42	2.96	2.37	2.13	Gamma.-Terpinene
4.18	1.46	0.70	0.89	0.85	0.72	1.75	1.44	1.01	Delta.-Cadinene
4.10	1.38	0.87	0.89	1.04	0.95	1.44	1.33	0.85	Geranylaceton
-	1.67	0.75	1.07	1.09	0.98	2.09	1.56	1.34	α-Humulene
-	1.34	1.27	1.25	1.52	1.22	1.48	1.38	1.06	Verbenene
-	1.62	1.17	1.35	2.45	1.23	-	0.69	-	Filifolone
-	1.32	1.07	-	1.38	-	1.62	1.51	2.17	Delta. 3 Carene
-	1.06	0.75	0.77	1.22	0.88	1.14	1.05	0.74	Verbenone
-	0.79	0.66	-	0.88	0.68	0.96	-	0.70	Phellandrene
1.08	-	0.63	0.61	1.02	-	-	-	-	Tricyclene

Bist *et al* (2000) reported that the addition of nitrogen to the soil increased Carvone percent, whereas Dill-apiol percent of Dill (*Anethum graveolens* dhi) seed essential oil dropped. Khan et al (1999) reported solid fertilizers increased the amount of anethole in (*Foeniculum vulgare)* essential oil and reduced amount of fenchone. Due to changes in the amount of composition essential oil of medicinal plants is affect the environmental conditions, crop nutrients and other factors placed (Abaszade *et al.,* 2006). According Table 5, all fertilizers treatment affected on these compounds and the difference between them has been statistically highly significant in 1% level. Most compounds in essential oil of rosemary in this experiment, including Alpha-Pinene, 1,8 cineol, Camphene, Camphor, Borneol, Caryophyllene and Bornyl acetate, this 7 types of compounds as the major compounds of the essential oil of rosemary. Alpha-Pinene had the highest amount about 16.09 to 27.18 percent (compound dominant) and Bornyl acetate had lowest amount about 0.91 to 10.2 among all rosemary essential oil compounds (Table 6).

Table 5: Mean square of the effect of used treatment on the major component of the herb rosemary.

Bornyl acetate	Caryophyllene	Borneol	Camphor	Camphene	1,8-Cineole	Alpha-Pinene	Degrees of freedom	Sources of variation
63.532**	15.934**	33.159**	163.189**	12.981**	125.172**	34.619**	8	Treatment
0.012	0.027	0.009	0.004	0.027	0.017	0.025	25	Error
1.95	2.70	1.48	0.96	1.68	1.06	0.76	--	CV

*High significant at 1%

Table 6: Table Mean comparison of the effects of fertilizer treatments on some of the major components of the herb rosemary.

Bornyl acetate (%)	Caryophyllene (%)	Borneol (%)	Camphor (%)	Camphene (%)	1,8-Cineole (%)	Alpha-Pinene (%)	Treatment
8.76^{c}	5.62^{e}	6.64^{e}	9.66^{c}	7.97^{h}	15.30^{c}	20.22^{f}	Control
10.02^{a}	7.25^{cd}	5.73^{h}	0^{f}	9.45^{e}	18.30^{a}	22^{c}	Vermicompost
0.91^{gh}	9.39^{a}	7.71^{c}	0^{f}	13.23^{a}	9.62^{fg}	27.18^{a}	Sheep manure
5.46	8.32	6.72	0	11.34	13.96	24.59	Total Average
9.45^{b}	4.60^{fg}	7.31^{d}	14.01^{a}	10.24^{c}	9.66^{f}	20.49^{de}	N150-P150
7.46^{de}	4.12^{h}	6.61^{ef}	10.91^{d}	10.11^{cd}	12.54^{e}	16.09i	N150-P200
7.5^{d}	4.79^{f}	10.03^{a}	11.5^{c}	9.42^{f}	14.97^{d}	19.96^{g}	N150-P250
7.07^{f}	3.76^{i}	9.46^{b}	13.32^{b}	8.73^{g}	14.97^{d}	19.82^{gh}	N200-P150
1.07^{g}	7.44^{c}	6.03^{g}	0^{f}	11.93^{b}	17.39^{b}	22.54^{b}	N200-P200
0^{i}	8.18^{b}	0^{i}	0^{f}	7.65^{i}	0^{h}	20.55^{d}	N200-P250
6.51	5.48	7.88	12.43	9.68	13.90	19.90	Total Average

* Numbers with at least one common letter are statistically significant at the 5% level, no significant differences.

According to table 6, the highest and lowest amount of Alpha-Pinene respectively obtained from sheep manure and chemical fertilizer (N150- P200). Sheep manure used in this experiment has been able increased the amount of Alpha-Pinene to about 23% than the vermicompost and 34.42% increased compared to the control. Average amount of Alpha-Pinene obtained by organic fertilizers (treatments vermicompost and Sheep manure), about 31% higher than chemical fertilizers (treatment N150-P150, N150-P200 and N150-P250). This indicated that organic fertilizers be most effective than chemical fertilizers to increase compounds in this essential oil. Increase the amount of Alpha-Pinene of Rosemary essential oil due to high levels of micro-nutrients in fertilizers.

The maximum percentage of 1, 8 cineol observed from manure vermicompost, and the lowest observed from manure treatment, so the amount obtained from vermicompost about 90% higher than sheep manure. The amounts of 1, 8 cineol obtained by organic fertilizers (treatments vermicompost and Sheep manure), was roughly equal to the average amount obtained from chemical fertilizers (treatment N150-P150, N150-P200 and N150-P250). Vermicompost treatment increased amount of 1, 8-cineol compound (19.60%) compared to the control. Khalesru *et al* (2011), stated among different level of vermicompost, the higher amount of Anethole and Methyl Chavicol in Anise plant (*Pimpinella anisum*) obtained by vermicompost (10 ton/ha). Based on the results of this study, the application of vermicompost increased amount and composition of the essential oils such as Anethole and Methyl Chavicol. Vermicompost also improved amount and quality Roman chamomile essential oil (Luic & Pank, 2005).

Vermicompost increased amount nitrogen, phosphorus and potassium in plant seed. Most composition percent camphene obtained in sheep manure treatment and the lowest amount obtained from chemical fertilizer (N200-P250). The amount of Camphene composition in sheep manure was more than other treatments, so that increased 40% and 66% respectively compared to the control and the vermicompost. The average amount of Camphene obtained from organic fertilizers, 14/17 percent more than the average amount of obtained from chemical fertilizers. The maximum amount of Camphor observed from The N150-P150 treatment, that increased 45% compared to control. In a study on Thyme herb reported the NP treatment had the highest effected on percentage of Carvacrol (Sharafzadeh *et al.*, 2008).

The highest and lowest percentage of Borneol compound obtained from N150-P250andvermicompost treatment respectively and the average amount of the chemical fertilizer 26/17% more than the average amount of the organic fertilizers. Also this treatment increased the amount of Borneol about 51%tocontrol. According to research on the Labiateae plants Pourhadi (2011) showed that nitrogen fertilizer treatments had significant effect on the amount of Menthol in peppermint essential oil, so that the maximum amount of Menthol in 75 and 100 kg/ha urea treatment and lowest was obtained in the control treatment.

The highest and lowest of Caryophyllene compound obtained in sheep manure and N200-P150 treatments. Among organic fertilizers, sheep manure increased Caryophyllene composition 30 percent more than vermicompost and 67 percent compared to the control. Caryophyllene average rate obtained from organic fertilizers 82/51% more than the average amount of chemical fertilizers. Vermicompost fertilizer treatments increased Burnyl acetate amount in the herb rosemary to 90% compared to sheep manure and 38/14 percent compared to the control.

The results showed that the average amount of Burnyl acetate obtained from organic and chemical fertilizers. Other studies showed that the favorable effect of vermicompost due to improve microbial and biological properties of culture medium and also regulate pH and significant increase of water-holding capacity (McGinnis *et al.*, 2003). According to the results, the average major compounds obtained by organic fertilizers 17 to 51 percent higher than chemical fertilizers. As shown in Table 3, the average dry yield, essential oil and oil yield obtained by organic fertilizers increased respectively 20, 42 and 75% compared to chemical fertilizers.

Thus it can be stated that organic fertilizers used in this experiment, besides being able to increase dry yield, the amount and yield of rosemary essential oil compare to control and chemical fertilizers, increased the amount and type of compounds in the herb rosemary. Among organic fertilizers, vermicompost increased only two types of large component (1,8-cineole and Burnyl acetate) than sheep manure but sheep manure increased 4 types of large component (Alpha-Pinene, Camphene, Burnyl and Caryophyllene than vermicompost. On the other hand, the highest percentage of the three main compounds rosemary essential oil obtained by sheep manure. So can use sheep manure compared to vermicompost recommended to enhance the performance of the essence, amount and type of constituents of the herb rosemary in the climatic conditions of experimental site. Therefore it can be said that nutritional factors can affect the type and percentage chemical composition of the essential. Also the result of Abaszadeh *et al.* (2006) studies confirms this subject, they stated that by using feed the plant can acted to produce purposeful of medicinal plants and chemical composition of the active ingredient in a pharmaceutical plant changed, and by identify nutritional factors influencing the amount and type of plant oils and how to apply them, medicinal plants with a variety of specific compounds or compound with a high percentage can be produced

CONCLUSION

All treatments were applied (organic and chemical fertilizers) had statistically significant at the 1% difference on all tested traits such as dry yield, essential oil and type and amount of compound of the essential oil compared to the control. Organic fertilizers are used in this experiment increased all studied traits statistically compared to chemical fertilizers, so that the average dry yield, essential oil, essential oil yield and the average percentage of the major compounds of the essential oil increased by organic fertilizers, respectively, 20, 42, 75 and 17 to 51 percent compared to chemical fertilizers. Among the organic fertilizers, sheep manure had the highest dry yield (1344 kg ha), essential oil (3.72%) and essential oil yield (50.07 liters) compared to the controls increased 2, 2.4 and 4.5 higher. Among the compound of the essential oil, Alpha-Pinene with 27.18% gad the highest level and obtained by sheep manure treatment. Also this treatment increased 4 types of major compounds (Alpha-Pinene, camphene, Burnyl and Caryophyllene) compare to the vermicompost. On the other hand, among treatments, the highest percentage of the three main compounds of Rosemary plant (Alpha-Pinene, 1,8 cineol and camphene) obtained quantitatively by sheep manure.

So can be use sheep manure compared to vermicompost and other chemical treatments recommended to increase the dry yield, essential oil and type and amount of compound of the essential oil in the plant of Rosemary in climatic conditions of experimental site. However, the cost of production organic fertilizers is more than chemical fertilizers, but its long-term effects on soil properties, providing macro and micronutrients and maintain soil biology can increase qualitative and quantitative yield crops, as a result, while reducing the adverse effects of chemical fertilizers for plant health, soil and eventually humans, consecutive and optimal use of agricultural land as possible.

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