Original Article

Influence of Chicken Manure Applications on the Yield and the Essential Oil content of *Origanum onites* L.

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ABSTRACT

Background: *Origanum onites* L. is one of the most important export plant collected from natural flora and cultuvated in Turkey. **Methods:** This study was conducted to determine the effects of different doses of chicken manure on yield characteristics of *O. onites*, in Odemis, Izmir ecological conditions during 2014 and 2015 vegetation periods. The experiment was established as randomized blocks design with three replications and five chicken manure (0, 10, 20, 30, 40 ton ha^{-1}) were applied. **Results:** Plant height, fresh herb yield, dry herb yield, dry leaf yield, dry stem yield and essential oil content were significantly affected by year, harvest number and chicken manure doses. Mean value of the plant height ranged between 56.80 to 94.87 cm, fresh herb yield was 54000.0–135150.0 kg ha^{-1}, dry herb yield was 5770.7–31040.7 kg ha^{-1}, dry leaf yield was 3560.7–15470.7 kg ha^{-1} and dry stem yield was 1430.6–19060.0 kg ha^{-1}. The total essential oil content ranged between 3.5–5.4%. **Conclusion:** For the highest drog herb and drog leaf yields, which is the most important features for the production of oregano, 20 ton ha^{-1} of chicken manure application can be recommended. 30 ton ha^{-1} chicken manure dose can be suggested as the effective for the essential content.

Key words: Oregano, Fertilization, Fresh herb yield, Dry herb yield, Dry leaf yield, Essential oil.

INTRODUCTION

Oregano (*Origanum onites* L.) belongs to the Lamiaceae family is a perennial plant and is widespread in the West and South part of Turkey.[1] Turkey is one the biggest oregano producers in the world of exports 15 161 tons of oregano from $ 3.7 per kilogram in 2015.[2] The most exported Origanum species of Turkey are *Origanum onites*, *O. vulgare* subsp. *hirtum*, *O. minutiflorum*, *O. dubium*, *O. syriacum* var. *bevanii*. The other species used as oregano in our country are *Thymbra spicata, T. sintenisii, Coridothymus capitatus, Satureja cuneifolia, S. hortensis, S. montana, S.spicigera.*

Origanum genus is widely used as spices, flavouring of food products as well as cosmetic and cleaning industry. Also; their essential oils are used as natural food preservatives because of antioxidant and antimicrobial activities. The essential oil content of *Origanum onites* is ranging from 1.8% to 4.5%[3]. The main constituent of the Origanum essential oil is mostly carvacrol. A carvacrol content changing from 51.0% to 84.5%.[3]

Plant nutrition is one the most important factors that increase plant production and nitrogen is the most recognized in plants for its presence in the structure of the protein molecule.[3] The mineral nutrition of herbs can affect oil production and quality.[4] A successful fertilizing program adds enough nutrient elements to the soil to promote growth and/or oil production.[5] In sustainable agriculture, organic fertilizers not only supply plant nutrients but also improve soil organic matter contents.[6] Nitrogen fertilization reduced the essential oil content of some

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plants such as juniper, thyme, anise and cumin.[7] However; the essential oil concentration did not affect from the nitrogen application however, the herbage yield was affect.[8]

In this study, it was aimed to determine the effect of the chicken manure on the plant height, fresh herb yield, dry herb yield, dry leaf yield, dry stem yield and essential oil content of *Origanum onites* grown in Odemis, Izmir ecological conditions.

MATERIAL AND METHODS

Origanum onites L. seeds were obtained from Field Crops Department of Agriculture Faculty, Ege University in Izmir, Turkey. The field research was conducted in the Odemis Vocational School of Ege University during the 2014 and 2015 growing seasons. The experiment was established as randomized blocks design with three replications. The parcels were planned in six rows of 3 m length with 250 cm between rows and the plant density was 40×20 cm. Seedling date was on 21 May, 2013. In parcels 4 middle rows with 2.5 m length were harvested. Plants were harvested at florescence stage. First year harvest was made in 2013 not taking into consideration. Harvests were done on April 24th and July 2th, 2014 and in the second year were on May 21th and August 27th, 2015. Different chicken manure doses (control, 10, 20, 30, 40 tone ha^{-1}) were applied for three years in 2013, 2014, and 2015. Soil samples taken from 0–20 cm and 20–40 cm depth of the experiment field were analyzed in the Soil Laboratory of Odemis Vocational School of Ege University. The soil was sandy loam (69% sand, 24% loam, 7% clay) with 1.6% organic material and pH 7.3. At the end of the compositing process in chicken manure, the pH value was 6.02, and organic matter and total N contents were 6.80% and 0.35%, respectively. Available P (P_2O_5) was 22.5 mg kg^{-1} and the EC value was 0.04 ms in manure.

Plant heights were measured from soil level to the highest point with ten plants in each plot. Fresh herb yield was determined after the shelter side effects were left; the remaining plants in each plot were cut with saw knife 10 cm above the surface and immediately weighed for obtaining plot yield. Then plot yield was transformed to yield per hectare (ha^{-1}). Dry leaf yield was obtained from a sample of 500 g of the fresh herb taken from each plot; these samples were then dried in an oven at 30°C for 72 h and the samples were weighed. Then the leaves of the samples were separated from the stem by hand and weighed. The ratio of dry leaves to fresh herb was thus obtained and the dry leaves yield was calculated per hectare. The essential oils were extracted by hydro distillation for 3 h using a Clevenger type apparatus with 10 g of the oven-dried samples at 30°C for 72 h harvested from each plot in different harvest time in both years. The essential oils were stored in dark glass bottles at 4°C until analysis.[9] The essential oil content was measured by the volumetric method (v/w).[10] Every characteristic were subjected to analysis of variance in the TARIST statistics soft-ware package according to the experimental design of randomized blocks. Differences were determined by the F test and mean values were compared according to LSD test.

RESULTS AND DISCUSSION

The studied parameters were found statistically different under the different chicken manure fertilization doses. All the research factors and their interactions were found statistically significant for all the fresh herb yields. The application doses of chicken manure were examined in terms of the fresh herb yield and stem yield; 40 ton ha^{-1} application provided the highest value; by comparison 20 ton ha^{-1} application was the most highest for the herb and leaf yields. The highest value for the essential oil content was obtained from 30 ton ha^{-1} chicken manure doses.

Significant differences were observed between year, harvest time, and their interactions for the plant heights (Table 1). Plant heights varied between 56.80 and 94.87 cm in the first year and 69.87 and 91.17 cm in the second year. In interaction between the year and harvest time, the highest plant heights were 89.69 cm in first harvest for the first year and 85.00 cm in the second harvest for the second year. There was no similarity found among the years according to harvest times.

The interaction of the year, harvest time and chicken manure application doses were found statistically significant for fresh herb, dry herb, dry leaf and dry stem yields (Table 1, 2, 3). Fresh herb yields varied between 54000.0 and 135150.0 kg ha^{-1}in the first year; 21850.0 and 65650.0 kg ha^{-1} in the second year. When the general averages of fresh herb yields were investigated for the first year, the highest values were recorded from the 40 ton ha^{-1} application for the 1th harvest and the control for 2th harvest. For the second year, the highest values were obtained from the 40 ton ha^{-1} application for the 1th harvest and the 20 ton ha^{-1} application for 2th harvest. The similarity was found for the first harvests in terms of the manure applications for the years but it was not valid for the second harvests.

Dry herb yields varied between 13918.3 and 31047.1 kg ha^{-1} in the first year; 5776.7 and 18010.9 kg ha^{-1} in the second year. In the first year, 40 and 30 ton ha^{-1}

Table 1: Mean values of plant height (cm) and fresh herb yield (kg ha^{-1}) of *Origanum onites* L. in different, year, harvest times and chicken manure doses

	PLANT HEIGHT (cm)				FRESH HERB YIELD (kg ha^{-1})			
	First Year		Second Year		First Year		Second Year	
CMD*	1th harvest	2th harvest	1th harvest	2th harvest	1th harvest	2th harvest	1th harvest	2th harvest
0	82.10***	59.97	70.33	77.27	64300.0 d	71133.3 a	28000.0 c	21850.0 c
10	88.17	62.00	69.87	83.93	90400.0 c	66733.3 ab	45250.0 ab	48750.0 b
20	93.40	56.80	75.53	91.00	96850.0 c	59600.0 ab	53950.0 a	65650.0 a
30	94.87	59.33	72.67	81.63	120666.7 b	54000.0 b	37950.0 bc	50650.0 b
40	89.90	59.27	75.67	91.17	135150.0 a	55833.3 b	56100.0 a	56250.0 ab
Mean	89.69 a	59.47 b	72.81 b	85.00 a	101470.3	61460.0	44250.0	48630.0
LSD(yxh): 3.618					LSD(yxhxd):13585.4			

*: Chicken manure doses, **: y: year, h: harvest, d: chicken manure doses; ***: The columns with different letters mean statistically different according to LSD($p \leq 0.05$) test.

Table 2: Mean values of dry herb yield (kg ha^{-1}) and drog leaf yield (kg ha^{-1}) of *Origanum onites* L. in different, year, harvest times and chicken manure doses

	DRY HERB YIELD (kg ha^{-1})				DRY LEAF YIELD (kg ha^{-1})			
	First Year		Second Year		First Year		Second Year	
CMD*	1th harvest	2th harvest	1th harvest	2th harvest	1th harvest	2th harvest	1th harvest	2th harvest
0	16360.8c	17593.9a	7064.0 c	5776.7 c	8779.3d	9638.6a	4324.0c	3566.5c
10	22713.6b***	15632.2a	11964.5ab	12242.3b	11210.5cd	8838.4a	6925.1ab	7569.0b
20	24243.9b	15140.4a	14898.8a	18010.9a	12605.0bc	8006.9a	8683.9a	10373.4a
30	30184.0a	13918.3a	10049.6bc	13123.4b	15477.0a	8100.5a	5705.7bc	8445.0ab
40	31047.1a	14452.8a	15573.1a	15011.0ab	14093.0ab	7864.3a	8562.0b	8412.1 ab
Mean	24909.9	15347.5	11910.0	12832.9	12433.0	8489.7	6840.1	7673.2
LSD(yxhxd): 4241.0					LSD(yxhxd): 2438.5			

*: Chicken manure doses, **: y: year, h: harvest, d: chicken manure doses; ***: The columns with different letters mean statistically different according to LSD($p \leq 0.05$) test.

Table 3: Mean values of drog herb yield (kg ha^{-1}) and essential oil content (%) of *Origanum onites* L. in different, year, harvest times and chicken manure doses.

	DROG STEM YIELD (kg ha^{-1})				ESSENTIAL OIL CONTENT (%)		
	First Year		Second Year				
CMD	1th harvest	2th harvest	1th harvest	2th harvest	1th year	2th year	Mean
0*	7960.1 c***	7629.7 a	2737.7 b	1436.3 c	3.78 b	4.33 b	4.06 c
10	11830.4 b	6333.8 a	4746.3 ab	3709.9 bc	3.85 b	4.82 ab	4.33 bc
20	13078.8 b	6617.7 a	5429.3 a	6501.5 a	4.50 a	4.78 ab	4.64 ab
30	18568.0 a	5429.9 a	3854.1 ab	5048.0 ab	4.67 a	5.07 a	4.87 a
40	19060.4 a	5760.1 a	5724.5 a	5958.6 ab	4.68 a	4.37 b	4.53 ab
Mean	14099.6	6354.3	4498.4	4530.9	4.30 b	4.67 a	4.48
LSD(yxhxd):2397.5					LSD(yxd): 0.532; LSD(d):0.376		

*: Chicken manure doses, **: y: year, h: harvest, d: chicken manure doses; ***: The columns with different letters mean statistically different according to LSD($p \leq 0.05$) test.

applications were found significantly different for the first harvest, respectively; but there were no differences were found among the manure doses in the second harvests. For the second year, 40 and 20 ton ha^{-1} applications were found significantly different for the first harvest, respectively; and the 20 ton ha^{-1} was found for the second harvest.

Dry leaf yields varied between 7864.3 and 15477.0 kg ha^{-1} in the first year; 3566.5 and 10373.4 kg ha^{-1} in the second year. In the first year, 30 ton ha^{-1} applications were found significantly different for the first harvest, but there were no differences were found among the manure doses in the second harvests. For the second year, 20 ton ha^{-1} applications were found significantly different for the first and the second harvests.

Dry stem yields varied between 5429.9 and 19060.4 kg ha^{-1}in the first year; 1436.3 and 6501.5 kg ha^{-1} in the second year. In the first year, 40 and 30 ton ha^{-1} applications were found significantly different for the first harvest, respectively; but there were no differences were found among the manure doses in the second harvests. In the second year, 40 and 20 ton ha^{-1} applications were found significantly different, respectively; and the 20 ton ha^{-1} was found for the second harvest.

Significant differences were observed between year, chicken manure doses, year X harvest time and year X chicken manure dose interactions for essential oil content. As can be seen in table 3, the essential oil content ranged between 3.78 and 4.68 % in the first year and between 4.33 and 5.07 % in the second year and the general average of essential oil content was investigated as 4.48%. In the first year the highest contents were obtained from 40, 30 and 20 ton ha^{-1} applications, respectively and were found statistically different then control and 10 ton ha^{-1} applications. In the second year the highest content was investigated from the 30 ton ha^{-1} application with 5.07%. When the general averages of the chicken manure doses were compared, the highest value was recorded from 30 ton ha^{-1} application with 4.87 % as it was found to be statistically significant.

CONCLUSION

Some researchers revealed that the nitrogen fertilization promotes the herbage yields and essential oil contents[4,5,7] and some others also emphasized that the essential oil concentration did not affect from the nitrogen application however, the herbage yield was affect[8,11] and describe as follows nitrogen promotes the branching and secondary stems so the oil concentration is affected by cultivation period but not by nitrogen.[11]

As a result of the study it was seen that the different chicken manure doses applied to oregano plants were effective on the yields characteristics and essential oil contents. For the dry herb and dry leaf yields, which is the most important features for the production of oregano, 20 ton ha^{-1} of chicken manure application can be recommended. 30 ton ha-1 chicken manure dose can be suggested as the effective for the essential content.

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CONFLICT OF INTEREST

None

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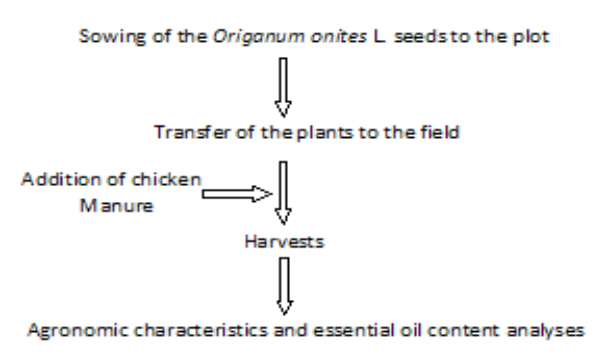
PICTORIAL ABSTRACT



SUMMARY

- *Origanum onites* L. is a widespread in West and South part of Turkey and Turkey is one of the biggest oregano producers in the world and exports.
- This study was conducted to determine the effects of different doses of chicken manure on yield characteristics and essential oil content of *Origanum onites* L., in Odemis, Izmir ecological conditions during 2014 and 2015 vegetation periods.
- Plant height, fresh herb yield, dry herb yield, dry leaf yield, dry stem yield and essential oil content were examined as characteristics.
- Plant height, fresh herb yield, dry herb yield, dry leaf yield, dry stem yield and essential oil content were significantly affected by year, harvest number and chicken manure doses.
- Mean value of the plant height ranged between 56.80 to 94.87 cm, fresh herb yield was 21850.0–135150.0 kg ha-1, dry herb yield was 5770.7–31040.7 kg ha-1, dry leaf yield was 3560.7–15470.7 kg ha-1 and dry stem yield was 1430.6–19060.0 kg ha-1.
- The total essential oil content ranged between 3.5–5.4%.
- For the drog herb and drog leaf yields, which is the most important features for the production of oregano, 20 ton ha-1 of chicken manure application can be recommended.
- 30 ton ha-1 chicken manure dose can be suggested as the effective for the essential content.

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