

## Effect of Chicken Manure and Humic Acid on Herb and Essential Oil Production of *Ocimum sp.*

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**Abstract:** This experiment was conducted at the Ornamental Horticulture Department, Faculty of Agriculture, Cairo University, Giza, Egypt during the two successive seasons of 2012 and 2013. This experiment was designed to study the effect of chicken manure, humic acid and their interactions on growth characters, essential oil percentage and number of glands of *Ocimum sp.* (*O. basilicum*, *O. sanctum* and *O. citriodorum*). The obtained results showed that using chicken manure at 10m<sup>3</sup>/feddan and humic acid at 125 ppm increased all growth parameters (plant height, number of branches, leaf area, herb fresh and air dry weights) and oil percentage in herb compared to the other treatments. *Ocimum* plants treated with chicken manure at 10m<sup>3</sup>/feddan and sprayed with humic acid at 125ppm gave the highest number of glandular hairs on the upper surface of *Ocimum* leaves compared to the other treatments. *Ocimum basilicum* gave the biggest number of glandular hairs /leaf.

**Key words:** *Ocimum sp.* • Chicken manure • Humic acid • Glandular hairs

### INTRODUCTION

*Ocimum sp.* are annual and perennial herbs and shrubs, mostly native to the tropical and warm temperate regions. They are members of the Lamiaceae family and are cultivated worldwide under a variety of ecological conditions. The genus *Ocimum* consists of 50-150 species with a large number of varieties [1]. Among the species of the genus, *Ocimum basilicum*, L. (sweet basil) is the major essential oil crop around the world and is cultivated in many countries. Basil has been used as a medicinal and aromatic plant for centuries. Due to their pharmaceutical and medical properties, basil species are used in the treatment of headaches, cough, diarrhoea, antihelminthic treatments and in kidney dysfunctions. The leaves can be used fresh and dried, as edibles or spices [2].

Environmental pollution due to excessive application of chemical fertilizers is one of the most important environmental and social concerns throughout the world especially in developing countries [3]. Soil organic matter has beneficial effects on soil quality and positive effects on crop productivity [4]. Al-Fraihat *et al.* on marjoram plants showed that plant height and number of branches were significantly affected by addition of organic fertilizer

[5]. Cattle manure had a significant positive effect on oil yield of *Ocimum basilicum* L. whereas its effect on other members of the variety (*Ocimum basilicum* L. cv. Purple and *Ocimum basilicum* L. cv. Green), was insignificant [6].

Humic acid exists in soil with high levels of organic matters. They are formed by microbial decay of plant tissues [7]. Humic acid is a negatively charged colloid recalcitrant to biodegradation. Therefore it can be stored in soil for a long time [8]. Prabhu *et al.* [9] found that sacred basil (*Ocimum sanctum*) leaves with humic acid increased plant height, number of leaves, leaf area and leaf area index at both stages of the plant growth.

The objective of this study was to investigate the effect of chicken manure and humic acid on growth, essential oil production and external secretory structures (glands) of *Ocimum* plants (*O. basilicum*, *O. sanctum* and *O. citriodorum*).

### MATERIALS AND METHODS

This study was carried out at the Department of Ornamental Horticulture, Faculty of Agriculture, Cairo University, Giza, Egypt during the two successive seasons of 2012 and 2013. Seeds of *Ocimum sp.*

(*O.basilicum*, *O. sanctum* and *O. citriodorum*) were obtained from Sekem Company, Egypt. The seeds were sown in clay medium on 15<sup>th</sup> February 2012 and 2013 (in the two seasons) in nursery beds inside greenhouse. Forty days after sowing, the seedlings were 12-15 cm in height. They were then transplanted to prepared plastic pots (25 cm) at the experimental field in the two seasons. Chicken manure were applied before transplanting at the rates of 10m<sup>3</sup>/feddan (100 g/pot) and 20m<sup>3</sup>/feddan (200 g/pot). One month after transplanting, humic acid was applied at the rates of 125 and 250 ppm. Humic acid application was also repeated after every cut. NPK treatment was fertilized with kristalon (NPK 19:19:19) at rate of 5 g/pot. Fertilization with kristalon started after one month from transplanting and repeated after every cut. These treatments were carried out for each of the *Ocimum* sp. (*O.basilicum*, *O. sanctum* and *O. citriodorum*) in the two seasons.

The Fertilization Treatments Were as Follows:

- Control(without fertilization)
- Recommended dose of NPK (19N:19P<sub>2</sub>O<sub>5</sub>:19K<sub>2</sub>O, 5 g plant<sup>-1</sup>)
- Chicken manure at 10m<sup>3</sup>/feddan (100 g/pot)
- Chicken manure at 20m<sup>3</sup>/feddan (200 g/pot)
- Humic acid at 125 ppm
- Humic acid at 250 ppm
- Chicken manure at 10m<sup>3</sup>/feddan (100 g/pot) and humic acid at 125 ppm

**Recorded Data:** The plants were harvested three times at the early bloom stages (on 15<sup>th</sup> June, 15<sup>th</sup> July and 15<sup>th</sup> August 2012 and 2013 in the two seasons).The plants were harvested by cutting vegetative parts at 10 cm above the soil surface.

**Data Were Recorded in the Two Seasons as Follows:**

- Plant height (cm).
- Number of branches/ plant.
- Leaf area (cm<sup>2</sup>) of the fifth leaf from above.
- Fresh weight of herb (g/plant).
- Air dry weight of herb(g/plant).
- Essential oil percentage in the fresh herb.
- Number of glandular hairs per unit surface area of leaves (0.04 cm<sup>2</sup>) and per leaf in the second cut of the first season.

**Anatomical Characteristics:** Pieces of 3 to 10 mm size were cut out of the leaves. The cut faces were sealed with glue (conductive carbon glue or two-component epoxy glue). The pieces were mounted on scanning electron microscope (SEM) stubs with a conductive adhesive tab. The fresh samples were examined without metal coating [10].

**Essential Oil Percentage in the Fresh Herb:** The oil percentage was determined in fresh herb in both seasons using the hydro-distillation method by Clevenger apparatus according to Guenther [11]. A known weight of fresh herb (100 g) was placed in a flask of 1 L capacity for distillation and an adequate amount of water was added. A proper essential oil trap and condenser were attached to the flask and enough water was added to fill the trap. The distillation continued for three hours until no further increase in the oil was observed. After finishing the distillation process the apparatus was left to be cooled and the essential oil percentage was estimated as follows:

$$\text{Essential \%} = \frac{\text{Essential oil vol. (Measuring pipette reading)}}{\text{Weight of sample}} \times 100$$

The oil was dried by sodium sulphate anhydrous.

**Statistical Analysis:** This experiment was designed using randomized complete block design with three factors; the first was treatments (7), the second was the *Ocimum* sp. (3) and the third was the cuts (3). Recorded data on growth characters were statistically analyzed and separation of means was performed using the Least Significant Difference (L.S.D.) test at the 5% level [12].

## RESULTS AND DISCUSSION

### Vegetative Growth

**Plant Height:** Data presented in Tables (1 and 2) showed the effect of chicken manure and humic acid on plant height of *Ocimum* sp. in both seasons. Treated *Ocimum* sp. by chicken manure at 10 m<sup>3</sup> /feddan (100 g/pot) and humic acid at 125 ppm gave the highest value of plant height (52.49 and 50.58cm) in the first and the second seasons, respectively.

Plant height was also significantly affected by variation of *Ocimum* sp. of *Ocimum*. In the first season, *Ocimum sanctum* recorded the tallest plants (a mean of 50.71cm) but *Ocimum citriodorum* gave the shortest plants (a mean of 44.31 cm). However in the second

Table 1: Effect of chicken manure and humic acid on plant height (cm) of *Ocimum sp.* in the first season, 2012.

Treatments	<i>Ocimum sp.</i>	First season, 2012			Mean a
		1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut	
Control	<i>O. basilicum</i>	41.99	41.00	45.00	43.22
	<i>O. sanctum</i>	42.03	44.83	53.67	
	<i>O. citriodorum</i>	39.44	34.98	46.00	
NPK(5 g/pot)	<i>O. basilicum</i>	50.54	48.00	56.50	51.63
	<i>O. sanctum</i>	47.02	47.17	69.83	
	<i>O. citriodorum</i>	48.50	39.56	57.54	
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)	<i>O. basilicum</i>	45.95	42.30	48.17	44.66
	<i>O. sanctum</i>	45.70	42.68	51.33	
	<i>O. citriodorum</i>	41.38	37.22	47.25	
Chicken manure at 20m <sup>3</sup> /feddan(200g/pot)	<i>O. basilicum</i>	44.40	44.57	41.33	44.74
	<i>O. sanctum</i>	44.75	45.14	57.67	
	<i>O. citriodorum</i>	37.38	36.89	50.50	
Humic acid at 125 ppm	<i>O. basilicum</i>	46.88	42.16	53.17	48.28
	<i>O. sanctum</i>	44.46	45.36	62.83	
	<i>O. citriodorum</i>	44.15	36.17	59.11	
Humic acid at 250 ppm	<i>O. basilicum</i>	47.05	42.91	50.33	46.04
	<i>O. sanctum</i>	44.30	45.37	60.83	
	<i>O. citriodorum</i>	44.10	36.10	43.39	
Chicken manure at 100 g/pot +Humic acid at 125 ppm	<i>O. basilicum</i>	48.95	46.72	56.17	52.49
	<i>O. sanctum</i>	48.94	50.54	70.17	
	<i>O. citriodorum</i>	48.58	41.98	60.33	
Mean b		46.86	50.71	44.31	
Mean c		45.07	42.47	54.34	
LSD value at 0.05					
Treatments (a) = 1.79	<i>Ocimum sp.</i> (b) = 1.31	Cuts (c)=1.17		Interaction(abc)= 5.99	
NPK= Full dose of NPK as recommended dose kristalon (NPK 19:19:19) at 5 g/pot					

Table 2: Effect of chicken manure and humic acid on plant height (cm) of *Ocimum sp.* in the second season, 2013.

Treatments	<i>Ocimum sp.</i>	Second season, 2013			Mean a
		1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut	
Control	<i>O. basilicum</i>	39.27	37.00	37.71	37.82
	<i>O. sanctum</i>	37.16	37.69	36.65	
	<i>O. citriodorum</i>	31.89	48.33	34.71	
NPK(5 g/pot)	<i>O. basilicum</i>	49.33	43.33	43.89	46.76
	<i>O. sanctum</i>	40.78	49.11	44.12	
	<i>O. citriodorum</i>	42.83	62.33	45.11	
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)	<i>O. basilicum</i>	44.00	37.22	37.27	40.20
	<i>O. sanctum</i>	41.50	42.60	41.59	
	<i>O. citriodorum</i>	35.22	42.33	40.05	
Chicken manure at 20m <sup>3</sup> /feddan(200g/pot)	<i>O. basilicum</i>	42.22	37.61	37.94	40.47
	<i>O. sanctum</i>	39.42	41.50	40.13	
	<i>O. citriodorum</i>	37.89	48.33	39.22	
Humic acid at 125 ppm	<i>O. basilicum</i>	42.28	37.44	36.11	39.49
	<i>O. sanctum</i>	37.22	41.76	39.88	
	<i>O. citriodorum</i>	35.17	45.33	40.22	
Humic acid at 250 ppm	<i>O. basilicum</i>	45.11	39.55	36.27	41.27
	<i>O. sanctum</i>	40.67	40.78	40.72	
	<i>O. citriodorum</i>	36.22	54.00	38.11	
Chicken manure at 100 g/pot +Humic acid at 125 ppm	<i>O. basilicum</i>	50.22	45.00	44.78	50.58
	<i>O. sanctum</i>	44.67	49.89	46.28	
	<i>O. citriodorum</i>	48.89	63.83	61.66	
Mean b		41.12	41.62	44.37	
Mean c		41.04	45.00	41.07	
LSD value at 0.05					
Treatments (a) = 2.49	<i>Ocimum sp.</i> (b) = 1.56	Cuts (c)= 1.45		Interaction(abc)= 7.13	
NPK= Full dose of NPK as recommended dose kristalon (NPK 19:19:19) at 5 g/pot					

season, plants of *Ocimum citriodorum* were significantly taller (44.37cm) than *Ocimum sanctum* and *O. basilicum* plants.

Regarding the timing of cuts, it can be seen from data in Tables (1 and 2) that *Ocimum sp.* in the third cut gave the tallest plants in the first season (54.34cm), but in the second season, the second cut gave the tallest plants (a mean of 45.00 cm). On the other hand, the second cut in the first season gave shorter plants (a mean of 42.47cm), but the first cut in the second season gave shorter plants (41.04cm).

Regarding the interaction between different treatments, *Ocimum sp.* variation and cuts, data reveal that, in the first season, *Ocimum sanctum* plants treated with chicken manure at 10 m<sup>3</sup> /feddan (100 g/pot) and sprayed with humic acid at 125 ppm in the third cut gave the tallest plants ( a mean of 70.17cm) followed by plants treated by NPK (69.83cm). Also, in the second season, *O. citriodorum* plants treated with chicken manure at 10 m<sup>3</sup> /feddan (100 g/pot) and sprayed with humic acid at 125 ppm in the second cut of showed the tallest plants (a mean of 63.83 cm).

Organic fertilization is very important for providing plants with their nutritional requirements without having an undesirable impact on the environment [13]. The increase in *Ocimum* plant height due to application of chicken manure might be attributed to the effect of organic fertilizer in improving physical, chemical and biological properties of soil; that is, increasing soil organic matter, cation exchange capacity, water holding capacity and availability of mineral nutrients. These results are in harmony with those obtained by other studies on marjoram [14, 15]. Similar increase in the height of plants receiving organic fertilizer and humic acid had been reported on sweet fennel [15]; on *Ruta graveolens* [16] and on *Melissa officinalis* [17].

**Number of Branches / Plant:** The results presented in Tables (3 and 4) showed that, in both seasons *Ocimum* plants treated with chicken manure at 10 m<sup>3</sup> /feddan (100 g/pot) and sprayed with humic acid at 125 ppm had the highest number of branches /plant(12.96 and 11.81 branches /plant in the first and second seasons, respectively), followed by plants treated with NPK

Table 3: Effect of chicken manure and humic acid on the number of branches per plant of *Ocimum sp.* in the first season,2012.

Treatments	<i>Ocimum sp.</i>	First season, 2012			Mean a
		1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut	
Control	<i>O. basilicum</i>	06.67	06.33	09.00	07.26
	<i>O. sanctum</i>	07.33	06.67	09.33	
	<i>O. citriodorum</i>	07.67	06.00	06.33	
NPK(5 g/pot)	<i>O. basilicum</i>	10.33	08.33	14.70	11.52
	<i>O. sanctum</i>	10.67	09.67	17.00	
	<i>O. citriodorum</i>	10.33	09.67	13.00	
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)	<i>O. basilicum</i>	8.333	07.00	8.667	09.26
	<i>O. sanctum</i>	9.333	07.33	14.67	
	<i>O. citriodorum</i>	09.67	08.67	9.667	
Chicken manure at 20m <sup>3</sup> /feddan(200g/pot)	<i>O. basilicum</i>	08.67	07.00	6.667	9.222
	<i>O. sanctum</i>	08.33	08.67	16.33	
	<i>O. citriodorum</i>	08.67	08.67	10.00	
Humic acid at 125 ppm	<i>O. basilicum</i>	08.33	06.00	9.667	09.11
	<i>O. sanctum</i>	06.33	08.00	18.00	
	<i>O. citriodorum</i>	08.00	07.33	10.33	
Humic acid at 250 ppm	<i>O. basilicum</i>	08.00	05.67	10.67	08.44
	<i>O. sanctum</i>	07.00	07.33	11.67	
	<i>O. citriodorum</i>	08.33	08.00	09.33	
Chicken manure at 10m <sup>3</sup> /feddan(100g/pot)+Humic acid at 125 ppm	<i>O. basilicum</i>	10.67	09.00	14.33	12.96
	<i>O. sanctum</i>	10.67	09.00	28.33	
	<i>O. citriodorum</i>	11.33	11.00	12.33	
Mean b		08.76	11.03	09.25	
Mean c		08.79	07.87	12.38	
LSD value at 0.05					
Treatments (a) = 0.69		<i>Ocimum sp.</i> (b) = 0.67 Cuts (c)= 0.69			Interaction(abc)= 3.09

NPK= Full dose of NPK as recommended dose kristalon (NPK 19:19:19) at 5 g/pot

Table 4: Effect of chicken manure and humic acid on the number of branches per plant of *Ocimum sp.* in the second season, 2013.

Treatments	<i>Ocimum sp.</i>	Second season, 2013			Mean a
		1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut	
Control	<i>O. basilicum</i>	06.67	04.33	05.67	06.26
	<i>O. sanctum</i>	07.33	07.33	06.33	
	<i>O. citriodorum</i>	07.00	05.67	06.00	
NPK(5 g/pot)	<i>O. basilicum</i>	10.00	08.67	11.67	10.11
	<i>O. sanctum</i>	10.00	09.33	11.00	
	<i>O. citriodorum</i>	10.67	09.33	10.33	
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)	<i>O. basilicum</i>	07.00	07.33	08.33	07.60
	<i>O. sanctum</i>	07.00	06.67	06.67	
	<i>O. citriodorum</i>	07.33	09.00	09.00	
Chicken manure at 20m <sup>3</sup> /feddan(200g/pot)	<i>O. basilicum</i>	07.33	07.33	06.33	7.481
	<i>O. sanctum</i>	07.33	06.67	08.00	
	<i>O. citriodorum</i>	07.67	08.00	08.67	
Humic acid at 125 ppm	<i>O. basilicum</i>	08.00	05.67	09.33	07.86
	<i>O. sanctum</i>	08.33	09.67	06.00	
	<i>O. citriodorum</i>	08.00	06.33	09.33	
Humic acid at 250 ppm	<i>O. basilicum</i>	06.33	06.00	10.67	07.82
	<i>O. sanctum</i>	08.00	07.33	08.67	
	<i>O. citriodorum</i>	09.00	07.67	06.67	
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)+Humic acid at 125 ppm	<i>O. basilicum</i>	11.33	09.33	12.67	11.81
	<i>O. sanctum</i>	11.00	12.33	14.33	
	<i>O. citriodorum</i>	11.00	11.00	13.33	
Mean b		08.10	08.54	08.62	
Mean c		08.40	07.86	09.00	
LSD value at 0.05					
Treatments (a) = 1.218	<i>Ocimum sp.</i> (b) = 0.51		Cuts (c) = 0.60		Interaction(abc) = 2.36

NPK= Full dose of NPK as recommended dose kristalon (NPK 19:19:19) at 5 g/pot

(11.52 and 10.11 branches /plant in the first and second seasons, respectively) compared to the control plants (7.26 and 6.26 branches /plant in the first and second seasons, respectively).

Concerning the effect of *Ocimum sp.* difference on number of branches/plant, remarkable changes were noted from season to season. In the first season *O. sanctum* had the highest number of branches/plant followed by *O. citriodorum* then *O. basilicum*. In the second season *O. citriodorum* gave the highest number of branches/plant followed by *O. sanctum* then *O. basilicum*.

Data in Tables (3 and 4) also indicate that the harvest time had a significant effect on the number of branches/plant. In both seasons, the third cut gave the highest number of branches/plant compared to the first and second cut (12.38 and 9.00 branches/plant in the first and the second seasons, respectively).

Regarding the interaction between different treatments, *Ocimum sp.* difference and the timing of cuts on the number of branches/plant in basil plants, data presented in Tables (3 and 4) showed that, the highest number of branches (28.33 and 14.33 branches/plant in the first and the second seasons, respectively) were obtained

from plants treated with chicken manure at 10 m<sup>3</sup>/feddan (100 g/pot) and sprayed with humic acid at 125 ppm in the third cut of *O. sanctum*.

The mean values of the number of branches at the third cut were higher than those of the first and second cuts, which could be attributed to the fact that cutting stimulated branching and increased new shoots which incorporate into more accumulation of dry matter [18]. A similar increase in the number of branches / plant was detected with the application of organic treatments by [19] on *Rosmarinus officinalis* and [20] on *Plantago arenaria*.

**Leaf Area (cm<sup>2</sup>):** The recorded results in the two seasons (Tables 5 and 6) showed that the plants treated with organic fertilizers (chicken manure) had an increased leaf area of *Ocimum sp.*, compared to control plants. In the first season, plants treated with NPK had the largest leaves with mean area of 13.89 cm<sup>2</sup>, whereas in the second season, plants treated with chicken manure at 10m<sup>3</sup>/feddan (100 g/pot) and sprayed with humic acid at 125 ppm had the largest leaves with a mean area of 17.53 cm<sup>2</sup>.

Table 5 : Effect of chicken manure and humic acid on leaf area(cm<sup>2</sup>) of *Ocimum sp.* in the first season,2012.

Treatments	<i>Ocimum sp.</i>	First season, 2012			Mean a
		1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut	
Control	<i>O. basicum</i>	9.507	10.65	11.06	07.40
	<i>O. sanctum</i>	05.46	06.65	06.68	
	<i>O. citriodorum</i>	06.77	05.20	04.65	
NPK(5 g/pot)	<i>O. basicum</i>	20.18	17.90	19.08	13.89
	<i>O. sanctum</i>	10.94	13.92	12.96	
	<i>O. citriodorum</i>	10.02	10.18	9.810	
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)	<i>O. basicum</i>	12.12	14.71	13.74	08.73
	<i>O. sanctum</i>	6.127	06.60	07.63	
	<i>O. citriodorum</i>	08.29	04.70	04.62	
Chicken manure at 20m <sup>3</sup> /feddan(200g/pot)	<i>O. basicum</i>	12.84	13.65	12.13	08.60
	<i>O. sanctum</i>	05.88	07.28	07.17	
	<i>O. citriodorum</i>	08.38	05.51	04.59	
Humic acid at 125 ppm	<i>O. basicum</i>	13.30	12.20	12.90	08.77
	<i>O. sanctum</i>	6.510	06.91	08.31	
	<i>O. citriodorum</i>	06.81	05.73	06.22	
Humic acid at 250 ppm	<i>O. basicum</i>	12.18	12.50	13.42	08.76
	<i>O. sanctum</i>	06.68	05.94	07.72	
	<i>O. citriodorum</i>	07.95	06.03	06.40	
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)+Humic acid at 125 ppm	<i>O. basicum</i>	17.57	18.41	18.43	13.31
	<i>O. sanctum</i>	10.54	12.59	12.67	
	<i>O. citriodorum</i>	10.00	10.45	9.117	
Mean b		14.21	08.34	07.21	
Mean c		09.91	09.89	09.97	
LSD value at 0.05					
Treatments (a) = 0.77	<i>Ocimum sp.</i> (b) = 0.74	Cuts (c)= N.S.		Interaction(abc)= 3.38	

NPK= Full dose of NPK as recommended dose kristalon (NPK 19:19:19) at 5 g/pot

Table 6 : Effect of chicken manure and humic acid on leaf area(cm<sup>2</sup>) of *Ocimum sp.* in the second season,2013.

Treatments	<i>Ocimum sp.</i>	Second season, 2013			Mean a
		1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut	
Control	<i>O. basicum</i>	13.72	14.69	10.04	08.56
	<i>O. sanctum</i>	09.37	07.68	07.96	
	<i>O. citriodorum</i>	05.46	04.42	03.68	
NPK(5 g/pot)	<i>O. basicum</i>	29.80	26.02	23.13	16.13
	<i>O. sanctum</i>	16.16	14.76	12.74	
	<i>O. citriodorum</i>	06.57	09.31	06.65	
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)	<i>O. basicum</i>	21.49	19.33	16.30	11.30
	<i>O. sanctum</i>	11.29	09.54	08.91	
	<i>O. citriodorum</i>	05.41	05.55	03.84	
Chicken manure at 20m <sup>3</sup> /feddan(200g/pot)	<i>O. basicum</i>	18.98	12.98	13.12	09.93
	<i>O. sanctum</i>	10.95	09.54	09.14	
	<i>O. citriodorum</i>	04.27	05.42	04.98	
Humic acid at 125 ppm	<i>O. basicum</i>	10.69	13.72	18.47	09.59
	<i>O. sanctum</i>	13.88	08.66	08.18	
	<i>O. citriodorum</i>	05.14	04.02	03.51	
Humic acid at 250 ppm	<i>O. basicum</i>	16.59	18.23	17.98	10.39
	<i>O. sanctum</i>	10.07	09.52	08.20	
	<i>O. citriodorum</i>	05.74	04.06	03.12	
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)+Humic acid at 125 ppm	<i>O. basicum</i>	31.11	32.05	25.84	17.53
	<i>O. sanctum</i>	16.75	14.55	14.84	
	<i>O. citriodorum</i>	07.67	08.15	6.787	
Mean b		19.25	11.08	05.42	
Mean c		12.91	12.01	10.83	
LSD value at 0.05					
Treatments (a) = 1.87	<i>Ocimum sp.</i> (b) = 1.01	Cuts (c)= 0.81		Interaction(abc)= 4.63	

NPK= Full dose of NPK as recommended dose kristalon (NPK 19:19:19) at 5 g/pot

Data in Tables (5 and 6) also showed that in both seasons the largest leaves (with mean areas of 14.21 and 19.25 cm<sup>2</sup> in the first and the second seasons, respectively) were obtained in *O. basilicum* compared to other *Ocimum sp.* (*O. sanctum* and *O. citriodorum*).

Presented data showed that, in the first season the timing of cuts had no significant effect on leaf area of *Ocimum sp.* On the other hand, the timing of cuts had significant effect on leaf area in the second season. The largest leaves (12.91 cm<sup>2</sup>) were obtained in the second season from the first cut compared to other cuts.

The interaction between the three factors (different treatments, *Ocimum sp.* variation and the timing of cuts) revealed that in the first season, the largest leaves were obtained from plants treated with NPK in the first cut of *O. basilicum* (20.18 cm<sup>2</sup>). However, in the second season plants treated with chicken manure at 10m<sup>3</sup>/feddan (100 g/pot) and sprayed with humic acid at 125 ppm in the second cut of *O. basilicum* gave the largest leaves (32.05 cm<sup>2</sup>).

Chicken manure and humic acid significantly promoted leaf area. The possible reason for this acceleration of growth might be due to the increase in nitrogen content, being the chief constituent of protein

essential for the formation of protoplasm, which leads to cell division and cell enlargement [21]. The effect of humic acid on growth characters may be due to the presence of cytokinin and its effect on cell elongation [22]. These results agree with those obtained by [17] on *Melissa officinalis*; [9] on *Ocimum sanctum* and [23] on *Ocimum basilicum*.

**Herb Fresh Weight (g/ Plant):** Data presented in Tables (7 and 8) showed that plants treated with chicken manure at 10 m<sup>3</sup>/feddan (100 g / plant) and sprayed with humic acid at 125 ppm had a significant highest herb fresh weight. The values were 308.9 and 292.7 g/plant in the first and second seasons, respectively.

In the first season, the variation of *Ocimum sp.* had no significant effect on plant fresh weight. *O. basilicum* gave the heaviest fresh weight (229.9 g/plant). The highest total yield per plant obtained from *O. sanctum* (1029.6 g/plant/season) in the first season. On the contrary, *Ocimum sp.* variation in the second season had a significant effect on fresh weight of plant. In the second season, the highest total yield per season was obtained from *O. citriodorum* (899.6 g fresh weight/ plant/season).

Table 7 : Effect of chicken manure and humic acid on herb fresh weight(g/plant) of *Ocimum sp.* in the first season,2012.

Treatments	<i>Ocimum sp.</i>	First season, 2012			Mean a	Total yield/ plant/season
		1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut		
Control	<i>O. basilicum</i>	195.5	208.6	164.3	169.3	568.4
	<i>O. sanctum</i>	144.8	136.8	143.7		425.3
	<i>O. citriodorum</i>	162.7	227.7	139.9		530.3
NPK(5 g/pot)	<i>O. basilicum</i>	338.5	321.0	236.3	307.8	895.8
	<i>O. sanctum</i>	245.2	305.2	424.8		975.2
	<i>O. citriodorum</i>	352.9	308.2	238.5		899.6
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)	<i>O. basilicum</i>	255.9	278.5	171.3	223.3	705.7
	<i>O. sanctum</i>	198.4	222.0	201.1		621.5
	<i>O. citriodorum</i>	242.4	281.5	158.8		682.7
Chicken manure at 20m <sup>3</sup> /feddan(200g/pot)	<i>O. basilicum</i>	272.9	279.0	208.0	239.6	759.9
	<i>O. sanctum</i>	210.0	225.0	279.2		714.2
	<i>O. citriodorum</i>	201.1	268.5	212.5		682.1
Humic acid at 125 ppm	<i>O. basilicum</i>	217.1	252.3	184.8	225.6	654.2
	<i>O. sanctum</i>	205.6	248.6	306.0		760.2
	<i>O. citriodorum</i>	201.6	227.5	186.5		615.6
Humic acid at 250 ppm	<i>O. basilicum</i>	254.7	244.2	209.2	220.0	708.1
	<i>O. sanctum</i>	179.3	184.7	247.1		611.1
	<i>O. citriodorum</i>	200.4	272.8	187.7		660.9
Chicken manure at 10m <sup>3</sup> /feddan (100 /pot)+ Humic acid at 125 ppm	<i>O. basilicum</i>	331.4	295.3	226.6	308.9	853.3
	<i>O. sanctum</i>	279.2	362.5	387.9		1029.6
	<i>O. citriodorum</i>	351.9	304.7	241.0		897.6
Mean b		245.0 .4 c	244.6	236.6		
Mean c		240.1 b	259.7	226.4		

LSD value at 0.05

Treatments (a) = 15.63

*Ocimum sp.* (b) = N.S.

Cuts (c)= 14.34

Interaction(abc)= 53.24

NPK= Full dose of NPK as recommended dose kristalon (NPK 19:19:19) at 5 g/pot

Table 8: Effect of chicken manure and humic acid on herb fresh weight (g/plant) of *Ocimum sp.* in the second season, 2013.

Treatments	<i>Ocimum sp.</i>	Second season, 2013			Mean a	Total yield/ plant/season
		1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut		
Control	<i>O. basilicum</i>	170.1	226.1	175.9	170.2	572.1
	<i>O. sanctum</i>	119.9	130.7	200.3		450.9
	<i>O. citriodorum</i>	136.4	177.2	195.0		508.6
NPK(5 g/pot)	<i>O. basilicum</i>	223.1	312.8	261.7	282.6	797.6
	<i>O. sanctum</i>	292.1	334.2	254.9		881.2
	<i>O. citriodorum</i>	302.6	302.2	259.9		864.7
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)	<i>O. basilicum</i>	212.1	243.7	234.1	213.6	689.9
	<i>O. sanctum</i>	173.8	177.6	224.2		575.6
	<i>O. citriodorum</i>	227.3	207.1	222.8		657.2
Chicken manure at 20m <sup>3</sup> /feddan(200g/pot)	<i>O. basilicum</i>	212.4	241.1	213.0	200.7	666.5
	<i>O. sanctum</i>	145.1	205.3	231.8		582.2
	<i>O. citriodorum</i>	157.7	191.0	208.7		557.4
Humic acid at 125 ppm	<i>O. basilicum</i>	149.0	196.3	234.1	197.3	579.4
	<i>O. sanctum</i>	174.2	240.2	192.8		607.2
	<i>O. citriodorum</i>	204.9	203.4	180.5		588.8
Humic acid at 250 ppm	<i>O. basilicum</i>	140.8	281.8	217.5	201.5	640.1
	<i>O. sanctum</i>	182.3	192.6	151.4		526.3
	<i>O. citriodorum</i>	235.2	197.1	214.7		647.0
Chicken manure at 10m <sup>3</sup> /feddan(100g/pot)+ Humic acid at 125 ppm	<i>O. basilicum</i>	249.8	343.6	289.7	292.7	883.0
	<i>O. sanctum</i>	256.5	337.0	258.3		851.8
	<i>O. citriodorum</i>	306.7	305.2	287.7		899.6
Mean b		229.9	213.1	224.9		
Mean c		203.4	240.3	224.2		

LSD value at 0.05

Treatments (a) = 18.4

*Ocimum sp.* (b) = 14.40

Cuts (c) = 11.65

Interaction(abc) = 66.00

NPK= Full dose of NPK as recommended dose kristalon (NPK 19:19:19) at 5 g/pot

The timing of harvest had a significant effect on plant fresh weight. The second cut gave the heaviest fresh weight compared to the first and the third cuts; the mean values were 259.7 and 240.3 g/plant in the first and second seasons, respectively.

Regarding the interaction between the three factors (different treatments, *Ocimum sp.* variation and the timing of cuts, in the first season plants treated with NPK in the third cut of *O. sanctum* gave the heaviest fresh weight (424.8 g/plant). In the second season, plants treated with chicken manure at 10 m<sup>3</sup>/feddan (100 g/pot) and sprayed with humic acid at 125 ppm in the second cut of *Ocimum basilicum* gave the heaviest fresh weight (343.6 g/plant).

Chicken manure increases the growth rate because of the increase in water and mineral uptake such as nitrogen and phosphorus, which leads to the biomass yield improvement. This finding is in accordance with the previous observations on basil chemotype eugenol [24]. Humic acid can be used as organic fertilizer and growth regulator to adjusted hormone level for plant growth improvement and enhancement of stress tolerance along with increasing shoot and root growth [25]. The increase

in the fresh weight as a result of organic and humic acid treatments is similar to that obtained on *Ocimum basilicum* [6], on *Rosmarinus officinalis* [19] and on *Borago officinalis* [20,26].

**Herb Dry Weight (g/ Plant):** Data presented in Tables (9 and 10) showed that treating *Ocimum* plants with chicken manure at 10 m<sup>3</sup>/feddan (100 g/pot) and spraying with humic acid at 125 ppm recorded the heaviest dry weight in both seasons (120.1 and 113.7g /plant in the first and second seasons, respectively). On the other hand, the lowest dry weigh (49.99 and 50.36 g/plant in the first and second seasons, respectively) were obtained from control plants.

Data presented in Tables (9 and 10) also showed variation of *Ocimum sp.* had no significant effect on herb dry weight in both seasons. In the first season the heaviest dry weight (with mean values of 82.46 g/plant) were formed by *O. sanctum*. However, in the second season the heaviest weight (with a mean value of 76.48 g/plant) was formed by *O. basilicum*. The highest total yield was obtained with *O. sanctum*



Table 9 : Effect of chicken manure and humic acid on herb dry weight (g/plant) of *Ocimum sp.* in the first season,2012.

Treatments	<i>Ocimum sp.</i>	First season, 2012			Mean a	Total yield/ plant/season
		1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut		
Control	<i>O. basilicum</i>	57.65	61.85	47.56	49.99	164.07
	<i>O. sanctum</i>	42.84	40.81	42.24		125.89
	<i>O. citriodorum</i>	48.10	67.56	41.33		156.99
NPK(5 g/pot)	<i>O. basilicum</i>	127.6	108.4	89.02	114.2	325.02
	<i>O. sanctum</i>	92.25	111.9	160.0		364.15
	<i>O. citriodorum</i>	133.1	116.1	89.81		339.01
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)	<i>O. basilicum</i>	77.88	83.97	51.22	67.26	245.89
	<i>O. sanctum</i>	59.72	67.12	60.67		228.55
	<i>O. citriodorum</i>	72.58	84.81	47.39		246.10
Chicken manure at 20m <sup>3</sup> /feddan(200g/pot)	<i>O. basilicum</i>	91.58	88.40	65.91	76.72	213.07
	<i>O. sanctum</i>	66.48	73.79	88.28		187.51
	<i>O. citriodorum</i>	63.70	85.08	67.32		204.78
Humic acid at 125 ppm	<i>O. basilicum</i>	66.25	77.04	56.30	68.79	224.52
	<i>O. sanctum</i>	62.58	75.69	93.43		193.95
	<i>O. citriodorum</i>	61.49	69.44	56.86		209.53
Humic acid at 250 ppm	<i>O. basilicum</i>	80.82	77.38	66.32	69.78	199.59
	<i>O. sanctum</i>	56.73	58.68	78.54		231.70
	<i>O. citriodorum</i>	63.55	86.53	59.45		187.79
Chicken manure at 10m <sup>3</sup> /feddan(100g/pot)+ Humic acid at 125 ppm	<i>O. basilicum</i>	128.9	115.0	88.80	120.1	332.7
	<i>O. sanctum</i>	108.5	140.8	150.6		399.90
	<i>O. citriodorum</i>	136.5	118.4	93.81		348.71
Mean b		81.32	82.46	79.18		
Mean c		80.90	86.12	75.95		
LSD value at 0.05						
Treatments (a) = 7.956		<i>Ocimum sp.</i> (b) = N.S.		Cuts (c)= 4.613		Interaction(abc)= 19.30

NPK= Full dose of NPK as recommended dose kristalon (NPK 19:19:19) at 5 g/pot

Table 10: Effect of chicken manure and humic acid on herb dry weight(g/plant) of *Ocimum sp.* in the second season,2013.

Treatments	<i>Ocimum sp.</i>	Second season, 2013			Mean a	Total yield/ plant/season
		1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut		
Control	<i>O. basilicum</i>	50.43	67.01	51.63	50.36	169.07
	<i>O. sanctum</i>	35.55	38.54	59.26		133.35
	<i>O. citriodorum</i>	40.50	52.41	57.87		150.78
NPK(5 g/pot)	<i>O. basilicum</i>	84.03	117.8	97.71	106.4	299.54
	<i>O. sanctum</i>	110.2	125.8	95.98		331.98
	<i>O. citriodorum</i>	114.0	114.0	97.86		325.86
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)	<i>O. basilicum</i>	63.95	73.73	69.49	64.41	210.51
	<i>O. sanctum</i>	51.99	53.14	67.64		185.00
	<i>O. citriodorum</i>	69.40	63.14	67.16		176.85
Chicken manure at 20m <sup>3</sup> /feddan(200g/pot)	<i>O. basilicum</i>	67.44	76.28	66.79	63.60	207.17
	<i>O. sanctum</i>	45.74	65.74	73.52		172.77
	<i>O. citriodorum</i>	50.00	61.05	65.80		199.70
Humic acid at 125 ppm	<i>O. basilicum</i>	45.42	59.84	70.64	60.11	201.76
	<i>O. sanctum</i>	53.16	73.17	58.76		166.91
	<i>O. citriodorum</i>	62.69	62.20	55.07		205.25
Humic acid at 250 ppm	<i>O. basilicum</i>	44.63	89.16	67.97	63.77	175.90
	<i>O. sanctum</i>	58.11	60.88	47.92		185.09
	<i>O. citriodorum</i>	74.77	62.45	68.03		179.96
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)+ +Humic acid at 125 ppm	<i>O. basilicum</i>	96.87	133.4	111.8	113.7	342.07
	<i>O. sanctum</i>	99.77	131.0	100.3		331.074
	<i>O. citriodorum</i>	119.0	119.0	111.7		349.70
Mean b		76.48	71.72	75.62		
Mean c		68.46	80.94	74.43		
LSD value at 0.05						
Treatments (a) = 9.191		<i>Ocimum sp.</i> (b) = N.S.		Cuts (c)= 3.971		Interaction(abc)= 22.13

NPK= Full dose of NPK as recommended dose kristalon (NPK 19:19:19) at 5 g/pot

(399.90 g/plant/season) in the first season. However, in the second season, the highest total yield was obtained with *O. citriodorum* (349.70 g/plant/season).

Concerning the effect of the timing of cuts on herb dry weight of *Ocimum* plant, the second cut recorded the heaviest dry weight compared to other cuts in both seasons (86.12 and 80.94 g /plant in the first and second seasons, respectively).

Regarding the interaction between different treatments, *Ocimum sp.* variation and the timing of cuts on herb dry weight data presented in Table (9 and 10) showed significant differences between herb dry weights resulting from application of various combinations of treatments, *Ocimum sp.* and cuts. In the first season, maximum values of herb dry weight were observed with NPK treatment in the third cut of *O. sanctum* with a mean value of 160.0 g/plant.

On the other hand, in the second season chicken manure at 10 m<sup>3</sup>/ feddan (100 g/pot) with humic acid at 125 ppm was the most effective treatment for increasing the herb dry weight of *O. basilicum* in the second cut (133.4 g/plant). These results agree with those on *Plantago arenaria* [20], on *Ocimum basilicum* [27] and on coriander [28].

**Essential Oil Percentage in the Fresh Herb:** The recorded data in Tables (11 and 12) showed that the treatment of chicken manure at 10 m<sup>3</sup>/feddan (100 g/pot) and humic acid at 125 ppm was associated with the production of fresh herbs having oil percentages of 0.224 and 0.228 % in the first and second seasons, respectively. Other treatments slightly increased essential oil percentage compared to control.

Data in Tables (11 and 12) also showed that in both seasons, the maximum essential oil percentages were formed in *O. sanctum* (with mean values of 0.189 and 0.171 % in the first and second seasons, respectively) compared to the two other *Ocimum sp.* (*O. basilicum* and *O. citriodorum*).

Data in Tables (11 and 12) also indicated that the timing of cuts had a significant effect on oil percentage in the fresh herb of *Ocimum sp.* plants. In both seasons, the second cut resulted in the maximum essential oil percentages (0.196 and 0.181% in the first and second seasons, respectively). This effect may be attributed to some environmental factors such as temperature.

The interaction between the three factors (different treatments, *Ocimum sp.* variation and timing of cuts)

revealed that in the first season, *O. basilicum* plants treated with chicken manure at 10 m<sup>3</sup>/feddan (100 g/pot) and sprayed with humic acid at 125 ppm gave the maximum essential oil percentage (0.3%) in the second cut. On the other hand, *O. basilicum* plants treated with NPK in the second season gave the maximum essential oil percentage (0.280%) in the second cut. These results agree with previous works on basil [18] and on Genovese basil [27].

**Number of Glandular Hairs:** Data presented in Table (13) showed the effect of chicken manure and humic acid on the number of glandular hairs per unit surface area (0.04 cm<sup>2</sup>) and per leaf of *Ocimum sp.* in the second cut of the first season.

Variation of *Ocimum sp.* was associated with change of the number of glandular hairs per unit (0.04 cm<sup>2</sup>) and per leaf on the upper and lower leaf surfaces. *Ocimum sanctum* gave the highest number of glandular hairs per unit of 0.04 cm<sup>2</sup> (10.43 and 14.86 on the upper and lower leaf surfaces, respectively). On the other hand, *Ocimum basilicum* gave the highest number of glandular hairs per leaf (4063.286 and 5168.179 in the upper and lower leaf surface, respectively).

In the first season, the upper leaf surface of *Ocimum sp.* treated with chicken manure at 10m<sup>3</sup>/feddan (100 g/pot) and sprayed with humic acid at 125 ppm gave the highest number of glandular hairs (means of 13.00 and 5732.11 glandular hairs per unit and per leaf, respectively). On the lower leaf surface, plants treated with NPK gave the highest number of glandular hairs per unit and per leaf (14.33 and 6503.19 respectively).

Regarding the interaction between different treatments and *Ocimum sp.* variation in the second cut, data revealed that on the upper leaf surface, *Ocimum sanctum* plants treated with NPK and chicken manure at 10m<sup>3</sup>/ feddan (100 g/pot) and sprayed with humic acid at 125 ppm gave the highest number of glandular hairs per unit (0.04 cm<sup>2</sup>). On the other hand, *Ocimum basilicum* plants treated with NPK gave the highest number of glandular hairs per leaf. On the lower leaf surface, *Ocimum sanctum* plants sprayed with humic acid at 250 ppm gave the highest number of glandular hairs per unit (0.04 cm<sup>2</sup>) (20.00 glandular hairs ). However *Ocimum basilicum* plants treated with NPK gave the highest number of glandular hairs per leaf (10430.0 glandular hairs). Similar results were recorded on *O. sanctum* [29] and on basil plants [30].

Table 11: Effect of chicken manure and humic acid on oil percentage of *Ocimum sp.* in the first season, 2012.

Treatments	<i>Ocimum sp.</i>	First season, 2012			Mean a
		1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut	
Control	<i>O. basicum</i>	0.137	0.203	0.110	0.149
	<i>O. sanctum</i>	0.143	0.153	0.170	
	<i>O. citriodorum</i>	0.133	0.177	0.110	
NPK(5 g/pot)	<i>O. basicum</i>	0.233	0.250	0.183	0.220
	<i>O. sanctum</i>	0.227	0.217	0.223	
	<i>O. citriodorum</i>	0.177	0.210	0.260	
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)	<i>O. basicum</i>	0.143	0.217	0.120	0.165
	<i>O. sanctum</i>	0.180	0.160	0.180	
	<i>O. citriodorum</i>	0.160	0.133	0.190	
Chicken manure at 20m <sup>3</sup> /feddan(200g/pot)	<i>O. basicum</i>	0.093	0.210	0.120	0.156
	<i>O. sanctum</i>	0.157	0.170	0.197	
	<i>O. citriodorum</i>	0.137	0.127	0.190	
Humic acid at 125 ppm	<i>O. basicum</i>	0.147	0.227	0.137	0.171
	<i>O. sanctum</i>	0.183	0.183	0.177	
	<i>O. citriodorum</i>	0.130	0.167	0.187	
Humic acid at 250 ppm	<i>O. basicum</i>	0.140	0.213	0.123	0.172
	<i>O. sanctum</i>	0.163	0.190	0.197	
	<i>O. citriodorum</i>	0.170	0.167	0.183	
Chicken manure at 10m <sup>3</sup> /feddan(100g/pot)+Humic acid at 125 ppm	<i>O. basicum</i>	0.193	0.300	0.187	0.224
	<i>O. sanctum</i>	0.257	0.220	0.230	
	<i>O. citriodorum</i>	0.200	0.220	0.210	
Mean b		0.176	0.189	0.173	
Mean c		0.167	0.196	0.175	
LSD value at 0.05					
Treatments (a) = 0.0187		<i>Ocimum sp.</i> (b) = 0.0112		Cuts (c)= 0.0115	Interaction(abc)= 0.0513
NPK= Full dose of NPK as recommended dose kristalon (NPK 19:19:19) at 5 g/pot					

Table 12: Effect of chicken manure and humic acid on oil percentage of *Ocimum sp.* in the second season, 2013.

Treatments	<i>Ocimum sp.</i>	Second season, 2013			Mean a
		1 <sup>st</sup> cut	2 <sup>nd</sup> cut	3 <sup>rd</sup> cut	
Control	<i>O. basicum</i>	0.130	0.170	0.103	0.109
	<i>O. sanctum</i>	0.087	0.127	0.143	
	<i>O. citriodorum</i>	0.080	0.097	0.047	
NPK(5 g/pot)	<i>O. basicum</i>	0.217	0.280	0.227	0.226
	<i>O. sanctum</i>	0.217	0.250	0.217	
	<i>O. citriodorum</i>	0.200	0.240	0.190	
Chicken manure at 10m <sup>3</sup> /feddan(100 g/pot)	<i>O. basicum</i>	0.143	0.170	0.137	0.138
	<i>O. sanctum</i>	0.127	0.130	0.160	
	<i>O. citriodorum</i>	0.150	0.127	0.100	
Chicken manure at 20m <sup>3</sup> /feddan(200g/pot)	<i>O. basicum</i>	0.117	0.150	0.173	0.149
	<i>O. sanctum</i>	0.173	0.150	0.173	
	<i>O. citriodorum</i>	0.127	0.177	0.100	
Humic acid at 125 ppm	<i>O. basicum</i>	0.107	0.147	0.123	0.132
	<i>O. sanctum</i>	0.153	0.170	0.153	
	<i>O. citriodorum</i>	0.117	0.127	0.093	
Humic acid at 250 ppm	<i>O. basicum</i>	0.113	0.197	0.110	0.146
	<i>O. sanctum</i>	0.167	0.153	0.163	
	<i>O. citriodorum</i>	0.160	0.147	0.107	
Chicken manure at 10m <sup>3</sup> /feddan(100g/pot)+Humic acid at 125 ppm	<i>O. basicum</i>	0.200	0.277	0.217	0.228
	<i>O. sanctum</i>	0.193	0.240	0.250	
	<i>O. citriodorum</i>	0.217	0.267	0.190	
Mean b		0.167	0.171	0.146	
Mean c		0.152	0.181	0.151	
LSD value at 0.05					
Treatments (a) = 0.026		<i>Ocimum sp.</i> (b) = 0.0158		Cuts (c)= 0.0163	Interaction(abc)= 0.073
NPK= Full dose of NPK as recommended dose kristalon (NPK 19:19:19) at 5 g/pot					

Table 13: Effect of chicken manure and humic acid on the number of glands per unit surface area of leaf and per leaf in *Ocimum sp.* in the second cut of the first season, 2012.

Treatment	The upper surface				The lower surface			
	-----Number of glands/unit(0.04 cm <sup>2</sup> )-----							
	<i>O.basilicum</i>	<i>O.sanctum</i>	<i>O.citriodorum</i>	Mean	<i>O.basilicum</i>	<i>O.sanctum</i>	<i>O.citriodorum</i>	Mean
Control	4.00	3.00	5.00	4.00	6.00	11.00	10.00	9.00
NPK(5 g/pot)	11.00	17.00	6.00	11.33	14.00	18.00	11.00	14.33
Chicken manure at 10 m <sup>3</sup> /feddan(100 g/pot)	8.00	11.00	2.00	7.00	9.00	17.00	6.00	10.67
Chicken manure at 10m <sup>3</sup> /feddan(200g/pot)	6.00	10.00	8.00	8.00	10.00	14.00	12.00	12.00
Humic acid at 125ppm	1.00	8.00	10.00	6.33	4.00	13.00	11.00	9.33
Humic acid at 250 ppm	9.00	7.00	9.00	8.33	11.00	20.00	5.00	12.00
Chicken manure at 10 m <sup>3</sup> /feddan(10 g/pot)+ Humic acid at 125ppm	10.00	17.00	12.00	13.00	11.00	11.00	13.00	11.67
Mean	7.00	10.43	7.43		9.29	14.86	9.71	
	Number of glands /leaf							
Control	1372.00	702.75	682.00	918.92	2058.00	2576.75	1364.00	1999.58
NPK(5 g/pot)	8195.00	6868.00	985.95	5349.65	10430.0	7272.00	1807.575	6503.19
Chicken manure at 10 m <sup>3</sup> /feddan(100g/pot)	4298.00	3104.75	270.35	2557.7	4835.25	4798.25	811.05	3481.52
Chicken manure at 10m <sup>3</sup> /feddan(200g/pot)	2800.50	2737.50	848.00	2128.66	4667.50	3832.50	1272.00	3257.33
Humic acid at 125ppm	267.25	2776.00	1285.75	1443.00	1069.00	4511.00	1414.325	2331.44
Humic acid at 250 ppm	3732.75	1762.25	1291.50	2262.16	4562.25	5035.00	717.500	3438.25
Chicken manure 10 m <sup>3</sup> /feddan(100g/pot)+ Humic acid at 125ppm	7777.50	7118.75	2300.10	5732.11	8555.25	4606.25	2491.775	5217.76
Mean	4063.286	3581.429	1094.807		5168.179	4661.679	1411.175	

NPK= Full dose of NPK as recommended dose kristalon (NPK 19:19:19) at 5 g/pot

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