Journal of Plant Production

Journal homepage: www.jpp.mans.edu.eg
Available online at: www. jpp.journals.ekb.eg

Effect of Foliar Spray with Proline and Humic Acid on Productivity and Essential Oil Content of Chamomile Plant Under Different Rates of Organic Fertilizers in Sandy Soil

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ABSTRACT

Two field experiments were carried out at Experimental Farm of Fac. of Environ. Agric. Sci.,Arish Univ., El-Arish, North Sinai Governorate, Egypt during the two successive winter seasons of 2017/2018 and 2018/2019, to study the effect of foliar spray of proline and humic acid with some organic fertilizers on growth, productivity and oil content of *Matricaria chamomilla* L. The plants were fertilized with chicken manure and farmyard manure at (0, 10 or 20 m^3 $fed.^{-1}$ of each). All the above mentioned fertilization treatments received calcium super phosphate (15.5%P_2O_5) at 200 kg $fed.^{-1}$ and potassium sulphate (48% K_2O) at 50 kg $fed.^{-1}$. While foliar spray with humic acid and proline at (0, 50,100 or 150 mgl^{-1}).The obtained results showed that chicken manure addition at 20 m^3 $fed.^{-1}$with humic acid foliar spray at 150 mgl^{-1} recoded the highest values for all growth parameters as well as yield components (expressed asfresh weightof yearly flower heads/ plant, dry weightof yearly flower heads/ plant and yield of yearly flower heads/ feddan). Also, the same treatment recoded the highest values of the major components (which expressed as farnesene, α-Bisobolol Oxide B, α-Bisobolol, chamazuline and α-Bisobolol Oxide A) of chamomile oil (%) compared to the other treatments under study.

***Keywords**: Matricaria chamomilla* L., chicken manure, farmyard manure, proline, humic acid, growth, yieldand oil contents.

INTRODUCTION

Chamomile *(Matricaria chamomilla* L.) plant belongs to the composite family, is one of the most important aromatic and medicinal herb which growing as native on Europe southern and eastern. Egyptian chamomile is known by it altitude quality and, thus, great quantities of flower heads of this plant exported to west Europe, particularly Germany.

Chamomile, in special their flower-heads hold several groups of compounds having important curative values essentially sesquiterpene volatile oil. The α-bisabolol oxides, terpenes and chamazulene are the maximum important compounds; Chamomile can be utilized as a drug to treat sore of the skin, the mucous membranes and the skin bacterial diseases (Reichling and Beiderbeck, 1991).

North Sinai soil, Egypt was sandy textures which characterize with very low water holding capacity, low organic matter and high nutrient leaching losses. It is well known that such soil factors are known to limit mobility and availability of soil fertilizers therefore organic fertilization, as a particular way to supply macro and micro-nutrients.

Organic fertilizers such as poultry and chicken manure play an serious role in the vegetative growth, yield and active ingredients of many aromatic and medicinal plants (Banerjee *et al.*, 2011 and Garai *et al*., 2014).

Also, Farmyard manure is one of the conventional organic manure for enhancing soils properties, either physical or biological and chemical a side from saving water holding capacity (Marschener, 2012).

Proline application of for improvement of environmental stress tolerance was achieved in several plants. Hossain and Fujita (2010) indicated that exogenous proline provided a defensive action versus salt-induced oxidative injury by decreasing lipid per-oxidation level and H_2O_2 as well as by promoting methyl-glyoxal detoxification systems and antioxidant defense.

Moreover, proline application is recognized to induce abiotic stress tolerance in several plants (Ali *et al*., 2007 and Ashraf and Foolad, 2007), because proline may do protect membranes from damage, protein structure and minimize enzyme denaturation.

Ali *et al.* (2007) suggested that exogenous application of proline promotes gas exchange attributes like transpiration rate, conductance of stomata and net CO_2 assimilation rate. Also, Gamal El-Din and Abd El- Wahed (2005) demonstrated that plant height (cm) and number of branches as well as fresh and dry weights (g) of aerial vegetative parts and flower head of chamomile (*Matricaria chamomilla* L. Rausch) were increased by foliar application of 50 mg·L^{-1} ornithine and 100 mg·L^{-1}proline. Also, Abdelkader *et al.* (2019) on rosemary found that proline at 200 ppm as foliar spray recorded the highest values of plant height, number of branches /plant, dry

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DOI: 10.21608/jpp.2020.79156

weight of herb/ plant, salt resistance index, volatile oil percentage and yield/plant, total chlorophyll content (SPAD) and total carbohydrates percentage.

Foliar sprays of these substances also improve growth and increase yield and quality of several plants (at least partially through enhancing nutrient uptake, serving as a source of plant nutrients and their release regulator (Atiyeh*et al*., 2002 and Karakurt *et al*., 2009).

Humic acid provides many benefits to plant production. The papers reported that it effects the growth of plants directly and indirectly. The direct act of humic acid on plant growth is as increasing the cell chlorophyll content, hormonal growth responses, the respiration process acceleration, in plant membranes increasing substances penetration, dry matter production changing, and nutrients uptake. Amelioration of physical, biological and chemical conditions of soil is the indirect effects of humic acid. In addition, humates impact the respiration-process, the amount of sugars and accumulation of amino acids and nitrate (Boehme *et al.*, 2005).

So that, the aim of this study was to investigate the influence of foliar spray of proline and humic acid with some organic fertilizers on growth, productivity and oil content of *Matricaria chamomilla* L. under sandy soil conditions.

MATERIALS AND METHODS

Field experiment was carried out at the Experimental Farm, Fac. Environ. Agric. Sci., Arish Univ., North Sinai Governorate, Egypt during the two successive winter seasons of 2017/2018 and 2018/2019, to study the effect of foliar spray with humic acid and proline and some organic fertilizers on growth, productivity and oil content of *Matricaria chamomilla* L.

The soil used was sandy in texture. It was sampled before fertilizer application to a depth of 0-30 cm and analyzed for some chemical and physical characteristics as shown in Table (1). The experiment was conducted under drip irrigation system conditions using well water. Also, chemical analysis for irrigated well water is also presented in Table (1).

Table 1.Some initial chemical and physical characteristics of soil and well water during 2017/2018 and 2018/ 2019 seasons

Parameters	Soil		Well water
	1st season	2nd season	
Soluble ions* meq. L^{-1} (soil past extract)			
Ca^{++}	3.03	2.10	18.12
Mg^{++}	2.11	2.20	20.20
Na^{+}	1.18	4.49	17.72
K^{+}	0.48	0.31	0.25
Cl^{-}	1.02	2.30	38.40
Hco_3^{-}	2.00	2.40	6.25
So_4^{--}	3.78	4.40	11.64
EC*e*(dsm^{-1})	0.68	0.91	5.65
pH (1:2.5)	8.10	8.20	6.70
Organic carbon ($g.kg^{-1}$)	0.93	1.22	-
Organic mater ($g.kg^{-1}$)	1.60	2.10	-
Ca CO_3 ($g.kg^{-1}$)	3.95	3.95	-
Particular size distribution %			
Clay	0.16	0.16	-
Silt	0.33	0.33	-
Fine sand	76.1	76.1	-
Coarse sand	18.71	18.71	-
Soil texture	Sandy soil	Sandy soil	-

The experimental unit area was 20 $m^{2.}$. Everyexperimental unit contained three dripper lines with 20 m length. The distance between lineswas50 cm and between plants was 30 cm between plants (28000 plant per fed.).

Matricaria chamomilla L. seeds kindly supplied from the National Research Center, Doki, Cairo, Egypt. The seeds were sown in the nursery on 1st October, in both seasons. Uniform seedlings about 10 cm length were transplanted on 15th November.

Fertilization types

Organic manures viz., farmyard Manure (FYM), chicken manure (ChM) at 10 and 20 m3/fed of eachwere investigated in the present work. FYM and ChM were obtained from local animal production Farms, El- Arish, North Sinai and stored according to stander methods for applying from season to season at rates 0, 10 or 20 m^3fed^{-1}during soil preparation. Some chemical characteristics of the organic manures are presented in Table (2).Ordinary supper phosphate (15.5% P_2O_5) and potassium sulphate (48%K_2O) were added in one dose prior to sowing during soil preparation at the rate of 200 and 50 kg fed^{-1} respectively.

Foliar spray types

Two foliar spray types were applied in this work; humic acid (HA) and proline at 0, 50,100 or 150 mgl^{-1} were sprayed twice (at 30 and 60 days after transplanting). The source of proline acid [Pyrrolidine-2-carboxylic acid ($C_5H_9NO_2$)] was TECHNO GENE Company, Dokky, Giza, Egypt. Also, Vegetarian humic acid fertilizer was obtained from GrowTech For Agricultural Development Company which contains 86% humic acid.

Table 2. Some chemical analysis of chicken manure and farmyard manure

Parameters	Chicken manure (ChM)	Farmyard manure (FYM)
Total nitrogen (%)	2.35	1.57
Total phosphorus (%)	1.68	1.22
Totalpotassium (%)	1.43	0.67
C/N ratio	12.9	14.6

Recorded data

Random samples of plants in the middle line from each plot were manually selected for evaluating the After three and a half months from sowing date.

Vegetative growth

Plant height (cm)and main branches number.

Flowering characteristics

Fresh weight of yearly flower heads/ plant (g), dry weight of yearly flower heads/ plant (g) and dry weight of yearly flower heads/ fed (kg).

Oil yield measurements

Oil percentage

Determined from dry flower heads samples on May for the two seasons (10 g) and essential oil was determined on each treatment by steam hydro distillation according to Guenther (1961) and British Pharmacopoeia (1980).

Oil yield per plant was calculated as follows:

$$\text{Oil Yield per plant (ml)} = \frac{\text{oil percentage} \times \text{yearly flower yield}}{100}$$

Oil yield per feddan (L.) was calculated as follows:

$$\text{Oil yield per feddan (L.)} = \text{oil} \frac{\text{yield}}{\text{plant}} \times \text{number of plants. Fed} - 1$$

Active constituents in the oil

GLC (Gas Liquid Chromatography) (Hewlett, Packed,HP6890 series) analysis of the essential oil from the samples (mixture of two seasons) was utilized to determine volatile oil components for the obtained oil from different treatments.

Chemical constituents in herb

Chemical analysis were determined in dried samples of herb at 70° C taken after one month from the second spray, half gram powder of dried plant material of each sample was acid digested using a mixture of sulfuric and perchloric (Chapman and Pratt, 1961). The digest was analyzed for nitrogen and phosphorus according to the standard A.O.A.C. procedures (1975). Potassium was determined in the digest using aflame photometer (Jackson, 1973).

Experimental layoutand statistical analysis

This experiment included 35 treatments which were the combination between two types × two rates of each as well as control and six treatments of HA and Pro at different rates as well as control. The treatments arranged in randomized complete block design with three replicates.All collected data were analyzed with analysis of variance (ANOVA) procedure using MSTAT-C Statistical Software Package (Michigan State University, 1983). Differences between means were compared by using Duncan multiple range test at 0.05 (Duncan, 1955).

RESULTS AND DISCUSSION

Vegetative Traits:

Data illustrated in Table 3 show the effect of chicken manure and farmyard manure(FYM) combined with proline (Pro) and humic acid (HA) foliar spray on vegetative growth of Matricaria chamomilla L. during 2017 -2018 and 2018-2019 seasons.

Table 3. Effect of chicken manure and farmyard manure combined with proline and humic acid foliar spray on vegetative growth of *Matricaria chamomilla* L. during 2017/2018 and 2018/2019 seasons

Treatments		plant height (cm)		Number of main branches	
Fertilization	Foliar spray	(2017-2018)	(2018-2019)	(2017-2018)	(2018-2019)
Control	Control	38.66 w	41.00 t	12.33 q	13.66 t
	Pro_{50}	42.66 v	44.00 s	13.66 p	14.66 st
	Pro_{100}	45.00 u	47.00 r	15.33 m-o	16.00 q-s
	Pro_{150}	47.66 t	49.00 q	18.00 h-j	18.66 i-m
	HA_{50}	46.33 tu	48.33 qr	16.00 mn	16.66 o-q
	HA_{100}	51.50 rs	52.66 p	18.66 g-j	19.00 i-l
	HA_{150}	54.00 p	56.66 no	20.66 de	21.00 de
ChM ($10m^3$)	Control	56.22 o	59.00 lm	15.00 no	16.00 q-s
	Pro_{50}	65.33 hi	67.00 gh	18.00 h-j	19.00 i-l
	Pro_{100}	68.33 ef	70.00 e	19.00 f-i	19.66 g-j
	Pro_{150}	72.00 c	73.33 cd	20.33 d-f	21.00 de
	HA_{50}	67.33 fg	69.00 f	18.66 g-j	19.00 i-l
	HA_{100}	70.33 d	72.66 cd	20.33 d-f	20.66 f-h
	HA_{150}	75.00 b	77.33 b	21.66 cd	22.33 b-d
ChM ($20m^3$)	Control	56.22 o	59.00 lm	16.33 l-n	17.33 n-q
	Pro_{50}	66.66 gh	68.00 fg	19.66 e-g	20.00 f-i
	Pro_{100}	70.33 d	72.00 d	21.66 cd	22.33 b-d
	Pro_{150}	72.33 c	74.33 c	22.66 b	23.00 b
	HA_{50}	69.66 de	72.00 d	20.33 d-f	21.33 c-e
	HA_{100}	72.00 c	73.66 cd	21.66 cd	22.00 b-e
	HA_{150}	78.00 a	79.33 a	24.00 a	24.66 a
FYM ($10m^3$)	Control	47.66 t	50.00 q	13.66 p	15.00 rt
	Pro_{50}	52.33 r	54.33 p	16.66 k-m	18.00 k-m
	Pro_{100}	56.22 o	58.00 n	17.66 ij	18.33 j-m
	Pro_{150}	58.11 mn	61.00 k	19.33 e-h	20.00 f-i
	HA_{50}	57.33 no	60.00 kl	16.33 l-h	17.00 n-q
	HA_{100}	60.00 kl	63.00 j	19.00 f-i	19.66 g-j
	HA_{150}	63.50 j	65.33 hi	20.33 d-f	21.33 c-e
FYM ($20m^3$)	Control	50.66 s	53.00 p	15.66 mn	16.66 o-q
	Pro_{50}	56.22 o	58.00 n	18.66 g-j	19.33 h-k
	Pro_{100}	61.66 k	63.00 j	20.66 de	21.00 de
	Pro_{150}	64.33 j	66.00 h	21.33 cd	21.66 b-e
	HA_{50}	61.66 k	63.66 ij	18.66 g-j	19.33 h-k
	HA_{100}	64.33 j	67.00 gh	20.33 d-f	21.33 c-e
	HA_{150}	70.33 d	72.00 d	22.33 b	22.66 bc

Means having the same letter (s) within the same column are not significantly different according to Duncan's multiple range test at 5% level of probability

(ChM= Chicken Manure, FYM= Farmyard Manure, Pro = Proline at (0, 50, 100 and 150mgl^{-1})HA=Humic Acid at (0, 50, 100 and 150mgl^{-1})

Mean comparisons revealed that addition of ChM at 20 m^{3}fed^{-1} combined with HAfoliar spray at150 mgl^{-1}were the most effective treatments on both plant height (cm) and number of branches for both seasons, respectively(78.00, 79.33 and 24.00, 24.66).These results are in harmony with those found by (Awad, 2016) on caraway plants reported that the highest values of vegetative traits in both seasons were recorded at highest level of both poultry manure (PM) and humic acid (HA) followed by the recommended NPK dose with the highest level of HA.

The increase of vegetative growth may be due to addition of chicken manure which contains essential nutrient elements associated with high photosynthetic activities and thus enhanced plant and roots growth (John *et al.*, 2004)

Moreover, foliar spray with humic acid has many benefits include: organic matter addition to organicallydeficient soils, nutrient uptake improve, microbial activity stimulate, fertilizer retention increase, root vitality increase, healthy plants and improved yields, Also, The direct act of humic acid on plant growth is as increasing the cell chlorophyll content, hormonal growth responses, the respiration process acceleration, in plant membranes increasing substances penetration, dry matter production changing, and nutrients uptake. (Boehme *et al.,* 2005 and Ameri and Tehrainifar, 2012).

Flower heads yield:

Results presented in Table 4 show the effect of chicken manure and farm yard manure combined with proline and humic acid foliar spray on yearly flower heads yieldof *Matricaria chamomilla* L. during 2017 -2018 and 2018- 2019 seasons.

Table 4. Effect of chicken manure and farmyard manure combined with proline and humic acid foliar spray on yearly flower heads yield of *Matricaria chamomilla* L. during 2017/2018 and 2018/2019 seasons

Treatment		Fresh weight of yearly flower heads/ plant (g)		Dry weight of yearly flower heads/ plant (g)		Yield of yearly flower heads/ fed (kg)	
Fertilization	**Foliar spray**	**(2017-2018)**	**(2018-2019)**	**(2017-2018)**	**(2018-2019)**	**(2017-2018)**	**(2018-2019)**
Control	Control	38.50 t	40.00 s	7.83 t	8.00 s	219.24 t	224.00 s
	Pro_{50}	42.77 s	44.33 r	8.70 s	8.86 r	243.60 s	248.08 r
	Pro_{100}	46.88 r	48.16 q	9.54 r	9.63 q	267.12 r	269.64 q
	Pro_{150}	53.22 pq	54.38 op	10.83 pq	10.87 op	303.24 pq	304.36 op
	HA_{50}	45.22 rs	46.22 qr	9.20 rs	9.24 qr	257.60 rs	258.72 q
	HA_{100}	50.88 q	52.22 p	10.35 q	10.44 p	289.80q	292.32 p
	HA_{150}	55.22 op	56.55 no	11.24 op	11.31 no	314.72 op	316.68 no
ChM ($10m^3$)	Control	45.00 rs	46.11 qr	9.18 rs	9.22 qr	257.04 rs	258.16 qr
	Pro_{50}	52.22 q	53.38 p	10.63 q	10.76 p	297.64 q	301.28 p
	Pro_{100}	58.22 n	59.16 lm	11.85 n	11.83 m	331.80 n	331.24 m
	Pro_{150}	66.88 l	68.00 l	13.61 l	13.60 l	381.08 l	380.80 l
	HA_{50}	65.44 lm	66.11 l	13.32 lm	13.22 l	372.96 lm	370.16 l
	HA_{100}	75.44 i	76.44 i	15.35 i	15.28 i	429.80 i	427.84 i
	HA_{150}	86.44 f	87.84 f	17.59 f	17.48 f	492.52 f	489.44f
ChM ($20m^3$)	Control	65.85 lm	67.33 l	13.40 lm	13.46 l	375.20 lm	376.88 l
	Pro_{50}	72.33 jk	73.50 jk	14.72 jk	14.70 jk	412.16 jk	411.60 jk
	Pro_{100}	81.77 gh	82.83 h	16.64 gh	16.56 h	465.92 gh	463.68 h
	Pro_{150}	91.77 d	92.94 d	18.68 d	18.58 d	523.04 d	520.24d
	HA_{50}	82.66 gh	83.16 gh	16.82 gh	16.63 gh	470.96 gh	465.64 gh
	HA_{100}	95.11 c	96.27 b	19.36 c	19.25 c	542.08 c	539.00c
	HA_{150}	113.00 a	114.77 a	23.03 a	22.95 a	644.84 a	642.60 a
FYM ($10m^3$)	Control	44.00 s	45.50 r	8.95 s	9.10 r	250.60 s	254.80 r
	Pro_{50}	51.33 q	52.50 p	10.45 q	10.50 p	292.60 q	294.00 p
	Pro_{100}	56.77 no	57.94 mn	11.55 no	11.58 mn	323.40 no	324.24 mn
	Pro_{150}	64.77 lm	65.94 l	13.18 lm	13.18 l	369.04 lm	369.04 l
	HA_{50}	64.55 lm	65.72 l	13.14 lm	13.14 l	367.92 lm	367.92 l
	HA_{100}	74.22 ij	75.05 ij	15.10 ij	15.01 ij	422.80 ij	420.28 ij
	HA_{150}	84.11 fg	85.44 fg	17.12 fg	17.08 fg	479.36 fg	478.24 fg
FYM ($20m^3$)	Control	64.11 m	65.50 l	13.05 m	13.10 l	365.40 m	366.80 l
	Pro_{50}	71.44 k	73.16 jk	14.54 k	14.63 jk	407.12 k	409.64 jk
	Pro_{100}	80.88 h	82.16 h	16.46 h	16.43 h	460.88 h	460.04 h
	Pro_{150}	88.77 e	89.94 e	18.07 e	17.98 e	505.96 e	503.44 e
	HA_{50}	82.22 gh	83.38 gh	16.73 gh	16.63 gh	468.44 gh	465.64 gh
	HA_{100}	93.22 cd	94.55 cd	18.97 cd	18.91 cd	531.16 cd	529.48 cd
	HA_{150}	105.33 b	106.99 b	21.44 b	21.39 b	600.32 b	598.92 b

Means having the same letter (s) within the same column are not significantly different according to Duncan's multiple range test at 5% level of probability

ChM= Chicken Manure, FYM= Farmyard Manure, Pro = Proline at (0, 50, 100 and 150mgl^{-1})HA=Humic Acid at (0, 50, 100 and 150mgl^{-1})

Data clear that fertilization with ChM and HA foliar spray significantly increased yearly flower heads traits and the high rates of both treatments. ChM at 20 m^3 fed.$^{-1}$ with foliar spray of humic acid at 150 mgl^{-1} recorded the highest values of fresh weight of yearly flower heads/ plant (g), dry weight of yearly flower heads/ plant (g) and yield of yearly flower heads/ fed (kg)for both seasons, respectively (113.00, 114.77, 23.03, 22.95 and 644.84, 642.60).

In the second order fertilization with FYM at 20 m^3 fed.$^{-1}$ with foliar spray of HA at 150 mgl^{-1} have the same trend on values of fresh weight of yearly flower heads/ plant (g), dry weight of yearly flower heads/ plant (g) and yield of yearly flower heads/ fed (kg) for both seasons, respectively (105.33, 106.99, 21.44, 21.39 and 600.32, 598.92).

These results well agree with those obtained by(El-Sayed et al., 2015) on Ocimum sp. The obtained results revealed that using chicken manure at 10m /feddan^3 and humic acid concentration at 125 ppm increased the growth characters (plant height, number of branches per plant, leaf area as well as herb fresh and dry weights per plant) and herb oil percentage when compared with the other ones under study.

The increase of yearly flower heads/ fed (kg) may be results from humic acid foliar spray which plays an important role in enhancing soil pH which reflected on availability of elements to absorb by roots of plant and consequently increase plant growth and productivity, Also, organically charged bio-stimulant that significantly influences plant growth and development and increases crop yield (Nardi *et al*., 2004 and Marschener, 2012).

Volatile Oil Yield:

Data presented in Table 5 show the effect of ChM and FYM combined with pro and HA foliar spray onoil yield of Matricaria chamomilla L. during 2017 -2018 and 2018-2019 seasons.

Table 5. Effect of chicken manure and farm yard manure combined with proline and humic acid foliar spray on oil yield of *Matricaria chamomilla* L. during 2017/2018 and 2018/2019 seasons

Treatments		Oil percentage (%)		Oil yield (l. fed^{-1})	
Fertilization	Foliar spray	(2017-2018)	(2018-2019)	(2017-2018)	(2018-2019)
Control	Control	0.36 yz	0.37 w	0.75 v	0.80 v
	Pro_{50}	0.38 v-x	0.39 u-w	0.88 tu	0.93 tu
	Pro_{100}	0.39 t-x	0.41 s-u	1.00 r-t	1.06 r-t
	Pro_{150}	0.41 rs	0.42 q-t	1.19 pq	1.24 pq
	HA_{50}	0.39 t-x	0.40 t-v	0.96 st	0.99 st
	HA_{100}	0.40 tu	0.42 q-t	1.12 qr	1.17 qr
	HA_{150}	0.42 p-s	0.43 q-s	1.26 p	1.31 p
ChM (10m^3)	Control	0.39 t-x	0.40 t-v	0.96 st	1.00 st
	Pro_{50}	0.45 mn	0.47 l-n	1.29 o	1.34 p
	Pro_{100}	0.47 lm	0.48 k-m	1.49 mn	1.53 mn
	Pro_{150}	0.51 f-h	0.52 e-h	1.84 j	1.87 jk
	HA_{50}	0.48 k	0.49 j-l	1.70 kl	1.72 l
	HA_{100}	0.52 d-g	0.53 d-g	2.11 h	2.16 h
	HA_{150}	0.54 d	0.55 cd	2.53 f	2.58 f
ChM (20m^3)	Control	0.44 n-p	0.46 m-o	1.58 lm	1.65 lm
	Pro_{50}	0.49 i-k	0.50 i-k	1.92 ij	1.97 ij
	Pro_{100}	0.52 d-g	0.54 c-f	2.33 g	2.38 g
	Pro_{150}	0.55 c	0.56 c	2.74 cd	2.77 cd
	HA_{50}	0.52 d-g	0.53 d-g	2.33 g	2.36 g
	HA_{100}	0.55 c	0.56 c	2.84 c	2.89 c
	HA_{150}	0.60 a	0.61 a	3.68 a	3.77 a
FYM (10m^3)	Control	0.37 w-z	0.38 vw	0.89 tu	0.94 tu
	Pro_{50}	0.43 o-r	0.45 n-p	1.20 pq	1.26 pq
	Pro_{100}	0.45 mn	0.47 l-n	1.40 no	1.45 no
	Pro_{150}	0.49 i-k	0.50 i-k	1.71 kl	1.75 kl
	HA_{50}	0.44 n-p	0.45 n-p	1.54 m	1.58 m
	HA_{100}	0.50 h-j	0.51 gh	2.01 hi	2.05 hi
	HA_{150}	0.52 d-g	0.53 d-g	2.35 g	2.43 g
FYM (20m^3)	Control	0.43 o-r	0.44 op	1.49 mn	1.55 mn
	Pro_{50}	0.47 lm	0.48 k-m	1.82 jk	1.87 jk
	Pro_{100}	0.52 d-g	0.53 d-g	2.26 g	2.33 g
	Pro_{150}	0.53 de	0.55 cd	2.57 ef	2.63 ef
	HA_{50}	0.51 f-h	0.52 e-h	2.27 g	2.34 g
	HA_{100}	0.52 d-g	0.54 c-f	2.66 de	2.73 de
	HA_{150}	0.57 b	0.59 b	3.29 b	3.38 b

Means having the same letter (s) within the same column are not significantly different according to Duncan's multiple range test at 5% level of probability
(ChM= Chicken Manure, FYM= Farmyard Manure, Pro = Proline at (0, 50, 100 and 150mgl^{-1}), HA=Humic Acid at (0, 50, 100 and 150mgl^{-1})

Mean comparisons revealed thatfertilization with ChM and HA foliar spray significantly increased oilyield and the high rates of both treatments ChM at 20 m^3 fed.$^{-1}$ with foliar spray of HA at 150 mgl^{-1} recorded the highest values of oil percentage (%) and oil yield (l. fed^{-1}) for both seasons, respectively (0.60, 0.61 and 3.68, 3.77).

Also, it followed by fertilization with FYM at 20 m^3 fed.$^{-1}$ with foliar spray of HA at 150 mgl^{-1} which have the same trend on values oil percentage (%) and oil yield (l. fed^{-1}) for both seasons, respectively (0.57, 0.59and 3.29, 3.38).

These results coincide with those obtained by (El-Sayed et al., 2015) on Ocimum sp. The obtained results referred to that using 10 m^3 /feddan of chicken manure and 125 ppm of humic acid increased plant height, branch number per plant, leaf area, herb fresh and air dry weights and herb oil percentage.

Also, (Awad, 2016) on caraway plants found that increasing the applied level of humic acid or poultry manure recognized a positive influence on yields of fruit and volatile oil.

The possible reason for this raise of oil yield may be results from humic acid stimulates plant development by the assimilation of macro and micro elements, changes in membrane permeability, enzyme activation and protein synthesis as well as the activation of biomass production (Ulukan,2008).

Nitrogen, phosphorus and potassium contents of chamomile Plants:

Data presented in Table 6 show the effect of ChM and FYM combined with Pro and HA foliar spray on nitrogen, phosphorus and potassium contentsof Matricaria chamomilla L. during 2017 -2018 and 2018- 2019 seasons.

In general, chicken manure and humic acid significantly increased nitrogen (N), phosphorus (P) and potassium (K) contents of Matricaria chamomilla L.

Mean comparisons revealed that fertilization with ChM and HA foliar spray significantly increased N, P and K percentage and the high rates of both treatments ChM at 20 m^{3}fed.$^{-1}$ with foliar spray of HA at 150 mgl^{-1} recordedthe highest values N,P and K percentage for both seasons, respectively (3.90, 4.03,0.40, 0.42 and 2.88 , 2.93,respectively).

Table 6. Effect of chicken manure and farm yard manure combined with proline and humic acid foliar spray on herb chemical constitutes of *Matricaria chamomilla* L. during 2017/2018 and 2018/2019 seasons

Treatments		N (%)		P (%)		K (%)	
Fertilization	Foliar spray	(2017-2018)	(2018-2019)	(2017-2018)	(2018-2019)	(2017-2018)	(2018-2019)
Control	Control	1.86 s	1.96 r	0.23 p	0.24 q	2.02 u	2.03 o
	Pro_{50}	2.06 r	2.20 qr	0.27 m-o	0.28 m-o	2.10 r-u	2.23 l-o
	Pro_{100}	2.50 op	2.60 l-o	0.28 l-o	0.30 h-j	2.20 p-r	2.36 i-m
	Pro_{150}	2.96 g-i	3.06 e-h	0.29 j-m	0.30 h-j	2.33 k-o	2.43 i-l
	HA_{50}	2.66 m-o	2.73 l	0.27 m-o	0.29 k-n	2.16 q-s	2.33 i-m
	HA_{100}	2.90 g-j	2.96 g-j	0.30 j-l	0.32 e-j	2.31 op	2.38 i-l
	HA_{150}	3.16 ef	3.26 de	0.33 c-e	0.34 c-f	2.47 g-j	2.51 e-h
ChM ($10m^3$)	Control	2.10 r	2.20 qr	0.24 p	0.25 pq	2.03 tu	2.13 m-o
	Pro_{50}	2.30 q	2.40 n-q	0.28 l-o	0.29 k-n	2.26 o-q	2.33 i-m
	Pro_{100}	2.86 h-k	2.96 g-j	0.29 j-m	0.31 f-j	2.36 j-n	2.43 i-l
	Pro_{150}	3.23 e	3.33 d	0.31 f-i	0.33 d-j	2.50 d-f	2.55 d-h
	HA_{50}	2.96 g-i	3.06 e-h	0.29 j-m	0.30 h-j	2.38 i-m	2.50 e-h
	HA_{100}	3.30 cd	3.36 c	0.33 c-e	0.34 c-f	2.53 c-f	2.61b-g
	HA_{150}	3.46 bc	3.56 bc	0.35 b	0.36 cd	2.61 b-d	2.68b-e
ChM ($20m^3$)	Control	2.36 pq	2.46 m-p	0.26 o	0.28 m-o	2.25 o-q	2.33 i-m
	Pro_{50}	2.53 n-p	2.63 l-n	0.29 j-m	0.31 f-j	2.41 h-l	2.55 d-h
	Pro_{100}	3.03 f-h	3.13 d-g	0.32 e-h	0.34 c-f	2.55 c-f	2.68 b-e
	Pro_{150}	3.53 b	3.63 b	0.33 c-e	0.35 c-e	2.63 bc	2.80 a-c
	HA_{50}	3.23 e	3.36 c	0.31 f-i	0.33 d-j	2.58 b-e	2.68 b-e
	HA_{100}	3.50 b	3.63 b	0.36 b	0.37 b	2.63 bc	2.78 a-d
	HA_{150}	3.90 a	4.03 a	0.40 a	0.42 a	2.88 a	2.93 a
FYM ($10m^3$)	Control	2.10 r	2.33 pq	0.24 p	0.26 oq	2.06 s-u	2.23 l-o
	Pro_{50}	2.23 qr	2.36 o-q	0.26 o	0.28 m-o	2.23 o-q	2.46 e-h
	Pro_{100}	2.60 m-o	2.70 lm	0.29 j-m	0.30 h-j	2.26 o-q	2.38 i-l
	Pro_{150}	2.90 g-j	3.00 f-i	0.30 j-l	0.32 e-j	2.36 j-n	2.48 e-h
	HA_{50}	2.70 mn	2.80 i-k	0.29 j-m	0.31 f-j	2.36 j-n	2.50 e-h
	HA_{100}	2.90 g-j	3.03 e-i	0.32 e-h	0.33 d-j	2.46 g-j	2.56 c-h
	HA_{150}	3.23 e	3.36 c	0.33 c-e	0.35 c-e	2.55 c-f	2.68 b-e
FYM ($20m^3$)	Control	2.40 pq	2.53 l-o	0.27 m-o	0.28 m-o	2.15 q-t	2.30 j-m
	Pro_{50}	2.50 op	2.63 l-n	0.29 j-m	0.30 h-j	2.31 op	2.53 e-h
	Pro_{100}	2.73 m	2.83 h-k	0.31 f-i	0.34 c-f	2.43 g-l	2.56 c-h
	Pro_{150}	3.16 ef	3.33 d	0.34 cd	0.36 cd	2.51 c-f	2.63 b-f
	HA_{50}	2.83 i-l	3.00 f-i	0.33 c-e	0.35 c-e	2.45 g-k	2.58 c-h
	HA_{100}	3.06 e-g	3.23 d-f	0.36 b	0.37 b	2.56 c-f	2.66 b-f
	HA_{150}	3.50 b	3.63 b	0.39 b	0.40 b	2.70 b	2.85 ab

Means having the same letter (s) within the same column are not significantly different according to Duncan's multiple range test at 5% level of probability
(ChM= Chicken Manure, FYM= Farmyard Manure, Pro = Proline at (0, 50, 100 and 150mgl^{-1}), HA=Humic Acid at (0, 50, 100 and 150mgl^{-1})

It could be concluded that, the improving of plant growth parameters by increasing chicken manure fertilizer levels it might be terminated that the supplement of high level of chicken manure to chamomile plant caused an increase of rooting zone nutritional elements, and in addition due to enhanced availability of nutrients especially nitrogen, phosphorus and potassium even from the plant growth early stage. Thus, the extra nutrients were absorbed so more and enhancement of growth parameters of plant.

Major active constitutes of chamomileoil

The obtained results in Table 7 show that interaction betweenChM at 20 m^{3}fed.$^{-1}$ with foliar spray of HA at 150 mgl^{-1} and gas liquid chromatographic analysis revealed that the highest values of main active constitutes of chamomile oil (Farnesene, , α-Bisobolol and Chamazulene) (12.35, 14.65 and 13.37, respectively). While the highest values of α-Bisobolol Oxide Band α-Bisobolol oxide A were obtained from fertilization withChM at 20 m3 Fed^{-1}alone.

Table 7. Effect of chicken manure and farmyard manure combined with proline and humic acid foliar spray on major active constitutes of *Matricariachamomilla*L.oil.

Treatments Major components of chamomile oil (%)	Control	ChM at 20 m^{3}fed^{-1}.	HA at 150 mg l^{-1}	ChM at 20 m^{3}fed^{-1}+ HA at 150 mg l^{-1}
Farnesene	9.65	10.65	8.75	12.35
α-Bisobolol Oxide B	8.32	9.22	6.05	7.43
α-Bisobolol	10.76	11.75	9.13	14.65
Chamazulene	11.92	12.20	11.32	13.37
α-Bisobolol oxide A	47.32	63.25	53.18	56.23

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تأثيرالرش الورقى للبرولين وحمض الهيوميك على الإنتاجية ومحتوى الزيت الثابت لنبات شيح البابونج تحت معدلات مختلفة من التسميد العضوى فى الأراضى الرملية

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أجريت التجربة الحقلية بالمزرعة التجريبية لكلية العلوم الزراعية البيئية –جامعة العريش بمحافظة شمال سيناء – مصر خلال الموسمين الشتويين لعام 2017-2018و 2018 -2019 لدراسة تأثير الرش الورقى للبرولين وحمض الهيوميك مع التسميد العضوى على النمو والإنتاجية ومحتوى الزيت لنبات شيح البابونج. تم تسميد النباتات بسماد الدواجن والسماد البلدى بمعدلات (0 ، 10 و 20 م^3 /فدان لكل منهما) مع إضافة سوبر فوسفات الكالسيوم بمعدل 200 كجم / فدان وسلفات البوتاسيوم بمعدل 50 كجم / فدان. بينما تم الرش بكل من البرولين وحمض الهيوميك بمعدلات (صفر ، 50 ، 100 و 150 مجم / لتر). أوضحت النتائج المتحصل عليها ان إضافة سماد الدواجن بمعدل 20 م^3 / فدان مع الرش الورقى بحمض الهيوميك بمعدل 150 مجم / لترأدت إلى الحصول على اعلى معدلات النمو الخضرى وكذلك مكونات المحصول. كما أدت نفس المعاملة إلى زيادة محتوى الزيت من المواد الفعالة الأساسية (معبراً عنها بالفرنيزين وألفا- بيزوبيلول أكسيد ب والألفا بيزوبيلول والكمازولين و ألفا- بيزوبيلول أكسيد أ) مقارنة بالمعاملات الأخرى تحت الدراسة.