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The response of essential oil yield and chemical composition of *Artemisia abrotanum* L. plants to cattle manure and some biostimulants treatments

M. S. Hanafy[1], A. A. M. Heikal[1], E.O. El-Ghawwas[2] and Z.H. Ali[2]

[1]Ornamental Horticulture Department, Faculty of Agriculture, Cairo University, Egypt.
[2]Medicinal and Aromatic Plants Research Department, Horticulture Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.

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ABSTRACT

This investigation was carried out at Fac. of Agric., Cairo Univ., and the experimental farm of Medicinal and Aromatic Plants Research Department, Horticulture Research Institute, Agricultural Research Center, Dokki, Giza, in the two successive seasons of 2014 and 2015.The research aimed to study the effect of cattle manure (CM) rates (15, 30 and 45 m^3/fed.) alone or and some different levels of yeast, ascorbic acid and Actosol on essential oil yield, essential oil components and chemical composition of *Artemisia abrotanum* L. plant. The results showed that, in both seasons, the highest essential oil yield, essential oil components and chemical composition were obtained by adding cattle manure at rate of 30 m^3/fed compared to other cattle manure treatments. Ascorbic acid at 100 ppm had a significant effect on all characteristics compared to dry yeast and actosol. Treating the plant with cattle manure at rate of 30 m^3/fed. combined with ascorbic acid at 100 ppm resulted in the highest values of all characteristics compared to other combination treatments.

***Keywords*:** *Artemisia abrotanum* , cattle manure, yeast, ascorbic acid,actosol

Introduction

Artemisia is a genus of small herbs and shrubs found in northern temperate regions. It belongs to the Compositae (Asteraceae) family, one of the most numerous plant groupings. A large number of members of the Artemisia genus are used as ornamental plants, or as medicinal and aromatic plants for their essential oil and active compounds (Abad *et al.*, 2012 and Krishna *et al.,* 2008).

The Artemisia genus has been used throughout history. Ancient Greek writings of its use for women's health suggest that the name "Artemisia" comes from Artemis, the Greek goddess of women. Artemisia plants have been used by the ancient Greeks, Chinese, Japanese and Aztecs for uses such as febrifuge and colic and stomach disorder treatment (Kay, 1996). They are mentioned in folk and modern medicine, in the cosmetic and pharmaceutical industry, and they received special attention for their content of artemisinins which are active molecules against malaria (Ho *et al.*, 2014) It is used as an aromatic plant and in traditional medicine for the treatment of a variety of disorders, such as infections (or inflammatory diseases) of the upper respiratory tract (Abad *et al.*, 2012).

Organic fertilizers are obtained from animal sources such as animal manure or plant sources like green manure. Continuous usage of inorganic fertilizer affects soil structure. Hence, organic manures can serve as alternative to mineral fertilizers for improving soil structure (Dauda *et al.*, 2008).

It has been reported that humic acid substances (HS) have beneficial effects on plant growth, nutrient uptake, root development, yield, seed germination and plant photosynthesis (Chen and Aviad 1990; Nardi *et al.*, 2002)

Actosol is a commercial product of humic acid, it contain humic acid which is valuable in correcting the widespread occurrence of certain nutrients deficiency symptoms, increas the soil water holding capacity, promoting soil structure and enhanc the metabolic activity of microorganisms. It is also act as a source of N, P and S for plants (El-Seginy, 2006; Fayza and Zakher, 2010 and Fawzy *et al.*, 2012).

Ascorbic acid (vitamin C.) has been known as antioxidant and it protects plants against damage resulting from aerobic metabolism, photosynthesis and a range of pollutants. It also acts as enzyme co–factor, especially hydrolase enzyme, electron transport, oxalate and tartarate synthesis. Moreover, the

Corresponding Author: M. S. Hanafy, Ornamental Horticulture Department, Faculty of Agriculture, Cairo University, Egypt.

endogenous level of ascorbic acid has recently been suggested to be important in the regulation of developmental senescence and plant defense against pests (Pastori *et al.*, 2003; Barth *et al.*, 2004 and Pavet *et al*., 2005).

Active dry yeast, a natural biostimulant, is safety and causes various promoted effects on plants and is a natural source of cytokinins which simulate cell division and enlargement as well as the synthesis of protein, nucleic acid and B-vitamin (Ezz El-Din and Hendawy, 2010).

Materials and Methods

The experiment of this study was conducted at the experimental farm of Medicinal and Aromatic Plants Research Department, Horticulture Research Institute, Agricultural Research Center, Dokki, Giza, in the two successive seasons of 2014 and 2015. The aim of the study was to investigate the effect of cattle manure and some biostimulants as active dry yeast, ascorbic acid and Actosol, applied at different rates) on essential oil yield, essential oil components and chemical composition of (southernwood plant) artemisia (*Artemisia abrotanum,* L.) plants aiming to improve the essential oil productivity and quality characteristics of the plant.

The seedlings of Artemisia were obtained from the farm of El-ikhlas, Saft al Alban, Giza governorate. On 20th March 2014 (first season) and on 15th March 2015 (second one) the seedlings were cultivated in clay pots (30 cm diameter) filled with a clay sand soil, the pots were kept in the open field. The physical and chemical analyses of the experimental soils are represent in Table (A).

The cattle manure was obtained from the Animal Production Department, Agricultural Research Center, El-Kanater El-Khaireya. The cattle manure was added during preparing the soil for cultivation. The physical and chemical characteristics of cattle manure are shown in Table (B)

Table A: Physical and chemical analyses of the soil.

Physical characteristics	**First season 2014**	**Second season 2015**
Clay %	39.21	38.36
Silt %	24.32	23.25
Fine sand %	27.14	29.21
Coarse sand %	2.23	2.10
Soil type	Clay sand	Clay sand
Chemical characteristic		
pH	7.31	7.20
N (ppm)	22.4	21.6
P2O5 (ppm)	104	102
K2O (ppm)	153	162
Zn (ppm)	3.20	2.33
Fe (ppm)	1.93	1.30
B (ppm)	2.21	2.10
Mn (ppm)	0.45	0.37
Cu (ppm)	0.45	0.47

Table B: Physical and chemical characteristics of the cattle manure.

Cattle manure Characteristics	**1st season 2014**	**2nd season 2015**
Weight of 1m^3 (kg)	460	472
Moisture content (%)	7.65	8.78
Organic matter (%)	65.24	63.55
Organic carbon (%)	37.80	35.63
Total N (%)	1.73	1.74
C:N ratio	21 : 4	20 : 5
NH_3 - N (ppm)	60.5	58.7
NO_3 – N (ppm)	184.31	195.23
Total P (%)	0.47	0.51
Total K (%)	1.36	1.24
Fe (ppm)	1775.6	1680.4
Mn (ppm)	235.8	210.3
Zn (ppm)	142.5	121.8
Cu (ppm)	42.73	41.74

Active dry yeast (ACD) was prepared by adding 2 and 4 g / 1 litre of fresh water plus 2g sucrose and left for 6 hours, then it was used. Ascorbic acid (Vit. C) was obtained from El–Gomhoria Company for Chemicals, Egypt, it was applied at 100 and 200 ppm. Humic acid (as Actosol©) was obtained from a (American Egyptian United Company) Cairo.

The chemical analysis of Actosol as follows: Carbon 53.80%, Hydrogen 6.20%, Oxygen 32.80%, Nitrogen 4.30%b and Sulfur 1.15%.

Each of ascorbic acid (Vit. C) and active dry yeast were sprayed, while the actosol was used as soil drench. these compounds were added at 4 times, the 1st one was applied a month after transplanting, and the 2nd one applied 21 days later, while the 3rd one was after the first cut and repeated after 21 days, the artimisia plants were sprayed in the morning till the run off point .

The plants were harvested twice during every season at full blooming stage, so, the first cut was done on June 29th, and 27th in the first and second seasons, respectively. The corresponding data for the second season were October 19th and 17th . The following measurements were recorded , for each cut **:** essential oil percentage in fresh herb, essential oil yield/plant (ml)**,** essential oil components, chlorophyll "a", "b" and carotenoids content in fresh leaves, N,P and K(D. W%) in herb, the content of total phenolic compounds and antioxidant activity %.

The experiment included the following treatments:-

The layout of the experiment was split plot design, including twenty one treatments, which were the combinations between three rates of cattle manure at 15, 30 and 45m^3/fed.(main plots) and seven treatments (active dry yeast at 2 g / l and 4g / l, ascorbic at 100ppm and 200ppm and actosol at 1 ml/pot and 2 ml/pot and control treatment(subplots).

Chemical determination:

Essential oil % was determined according to the British Pharmacopoeia (1963). GLC analysis was done for the oil obtained in the second cut of the second season, to determine their main constituents, as described by Bunzen *et al*., (1969). Chlorophyll a, b and total carotenoids were determined according to Saric *et al*. (1967). Nitrogen percentage was determined after digestion by micro-Kjeldhle method according to (Jackson, (1967), phosphorus content was estimated using the method recommended by King (1951). and potassium content was determined using atomic absorption spectrophotometer (Perkin Elemer, Model 3300).

The determination of the content of total phenolic compounds in the herb extracts was based on the method of Gutfinger (1981) as gallic acid (GAE). Antioxidant activity (AA %) by DPPH free radical-scavenging assay was done using the method is based on a procedure described and modified by Bandoniene *et al* .(2002).

Statistical analysis

Statistical analysis for split-plot design was made for each Gomez and Gomez (1984) whereas the cattal manure treatments were located at the main plots and the biostimulats treatments were located at the sub_plot. L.S.D was computed to compare differences among means at 5% of levels of probability.

Results and Discussion

Essential oil percentage in fresh herb

The oil percentage in fresh herb of artimisia plant as affected by cattle manure and biostimulats are shown in Figs. (1, 2, 3 and 4), it was found that cattle manure (CM) had a significant effect on oil percentage in both seasons. In the first season (CM) at 30 m3/ fed. gave the highest value of oil percentage in fresh herb with mean values of 0.41 and 0.42 %, at the first and second cuts, respectively. In the second season, there was no significant difference between CM at 30 m^3/fed. and CM at 45 m^3/fed., as these treatments gave (0.38%).

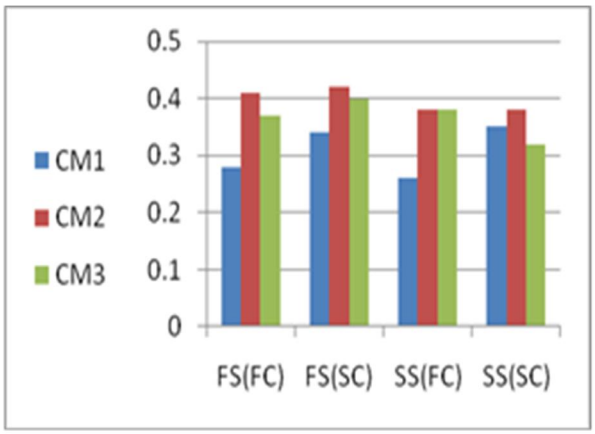

Fig. 1: Effect of Cattle manure on essential oil percentage (%) of Artemisia *abrotanum* L.) plants.

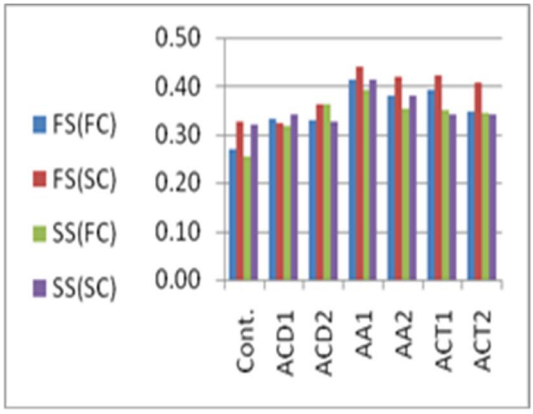

Fig. 2: Effect active dry yeast, ascorbic acid and Actosol on the essential oil percentage (%) of Artemisia (*Artemisia abrotanum* L.) plants.

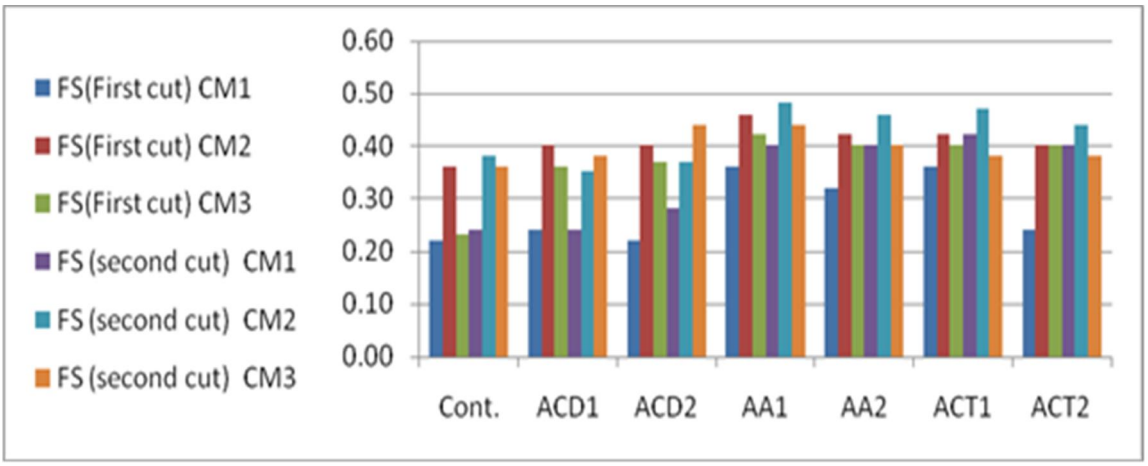

Fig. 3: Effect of cattle manure (CM) , active dry yeast, ascorbic acid and Actosol on the essential oil percentage (%) in fresh herb of Artemisia (*Artemisia abrotanum* L.) plants in 2014 season.

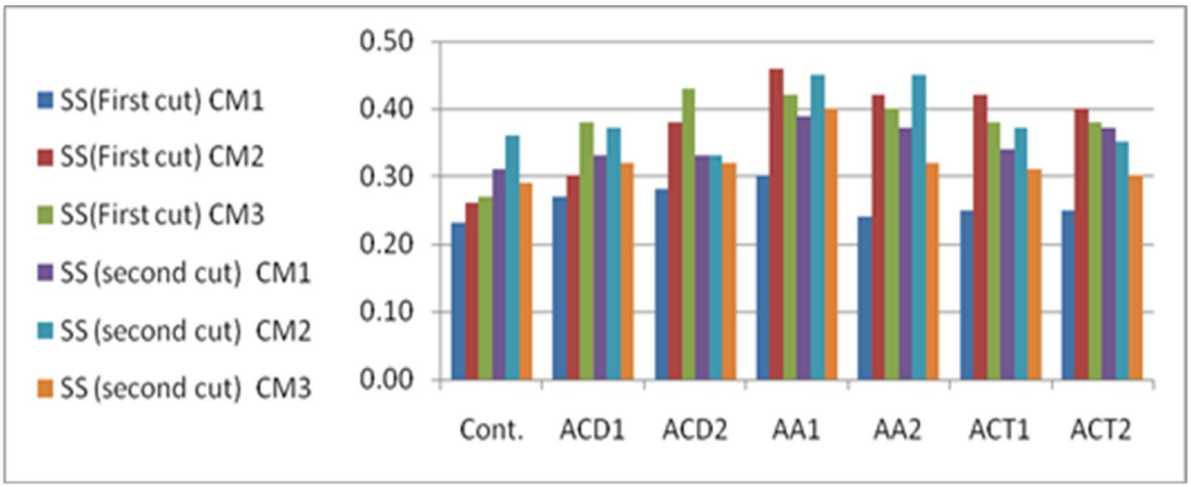

Fig.4: Effect of cattle manure (CM) , active dry yeast, ascorbic acid and Actosol on the essential oil percentage (%) in fresh herb of Artemisia (*Artemisia abrotanum* L.) plants in 2015 season..

CM1, CM2 and CM3: Cattle manure 15, 30 and 45 m^3/fed **. FS:** First Season**, FC:** First cut**, SS:** Second season**, SC:** Second cut **, Con :** Control**, ACD1:** Active dry yeast 2 gm**, ACD2:** Active dry yeast4 gm **AA1:** Ascorbic acid 100ppm **,AA2** Ascorbic acid 200ppm **, ACT1:** Actosol 1ml**, ACT2:** Actosol 2 ml

The increments in essential oil % plants treated with cattle manure treatments can be owing to the improvement of biomass yield, these findings are in accordance with the observations of Rao. (2001), Araya *et al.* (2006) and Santos *et al.* (2009)

Regarding the effect of biostimulants, the treatment of ascorbic acid at 100ppm gave significantly the highest essential oil percentages at the first and second cuts of both seasons increased giving of 0.41, 0.44, 0.39 and 0.41%, respectively. This result was in agreement with that obtained by Khalil *et al.* (2010) who found that 100, 150 and 200 ppm ascorbic acid treatments significantly increased in the percentage of volatile oil of basil herb.

The interaction effect indicated that in both seasons. The treatment of cattle manure at 30 m^3/fed. plus ascorbic acid at 100 ppm gave the highest values of oil percentage at two cuts (0.46 and 0.48%, 0.46 and 0.45 respectively) This finding was in agreement with that obtained by Abdou and Mahmoud (2014) on *Mentha piperita* who treated plants with 48 t/ ha of plant compost and salicylic acid + ascorbic acid, and found marked increment in essential oil percentage by 87% compared control.

Essential oil yield/plant (ml)

The data in Figs. (5, 6, 7 and 8) show that cattle manure treatments had significant effects on oil yield/ plant. The application of cattle manure at 30 m3/fed, increased oil yield/ plant, gaving 0.14 and 0.39 ml/ plant at both cuts, in the first season, respectively) in the second season in the first cut there was no significant difference between CM at 30 m3/fed. and CM at 45 m3/fed. oil yield (0.13 ml/ plant). On the other hand, the second cut gave the highest mean values (0.39 ml/ plant) when cattle manure was applied at 30 m3/ fed.

Regarding the effect of biostimulants on oil yield/ plant, the data in Figs. (5,6,7 and 8) show that the treatment, of ascorbic acid at 100 ppm gave the highest value, (0.14, 0.44, 0.15 and 0.39 ml/plant at first and second cuts, in both seasons, respectively). These results were in agreement with Eid *et al.* (2011) on marigold (*Tagetes erecta*) plants, they stated that ascorbic acid at 200 ppm increased oil %.

The interaction between cattle manure and biostimulants, indicated that at the first and second cuts, in both seasons, the treatment of CM at 30 m^3/fed. + ascorbic acid at 100 ppm gave the highest essential oil yield/ plant (0.18 ,0.55 ,0.20 and 0.54 ml/plant, respectively**.**

Essential oil components

The percentages of the essential oil components were determined according to the gas chromatography (G LC) analysis of samples obtained from artemisia plants grown in the second season (second cut) are shown in Table (1) and illustrated in Figs (9, 10 and 11). The GLC profile of the essential oil of the plants showed fourteen compounds (presenting approximately 76.52- 96.51 % of essential oil composition), namely: (1) camphene (2) Terpinene, (3) P-cymene, (4) Cineole (5) Linalool, (6) Terpineol (7) Cis-p-Menth-2-en-l-ol (8) Camphor (9) Borneol 10) Bornyl acetate (11) Myrtenol (12) Ascaridole, (13) Isolongifolne (14)and Garmacrene.

The main components were ascaridole (the main essential oil component) with values of 16.29-23.86%, followed by) p-cymene (11.34 – 18.56%), Camphor of 10.12 – 15.21%, Borneol (0.76 - 13.07%), Cineole (4.44 - 8.82) and Linalool (3.99- 7.53%)

Data presented in Table (1) and chromatograms (Figs 9, 10 and 11) showed that of the percentage of essential oil components differed according to different fertilization treatments. The highest ascaridole content (23.86%) was found in the oil of plants fertilized with cattle manure at 30m^3/fed + ascorbic acid at 100 ppm., followed by plants which received cattle manure at 45m^3/fed combined with ascorbic acid at 100 ppm22.54%, then the treatment of cattle manure 15m^3/fed combined with ascorbic acid at 200 ppm(22.43), compared to cattle manure 45m^3/fed treated active dry yeast at 4 g /l (16.29%).

Among the different fertilization treatments, it was found that cattle manure at 30m^3/fed with ascorbic acid at 100 ppm was the most effective treatment for increasing the total content of main components (giving a value of 96.51%), followed by cattle manure 15m^3/fed with actosol 1 ml treatment (94.63%), whereas, the lowest one (76.52%) was noticed with of cattle manure at 15m^3/fed combination with active dry yest2 g / l.

Table 1: GLC analysis of the essential oil of Artemisia (*Artemisia abrotanum,* L) plants in the second cut of the second season 2015.

Treatment	Camphene	Terpinene	P-cymene	Cineole	Lnalool	Terpineol	Cis-p-Menth-2-en-1-ol	Camphor	Borneol	bornyl acetate	Myrtenol	Ascaridole	Isolongifolne	Garmacrene	total
CM 1(15 m3/fed)	1.95	0.87	11.34	7.58	6.14	2.86	1.82	10.12	2.72	1.22	4.02	20.85	3.35	1.78	76.62
CM 2(30 m3/fed)	3.12	1.41	15.74	6.80	3.99	1.60	1.69	14.90	3.48	2.31	2.3	21.33	2.60	2.50	83.77
CM 3(45 m3/fed)	3.39	1.51	15.57	6.85	7.01	0.92	3.34	15.02	1.84	3.02	3.84	16.35	1.93	2.29	83.06
CM 1+ Dry yeast 2 g/l	4.08	0.90	13.68	5.11	5.63	4.12	1.9	11.75	0.95	0.34	2.66	19.63	4.36	1.41	76.52
CM 1+Dry yeast 4 g/l	2.16	1.56	14.37	7.03	6.97	2.82	1.58	13.16	3.39	1.20	5.46	22.16	2.40	2.01	86.27
CM 1+Ascorbic 100ppm	3.55	1.50	16.49	7.83	5.82	0.85	0.77	14.17	1.92	4.62	2.89	19.11	4.21	2.58	86.31
CM 1+Ascorbic 200ppm	2.74	0.46	13.54	4.44	6.48	4.63	1.61	12.51	2.19	3.06	3.03	22.43	3.65	2.78	83.547
CM 1+Actosol 1 ml/pot	3.59	1.73	16.77	8.24	6.17	1.44	4.43	14.23	2.11	4.18	2.46	20.45	5.58	3.25	94.63
CM 1+Actosol 2 ml/pot	2.07	1.02	13.52	6.66	7.53	7.89	2.19	15.99	2.76	1.30	2.47	18.21	2.22	1.99	85.82
CM 2+ Dry yeast 2 g/l	4.39	1.93	15.68	7.43	5.39	1.22	1.44	12.88	1.98	3.95	2.34	20.14	1.88	1.97	82.62
CM 2+ Dry yeast 4 g/l	4.08	1.80	14.68	7.79	5.55	1.46	1.37	12.61	1.61	2.49	2.32	19.28	3.63	2.02	80.69
CM 2+Ascorbic 100ppm	3.44	0.73	18.56	8.82	6.51	3.35	1.32	15.21	1.91	0.53	3.23	23.86	3.80	5.24	96.51
CM 2+Ascorbic 200ppm	2.05	0.84	12.38	4.93	5.60	2.28	1.72	12.43	13.0	2.34	3.34	20.94	4.15	2.39	88.46
CM 2 +Actosol 1 ml/pot	2.93	1.47	13.20	5.53	5.50	1.10	1.69	13.56	2.95	1.67	2.94	19.84	6.51	2.38	81.27
CM 2 +Actosol 2 ml/pot	3.89	1.30	14.50	7.82	5.20	2.71	3.59	12.79	2.59	1.78	3.69	20.99	7.60	2.30	90.75
CM 3 + Dry yeast 2 g/l	3.71	1.43	13.58	6.25	4.96	1.50	2.86	12.75	0.76	3.13	2.09	21.08	7.68	4.53	86.26
CM 3 + Dry yeast 4 g/l	3.28	1.57	13.31	6.03	6.31	1.73	2.89	12.23	2.76	2.02	4.33	16.29	2.52	3.61	78.88
CM 3+Ascorbic 100ppm	3.54	0.99	12.78	5.89	5.49	3.48	2.7	13.02	1.79	1.71	3.70	22.54	3.61	1.69	82.93
CM 3 +Ascorbic 200ppm	2.40	1.17	11.80	5.83	6.33	2.25	1.34	15.08	1.76	0.811	4.76	21.35	4.89	1.52	81.29
CM 3 +Actosol 1 ml/pot	3.99	1.67	15.41	8.12	4.85	1.41	1.28	14.54	2.09	1.53	4.33	19.00	1.75	2.52	82.49
CM 3 +Actosol 2 ml/pot	2.07	0.99	12.99	5.69	5.58	2.87	1.14	14.34	2.80	2.65	4.74	20.92	2.54	1.82	81.14

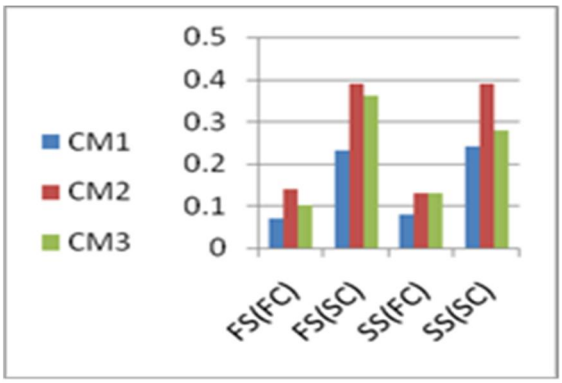

Fig. 5. Effect of cattle manure on essential oil yield/ plant (ml) of Artemisia *abrotanum* L.) plants.

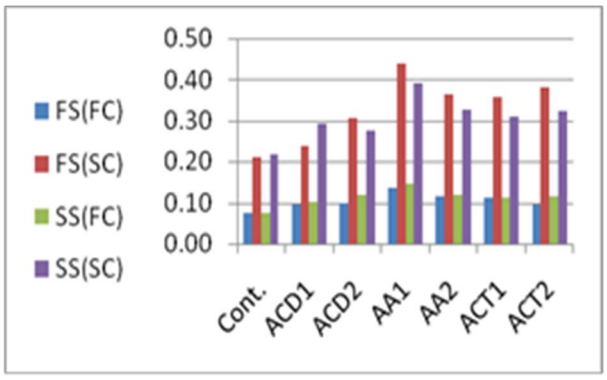

Fig. 6: Effect active dry yeast, ascorbic acid and actosol on the essential oil yield/plant (ml) of Artemisia (*Artemisia abrotanum* L.) plants

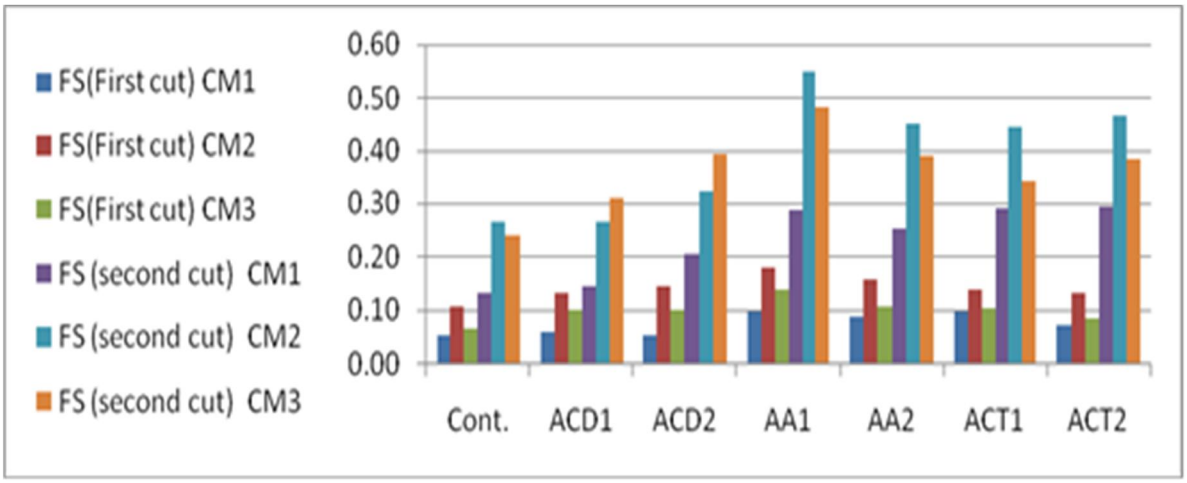

Fig. 7: Effect of cattle manure (CM), active dry yeast, ascorbic acid and actosol on the essential oil yield/plant (ml) of Artemisia (*Artemisia abrotanum* L.) plants in 2014 season.

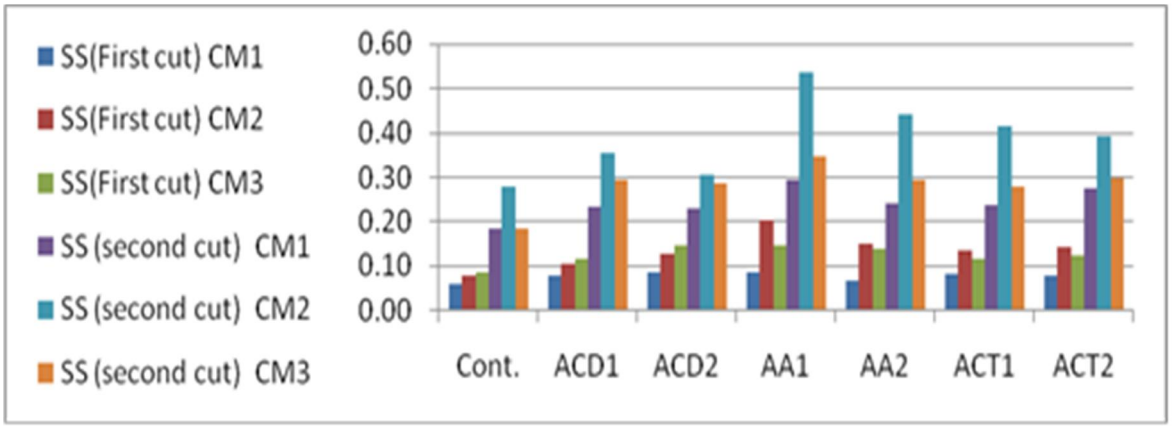

Fig. 8. Effect of cattle manure (CM), active dry yeast, ascorbic acid and actosol on the essential oil yield/plant (ml) of Artemisia (*Artemisia abrotanum* L.) plants in 2015season.

CM1, CM2 and CM3: Cattle manure 15, 30 and 45 m^3/fed **. FS:** First Season**, FC:** First cut, **SS:** Second season, **SC:** Second cut **, Con :** control, **ACD1:** Active dry yeast 2gm, **ACD2:** Active dry yeast4 gm, **AA1:** Ascorbic acid **AA2**: Ascorbic acid 200ppm, 100ppm**, ACT1:** Actosol 1ml**, ACT2:** Actosol 2 ml

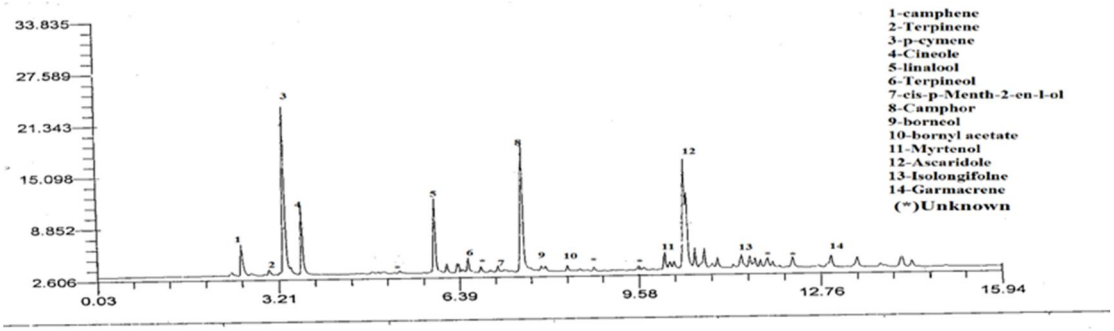

Fig. 9: Chromatogram of Artemisia(*Artemisia abrotanum,* L) plant essential oil distilled from plants treated with Cattle manure 30 m^3/fed+Ascorbic 100 ppm in the in the second cut of the second season.

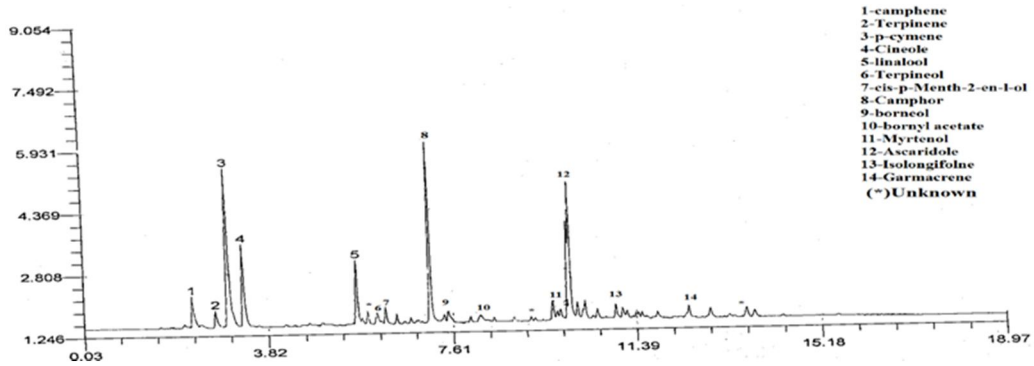

Fig. 10. Chromatogram of Artemisia(*Artemisia abrotanum,* L) plants essential oil distilled from plants treated with cattle manure 15m^3/fed+Actosol 1 ml/pot, in the second cut of the second season.

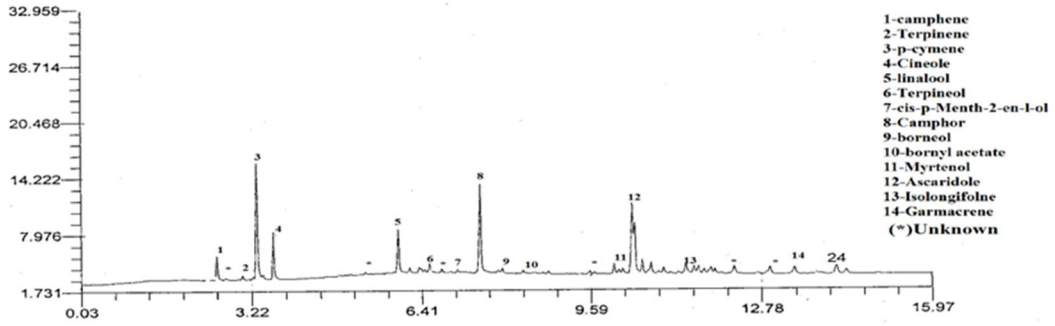

Fig. 11. Chromatogram of Artemisia(*Artemisia abrotanum,* L) plant essential oil distilled from plants treated with Cattle manure15m^3/fed+ Dry yeast 2 g/l in the second cut of the second season.

Chemical composition

a. Leaf pigments (Chlorophyll a, b, and carotenoids)

Data presented in Table (2 & 3) show that cattle manure had significant effect on chlorophyll "a" content. In the first season at both cuts, and the highest content was produced as a result of 30 m^3/fed cattle manure treatment (2.27 and 3.71 mg /g F.w) where as the lowest was recorded with CM at 15 m^3/fed (1.88 and 3.02 mg /g F.w) In the second season, (at both cuts) the highest contents of chlorophyll "a" was recorded with cattle manure at 30 m^3/fed (3.31 and 3.68 mg/g F.w), respectively). Whereas, the lowest content of chlorophyll "a" was recorded with CM at 45 m^3/fed(2.67 mg/ g F.w) in the first cut and CM at 15 m3/fed(3.48 mg/g F.w) in the second cut.

In first season. the treatment of active dry yeast at 2g/ l gave the highest chlorophyll "a" content (2.53 mg/ g F.w) in the first cut ,but in the second cut, the treatment of Ascorbic acid at 100 ppm was the most effective (3.76 mg / g F.w).

In the second season, , Ascorbic acid at 100 ppm gave the highest chlorophyll "a" content (3.78 mg/ g F.w) in the first cut, while in the second cut, active dry yeast at 2 g / l gave the highest chlorophyll

"a" content (3.73 mg / g F.w). Similar results were obtained by Khalil *et al.* (2010) on *Ocimum basilicum* indicated that the application of ascorbic acid in different concentrations showed significantly increased the pigments content

Table 2: Effect of cattle manure (CM), active dry yeast, ascorbic acid and Actosol on chlorophyll "a","b" and carotenoids content (mg/g F.W.) of Artemisia (*Artemisia abrotanum* L.) plant in 2014 season.

Biostimulants (B)	Chlorophyll-a							
	Frist cut				Second cut			
	CM1	CM 2	CM 3	Mean(B)	CM1	CM 2	CM 3	Mean(B)
Control	1.66	1.80	1.68	**1.71**	2.41	3.25	2.86	**2.86**
Active dry yeast 2 g/ l	2.49	2.74	2.35	**2.53**	3.05	3.41	3.03	**3.16**
Active dry yeast 4 g/ l	1.70	2.00	1.76	**1.82**	3.10	3.83	3.18	**3.37**
Ascorbic acid 100 ppm	1.96	2.83	2.16	**2.32**	3.60	3.93	3.76	**3.76**
Ascorbic acid 200 ppm	1.81	2.60	1.66	**2.02**	2.82	3.81	3.56	**3.40**
Actosol 1 ml/ l	1.81	2.05	1.82	**1.89**	2.87	3.84	2.83	**3.18**
Actosol 2 ml /l	1.71	1.84	1.91	**1.82**	3.29	3.92	3.09	**3.43**
Mean(A)	**1..88**	**2.27**	**1.91**		**3.02**	**3.71**	**3.20**	
	Chlorophyll-b							
Control	0.64	0.81	0.66	**0.70**	0.70	0.85	0.82	**0.79**
Active dry yeast 2 g/ l	1.16	0.96	0.65	**0.92**	1.04	1.01	0.86	**0.97**
Active dry yeast 4 g/ l	0.63	0.85	0.96	**0.81**	0.98	1.25	1.03	**1.09**
Ascorbic acid 100 ppm	0.62	1.13	0.97	**0.91**	1.23	1.68	1.54	**1.48**
Ascorbic acid 200 ppm	0.78	1.01	0.66	**0.82**	0.85	1.11	1.00	**0.99**
Actosol 1 ml/ l	0.67	0.72	0.76	**0.72**	0.86	1.02	1.22	**1.03**
Actosol 2 ml /l	0.65	0.80	0.81	**0.75**	0.97	1.44	1.23	**1.21**
Mean(A)	**0.74**	**0.90**	**0.78**		**0.95**	**1.19**	**1.10**	
	Carotenoids							
Control	1.22	1.46	1.46	**1.38**	1.71	1.64	1.57	**1.64**
Active dry yeast 2 g/ l	1.60	1.68	1.56	**1.61**	2.49	2.58	2.52	**2.53**
Active dry yeast 4 g/ l	1.31	1.49	1.28	**1.36**	2.23	2.88	1.57	**2.23**
Ascorbic acid 100 ppm	1.31	1.46	1.41	**1.39**	2.63	3.20	2.90	**2.91**
Ascorbic acid 200 ppm	1.28	1.40	1.29	**1.32**	1.93	2.78	2.88	**2.53**
Actosol 1 ml/ l	1.65	1.28	1.29	**1.41**	2.06	2.76	2.33	**2.38**
Actosol 2 ml /l	1.61	1.35	1.28	**1.41**	1.83	2.25	2.55	**2.21**
Mean(A)	**1.43**	**1.45**	**1.37**		**2.13**	**2.58**	**2.33**	

L.S.D. at 5% :	**Chlorophyll-a**		**Chlorophyll-b**		**Carotenoids**	
	First cut	**Second cut**	**First cut**	**Second cut**	**First cut**	**Second cut**
A.	**0.007**	**0.008**	**0.017**	**0.007**	**0.010**	**0.008**
B.	**0.024**	**0.024**	**0.029**	**0.024**	**0.250**	**0.024**
AXB	**0.034**	**0.035**	**0.041**	**0.035**	**0.036**	**0.034**

The interaction effect between cattle manure and biostimulants, revealed that the highest chlorophyll "a" content was obtained with CM at 30 m^3/fed + ascorbic acid at 100 ppm giving 2.83and 3.93 mg / g F.w at both cuts in first season, respectively. In the second season suppling plants CM at 30 m^3/fed + Ascorbic acid at 100 ppm gave the highest chlorophyll"a" content 3.97 mg / g F.w at the first cut while at the second cut CM at 15 m^3/fed +active dry yeast at 2 g /l gave the highest chlorophyll"a" content 3.93mg / g F.w. Similar results were obtained by Abdou *et al.* (2013) on black cumin

Data in Table (2 & 3) indicated that cattle manure treatments increased the chlorophyll “b” content and the highest content were obtained when cattle manure was applied at 30 m^3/fed, giving 0.90, 1.19, 1.10 and 1.28 mg/ g F.w at the first and second cuts of both seasons, respectively**.**

Treating plants with active dry yeast at 2g / l and Ascorbic acid at 100 ppm significantly increased chlorophyll "b" content gave the highest values (0.92 and 1.48/ g F.w).in first and second cuts respectively, in the first season. In the second season, the treatments of Ascorbic acid at 100 ppm and active dry yeast at 2 g / l were the most effective in this respect.

Concerning the interaction effect, the data indicated that, in the first season, fertilization with cattle manure at 15m^3/fed + active dry yeast at 2g / l gave the highest chlorophyll "b" content (1.16 mg/ g F.w) at the first cut, the treatment of cattle manure at 30 m^3/fed + Ascorbic acid at 100 ppm (1.68 mg/ g F.w) in the second one , and the first cut in the second season, gave the highest value (1.31 mg/

g F.w), While at the second cut, cattle manure 30m^3/fed + ascorbic acid at 200ppm and cattle manure at 30m^3/fed+ actosol at 1 ml were the most effective 1.36 mg/ g.

Data in Table (2 & 3) indicated that, in the both seasons, cattle manure treatment at 30m^3/fed gave the highest values of carotenoids content, at both cuts.

Regarding the effect of biositmulants it was found that adding yeast, ascorbic acid and actosol significantly increased carotenoids content in the first cut of first season and the treatment of active dry yeast ta 2g/ l gave the highest carotenoids content such increase in photosynthetic pigments formation could be attributed to the role of yeast cytokinins which delaying the aging of leaves by reducing the degradation of chlorophyll and enhancing the protein and RNA synthesis (Castelfranco and Beale, 1983). While in the second cut, as well as both cuts of the second season, the treatment of ascorbic acid at 100 ppm gave the highest value of carotenoids content. As for the interaction between cattle manure and biostimulants, the data indicated that, in the first season, fertilization with cattle manure at 30 m^3/fed + active dry yeast 2 g / l and CM at 30m^3/fed+ ascorbic acid at 100 ppm gave the highest values of carotenoids content in both cuts of the first season. In the second season cattle manure at 30 m^3/fed +ascorbic acid at 100 ppm gave the highest values of carotenoids content, at both cuts.

Table 3: Effect of cattle manure (CM), active dry yeast, ascorbic acid and Actosol on chlorophyll "a","b" and carotenoids content (mg/g F.W.) of Artemisia (*Artemisia abrotanum* L.) plant in 2015 season.

Biostimulants (B)	Chlorophyll-a							
	Frist cut				Second cut			
	CM1	CM 2	CM 3	Mean(B)	CM1	CM 2	CM 3	Mean(B)
Control	2.32	2.52	2.32	**2.39**	3.36	3.46	2.75	**3.19**
Active dry yeast 2 g/ l	3.06	3.80	2.68	**3.18**	3.93	3.61	3.65	**3.73**
Active dry yeast 4 g/ l	3.09	3.73	2.56	**3.13**	3.91	3.51	3.61	**3.68**
Ascorbic acid 100 ppm	3.70	3.97	3.67	**3.78**	3.41	3.86	3.77	**3.68**
Ascorbic acid 200 ppm	3.48	3.79	2.54	**3.27**	2.97	3.81	3.71	**3.50**
Actosol 1 ml/ l	2.91	2.77	2.42	**2.70**	3.10	3.86	3.65	**3.54**
Actosol 2 ml /l	2.91	2.62	2.53	**2.69**	3.70	3.67	3.36	**3.58**
Mean(A)	**3.07**	**3.31**	**2.67**		**3.48**	**3.68**	**3.50**	
	Chlorophyll-b							
Control	0.79	0.77	0.83	**0.80**	1.10	1.24	0.94	**1.09**
Active dry yeast 2 g/ l	1.01	1.23	0.94	**1.06**	1.34	1.27	1.24	**1.28**
Active dry yeast 4 g/ l	0.99	1.29	0.86	**1.05**	1.31	1.24	1.24	**1.26**
Ascorbic acid 100 ppm	1.27	1.31	1.19	**1.26**	1.13	1.32	1.27	**1.24**
Ascorbic acid 200 ppm	1.14	1.22	0.90	**1.09**	1.00	1.36	1.28	**1.21**
Actosol 1 ml/ l	0.78	0.99	0.95	**0.91**	1.04	1.36	1.22	**1.21**
Actosol 2 ml /l	0.99	0.86	0.84	**0.90**	1.22	1.19	1.10	**1.17**
Mean(A)	**1.00**	**1.10**	**0.93**		**1.16**	**1.28**	**1.18**	
	Carotenoids							
Control	1.43	1.56	1.49	**1.49**	1.36	2.21	1.46	**1.68**
Active dry yeast 2 g/ l	1.78	2.21	1.52	**1.84**	1.85	2.59	2.78	**2.41**
Active dry yeast 4 g/ l	1.73	2.77	1.56	**2.02**	2.10	3.45	2.91	**2.82**
Ascorbic acid 100 ppm	1.79	2.84	1.85	**2.16**	2.41	3.50	3.23	**3.05**
Ascorbic acid 200 ppm	1.73	2.00	1.52	**1.75**	1.73	3.17	2.17	**2.36**
Actosol 1 ml/ l	1.45	1.42	1.56	**1.48**	1.72	3.22	2.84	**2.59**
Actosol 2 ml /l	1.47	1.88	1.56	**1.64**	1.83	2.63	2.59	**2.35**
Mean(A)	**1.63**	**2.10**	**1.58**		**1.86**	**2.97**		

L.S.D. at 5% :	**Chlorophyll-a**		**Chlorophyll-b**		**Carotenoids**	
	First cut	**Second cut**	**First cut**	**Second cut**	**First cut**	**Second cut**
A.	**0.007**	**0.008**	**0.007**	**0.007**	**0.009**	**0.009**
B.	**0.024**	**0.024**	**0.024**	**0.024**	**0.024**	**0.025**
AXB	**0.034**	**0.035**	**0.034**	**0.035**	**0.035**	**0.035**

N, P and K contents

The reopens of N, P and K contents in *Artemisia abrotanum* herb to the application of CM as well as some biostmulants are presented in table (4 & 5). The obtained data revealed that cattle manure application had no significant effect on N**%** in the first cut of the first season, but in the second one CM at 30 m^3/fed, gave the highest content (3.44 %) as well as, the highest N content in both cuts of the second season, giving 3.11 and 3.19 D.W, respectively.

Using biostimulant ascorbic acid at 100 ppm significantly increased the nitrogen (%D.W) with mean values at (3.17, 3.52 and 3.27 and 3.45 %, at the first and second cuts of the first and second season , respectively)

The combined treatments between cattle manure and biostimulants significantly increased N (%) in the herb in both seasons, the best results were obtained with cattle manure at 30 m3/fed. + Ascorbic acid at 100 ppm (3.33, 3.68, 3.62 and 3.54 % D.W) at the first and second cuts of the both seasons, respectively). Similar results were reported Al-Shareif (2012) on black cumin, concluded that the highest contents of N, P and K were obtained with the combination treatment of compost + ascorbic acid.

Table 4: Effect of cattle manure (CM), active dry yeast, ascorbic acid and actosol on N, P and K percentage in dry herb of Artemisia (*Artemisia abrotanum* L.) plant in 2014 season.

Biostimulants (B)	N percentage							
	Frist cut				Second cut			
	CM1	CM 2	CM 3	Mean(B)	CM1	CM 2	CM 3	Mean(B)
Control	2.63	2.74	2.16	**2.51**	2.84	3.11	3.21	**3.05**
Active dry yeast 2 g/ l	2.67	2.87	2.86	**2.80**	2.89	3.32	3.23	**3.15**
Active dry yeast 4 g/ l	3.14	2.98	2.97	**3.03**	2.86	3.39	3.37	**3.21**
Ascorbic acid 100 ppm	3.13	3.33	3.05	**3.17**	3.34	3.68	3.55	**3.52**
Ascorbic acid 200 ppm	3.01	2.69	2.56	**2.75**	2.91	3.41	3.49	**3.27**
Actosol 1 ml/ l	3.20	2.78	2.75	**2.91**	3.09	3.54	3.23	**3.29**
Actosol 2 ml /l	2.63	2.88	3.01	**2.84**	2.94	3.60	3.37	**3.30**
Mean(A)	**2.92**	**2.90**	**2.77**		**2.98**	**3.44**	**3.35**	
	P percentage							
Control	0.24	0.31	0.30	**0.28**	0.27	.32	0.30	**0.30**
Active dry yeast 2 g/ l	0.28	0.41	0.34	**0.34**	0.34	0.40	0.37	**.037**
Active dry yeast 4 g/ l	0.29	0.37	0.32	**0.33**	0.36	0.38	0.44	**0.39**
Ascorbic acid 100 ppm	0.35	0.45	0.41	**0.40**	0.38	0.44	0.39	**0.40**
Ascorbic acid 200 ppm	0.36	0.39	0.36	**0.37**	0.34	0.41	0.31	**0.35**
Actosol 1 ml/ l	0.30	0.35	0.43	**0.36**	0.39	0.30	0.33	**0.34**
Actosol 2 ml /l	0.38	0.42	0.31	**0.37**	0.28	0.40	0.31	**0.33**
Mean(A)	**0.31**	**0.39**	**0.35**		**0.34**	**0.38**	**0.35**	
	K percentage							
Control	1.36	1.44	1.38	**1.39**	1.75	1.99	1.96	**1.90**
Active dry yeast 2 g/ l	1.40	1.79	1.94	**1.71**	1.79	2.03	2.09	**1.97**
Active dry yeast 4 g/ l	1.42	2.03	2.09	**1.85**	1.77	2.01	2.21	**2.00**
Ascorbic acid 100 ppm	2.13	2.23	2.10	**2.15**	1.94	2.33	2.82	**2.36**
Ascorbic acid 200 ppm	2.14	1.79	1.40	**1.78**	2.00	2.11	1.95	**2.02**
Actosol 1 ml/ l	2.06	1.58	1.44	**1.69**	1.90	2.24	1.99	**2.04**
Actosol 2 ml /l	1.77	1.99	2.06	**1.94**	2.02	2.68	2.18	**2.29**
Mean(A)	**1.75**	**1.84**	**2.06**		**1.88**	**2.20**	**2.17**	

L.S.D. at 5% :	**N percentage**		**P percentage**		**K percentage**	
	First cut	**Second cut**	**First cut**	**Second cut**	**First cut**	**Second cut**
A.	**ns**	**0.017**	**0.007**	**0.007**	**0.009**	**0.070**
B.	**0.269**	**0.015**	**0.025**	**0.024**	**0.025**	**0.081**
AXB	**0.387**	**0.021**	**0.036**	**0.035**	**0.036**	**0.115**

Also the data indicated that in the first season**,** the treatment of cattle manure at 30 m^3/fed gave the highest p. content (0.39 and 0.38 % D.W in the first and second cuts, respectively) as well as in the second one (0.38% D.W) but it had no significant effect in the second cut. Ateia *et al.* (2009**)** on *Thymus vulgaris* revealed that 20 m^3 compost combined with 10m^3 chicken or sheep manure increased the N, P and K percentages. Also data in Table (4 & 5) showed that active dry yeast, ascorbic acid and actosol significantly increased P content in the first season and Ascorbic acid at 100 ppm was the most effective(0.40%) at the second season Ascorbic acid at 100 ppm also gave the (0.40%)at the first cut ,and the high level of Ascorbic acid at 200 ppm gave the highest P content (0.42%.) at the second cut . In the first season, the application of cattle manure at 30 m^3/fed +ascorbic acid at 100 ppm. gave the highest value of p% in both two cuts (0.45 and 0.44%) In the second season in the first cut fertilization with cattle manure at 15 m^3/fed plus Ascorbic acid at 100 ppm , gave the highest P% 0.42 but in the second cut , cattle manure at 15m^3/fed + active dry yeast 2g/ L or CM at 45 m^3/fed + Ascorbic acid at 100and 200ppm gave the highest value (0.44 %).

Regarding the effect of CM and biostmulants on K. content , the data in Table (4&5) showed that cattle manure at 30 m^3/fed gave the highest K. content (1.84, 2.20, 2.08 and 1.91 D.W %) at the first and second cuts in both seasons, respectively). Treating artimisia plants with yeast, ascorbic acid and actosol significantly increased K %. in herb, in the first season, of Ascorbic acid at 100 ppm gave the highest K. content (2.15 and 2.36 %, at the first and second cuts, respectively). A similar trend was recorded in the second season.

In the first season, treating plants with cattle manure at 30 m^3/fed +ascorbic acid at 100 ppm gave the highest K. content (2.23 %D.W) in the first cut, while at the second cut the highest K. content (2.82 % D.W) was recorded with the combined treatment of cattle manure at 45 m^3/fed +Ascorbic acid at 100 ppm. In the second season, supplying plants cattle manure at 30 m^3/fed combined with Ascorbic acid at 100 ppm. gave the highest K. content 2.42 and 2.63 K. content% D.W)

Table 5: Effect of cattle manure (CM), active dry yeast, ascorbic acid and actosol on N,P and K percentage in dry herb of Artemisia (*Artemisia abrotanum* L.) plant in 2015 season.

Biostimulants (B)	Frist cut				Second cut			
	CM1	**CM 2**	**CM 3**	**Mean(B)**	**CM1**	**CM 2**	**CM 3**	**Mean(B)**
				N percentage				
Control	2.48	2.73	2.66	**2.62**	2.40	2.76	2.75	**2.64**
Active dry yeast 2 g/ l	2.71	2.75	2.78	**2.75**	2.60	3.51	2.76	**2.96**
Active dry yeast 4 g/ l	3.09	2.38	2.70	**2.72**	2.64	3.35	2.77	**2.92**
Ascorbic acid 100 ppm	3.32	3.62	2.88	**3.27**	3.38	3.54	3.44	**3.45**
Ascorbic acid 200 ppm	2.87	3.51	2.74	**3.04**	3.35	3.44	2.98	**3.26**
Actosol 1 ml/ l	2.90	3.45	2.70	**3.02**	2.91	2.78	2.92	**2.87**
Actosol 2 ml /l	2.83	3.30	3.10	**3.8**	2.86	2.92	2.78	**2.85**
Mean(A)	**2.89**	**3.11**	**2.79**		**2.88**	**3.19**	**2.91**	
				P percentage				
Control	0.32	0.31	0.27	**0.30**	0.29	0.36	0.34	**0.33**
Active dry yeast 2 g/ l	0.40	0.35	0.40	**0.38**	0.44	0.41	0.34	**0.40**
Active dry yeast 4 g/ l	0.36	0.42	0.40	**0.39**	0.40	0.42	0.39	**0.40**
Ascorbic acid 100 ppm	0.42	0.40	0.37	**0.40**	0.38	0.37	0.44	**0.40**
Ascorbic acid 200 ppm	0.30	0.37	0.37	**0.36**	0.41	0.42	0.44	**0.42**
Actosol 1 ml/ l	0.28	0.42	0.42	**0.36**	0.40	0.41	0.41	**0.41**
Actosol 2 ml /l	0.41	0.39	0.39	**0.39**	0.37	0.30	0.38	**0.35**
Mean(A)	**0.36**	**0.38**	**0.37**		**0.38**	**0.38**	**0.39**	
				K percentage				
Control	1.34	2.00	1.27	**1.54**	1.39	1.61	1.36	**1.45**
Active dry yeast 2 g/ l	1.73	1.98	1.75	**1.82**	1.43	1.98	1.56	**1.66**
Active dry yeast 4 g/ l	1.78	1.95	1.81	**1.85**	1.42	1.75	2.14	**1.77**
Ascorbic acid 100 ppm	2.16	2.42	2.15	**2.24**	2.10	2.63	2.05	**2.26**
Ascorbic acid 200 ppm	1.74	2.05	1.96	**1.92**	1.74	2.04	1.96	**1.91**
Actosol 1 ml/ l	2.13	2.02	2.00	2.05	1.98	1.57	1.80	1.78
Actosol 2 ml /l	1.96	2.15	2.05	2.05	2.03	1.80	2.12	1.98
Mean(A)	**1.83**	**2.08**	**1.86**		**1.73**	**1.91**	**1.86**	

L.S.D. at 5% :	**N percentage**		**P percentage**		**K percentage**	
	First cut	**Second cut**	**First cut**	**Second cut**	**First cut**	**Second cut**
A.	**0.018**	**0.030**	**0.007**	**ns**	**0.008**	**0.025**
B.	**0.036**	**0.048**	**0.024**	**0.225**	**0.024**	**0.034**
AXB	**0.062**	**0.089**	**0.035**	**0.032**	**0.035**	**0.044**

The content of total phenolic compounds.

Data in Table (6) indicated that cattle manure at different doses increased the total phenolic content in the herb. The highest contents were obtained with cattle manure at 30 m^3/fed. recording 25.26, 13.36, 27.29 and 14.48 mg /100 g D.W, at the first and second cuts of both seasons, respectively). Similar results were obtained by Javanmardi and Ghorbani (2012)on *Ocimum citriodorum* using chicken manure tea (CMT) and vermicompost tea (VCT) as soil drench, emphasized the possibility of using organic –based compost tea for enhancing herbal yield and important secondary metabolites. Arowosegbe (2016) On *Hibiscus sabdariffa* , it was found that plants treated with 120 g poultry manure contoured higher phenols in the calyces Also, the data revealed that.

Ascorbic acid at 100 ppm, significantly increased total phenolic content in both cuts of the two seasons giving 27.14, 14.49 and 28.94 and15.94 mg /100 g DW, respectively).

Regarding the interaction effects, (Table 6) there were marked differences in the total phenolic content in herb among the various combined of these two factors. The highest total phenolic content (27.72, 15.83,32.17 and 18.00mg /100 g DW ,at the first and second cuts of both seasons, respectively) were recorded in plants received Ascorbic acid at 100 ppm in combined with the medium Cattle manures at rate 30m^3/fed.

Table 6: Effect of cattle manure (CM), active dry yeast, ascorbic acid and actosol on the content of total phenolic compounds of Artemisia (*Artemisia abrotanum*, L) plant in 2014 and 2015 seasons.

Biostimulants (B)	First Season 2014							
	First cut				Second cut			
	Cattle manure m^3/fed.(A)				Cattle manure m^3/fed.(A)			
	15	30	45	Mean	15	30	45	Mean
Control	22.56	23.69	21.24	**22.50**	9.55	11.89	11.33	**10.92**
Active dry yeast 2 g/ L	27.52	25.85	21.86	**25.08**	14.10	12.94	12.22	**13.09**
Active dry yeast 4 g / L	23.67	27.11	25.89	**25.56**	14.90	13.73	13.01	**13.88**
Ascorbic acid 100ppm	27.14	27.72	26.57	**27.14**	13.99	15.83	13.65	**14.49**
Ascorbic acid 200ppm	23.30	24.58	25.75	**24.54**	10.86	12.82	13.20	**12.29**
Actosol 1ml/ L	24.30	24.14	23.26	**23.90**	14.53	12.55	11.95	**13.01**
Actosol 2 ml/ L	24.53	23.75	21.23	**23.17**	13.15	13.75	13.18	**13.36**
Mean	**24.72**	**25.26**	**23.69**		**13.01**	**13.36**	**12.65**	
LSD for:	**5%**				**5%**			
Cattle(A)	**0.372**				**0.43**			
Biostimulants (B)	**0.422**				**0.556**			
A*B	**0.607**				**0.801**			

Biostimulants (B)	Second Season 2015							
	First cut				Second cut			
	Cattle manure m^3/fed.(A)				Cattle manure m^3/fed.(A)			
	15	30	45	Mean	15	30	45	Mean
Control	23.90	22.18	20.16	**22.08**	10.07	12.82	12.12	**11.67**
Active dry yeast 2 g/ L	25.92	29.92	23.19	**26.34**	13.96	12.97	13.52	**13.48**
Active dry yeast 4 g / L	27.10	29.20	29.17	**28.49**	11.58	14.87	14.90	**13.78**
Ascorbic acid 100ppm	27.01	32.17	27.65	**28.94**	15.86	18.00	13.95	**15.94**
Ascorbic acid 200ppm	24.40	29.66	23.06	**25.71**	13.39	15.59	15.67	**14.88**
Actosol 1ml/ L	23.16	24.92	18.75	**22.28**	13.60	15.70	10.08	**13.13**
Actosol 2 ml/ L	26.85	22.98	23.08	**24.30**	12.75	11.41	12.75	**12.30**
Mean	**25.48**	**27.29**	**23.58**		**13.03**	**14.48**	**13.28**	
LSD for:	**5%**				**5%**			
Cattle(A)	**0.324**				**0.332**			
Biostimulants (B)	**0.885**				**0.889**			
A*B	**1.277**				**1.281**			

Antioxidant activity (%)

From the data recorded (Table 7),the obtained results that the cattle manure treatments had a clear effect on the antioxidant activity of *Artemisia abrotanum* as plants received cattle manure at 30 m^3/fed. had the highest antioxidant activity, with a mean values of 86.17, 80.96, 86.38 and 81.53 % at the first and second cuts of both ,seasons respectively. Similar results were reported by Taie *et al.* (2010) on sweet basil (*Ocimum basilicum*), found that the highest value of antioxidant and anticancer activity were obtained in plants grown in 50% and 75% compost treatments in the presence of biofertilizer. These results emphasized the importance of bio-organic fertilizers for enhancement the antioxidant activity , phenolics , flavonoids and essential oils of basil plant extract. Mohd *et al.* (2013) on *Labisia*

pumila indicated that the use of chicken dung can enhance the production of secondary metabolites and improved antioxidant activity. Whereas. Marcio *et al.* (2015) on *Passiflora incarnata* L showed that, the production of bioactive compounds such as polyphenols, total flavonoids and the antioxidant capacity were not influenced by the treatments of organic fertilization. In the first season, spraying plants with Ascorbic acid at 100 ppm gave the highest values of antioxidant activities (91.06 and 89.73% at the first and second cuts, respectively). Also, the results in Table (7) showed that the second season, there was a similar trend to that obtained in the first one. Regarding the interaction, it was found marked differences in the antioxidant activity between plants receiving the various combinations of these two factors. The highest antioxidant activity (97.28and 96.37%) was recorded in plants treated with Ascorbic acid at 100 ppm + cattle manure rate (30m3/fed.), A similar trend was detected in the second season .

Table 7: Effect of cattle manure (CM), active dry yeast, ascorbic acid and Actosol on the antioxidant activity of Artemisia (*Artemisia abrotanum*, L) plant in 2014 and 2015 seasons.

Biostimulants (B)	First Season 2014							
	First cut				Second cut			
	Cattle manure m^3/fed.(A)				Cattle manure m^3/fed.(A)			
	15	30	45	Mean	15	30	45	Mean
Control	43.86	78.79	75.44	**66.03**	21.86	78.52	63.79	**54.72**
Active dry yeast 2 g/ L	79.90	87.24	83.26	**83.47**	76.21	76.80	76.00	**76.34**
Active dry yeast 4 g / L	83.42	84.32	80.52	**82.75**	75.42	76.77	71.91	**74.70**
Ascorbic acid 100ppm	84.47	97.28	91.42	**91.06**	86.31	96.37	86.50	**89.73**
Ascorbic acid 200ppm	86.37	87.88	88.77	**87.67**	75.29	81.42	82.01	**79.57**
Actosol 1ml/ L	76.19	85.85	82.53	**81.52**	78.80	80.01	68.16	**75.66**
Actosol 2 ml/ L	68.48	81.84	78.68	**76.33**	76.71	76.82	74.84	**76.12**
Mean	**74.67**	**86.17**	**82.95**		**70.09**	**80.96**	**74.74**	
LSD for:	**5%**				**5%**			
Cattle(A)	**1.000**				**1.190**			
Biostimulants (B)	**2.020**				**1.970**			
A*B	**2.907**				**2.841**			
Biostimulants (B)	**Second Season 2015**							
	First cut				Second cut			
	Cattle manure m^3/fed.(A)				Cattle manure m^3/fed.(A)			
	15	30	45	Mean	15	30	45	Mean
Control	45.90	77.42	80.77	**68.03**	19.85	78.52	61.81	**53.39**
Active dry yeast 2 g/ L	79.88	85.23	85.28	**83.46**	80.22	74.80	78.03	**77.68**
Active dry yeast 4 g / L	85.39	84.37	82.50	**84.09**	77.42	78.80	71.91	**76.04**
Ascorbic acid 100ppm	84.53	97.26	91.39	**91.06**	84.32	96.32	88.50	**89.71**
Ascorbic acid 200ppm	86.34	89.86	90.83	**89.01**	79.28	83.44	78.05	**80.26**
Actosol 1ml/ L	76.17	89.90	86.50	**84.19**	78.80	78.03	72.14	**76.32**
Actosol 2 ml/ L	70.52	80.65	77.82	**76.33**	78.71	80.78	76.81	**78.77**
Mean	**75.53**	**86.38**	**85.01**		**71.23**	**81.53**	**75.32**	
LSD for:	**5%**				**5%**			
Cattle(A)	**0.33**				**2.13**			
Biostimulants (B)	**2.09**				**3.77**			
A*B	**3.010**				**5.444**			

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