Response of *Calendula officinalis* L. plants to some organic and bio-fertilizers types.

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ABSTRACT

This study was carried out during two successive seasons of 2011/2012 and 2012/2013 on *Calendula officinalis* L. plant at the Experimental Farm of Horticultural Department, Faculty of Agriculture, Al-Azhar University, Nasr City, Cairo, Egypt. Pot experiment was conducted to investigate the response of *Calendula officinalis* L. plants to three rates of poultry manure, two strains of bacteria (*Azospirillum brasilense*; nitrogen fixation bacteria, and *Bacillus megaterium* var. *phosphaticum*; phosphate dissolving bacteria) and Vesicular arbscular mycorrhizal (VAM) fungi were applied seedlings after transplanting of the seedlings.

Results showed that all treatments of organic and bio-fertilization improved different vegetative growth characters, promoted flowering parameters and stimulated various chemical constituents compared with control. The highest rate of poultry manure resulted in significant increases in vegetative growth, best quality and quantity of flower production and various chemical constituents such as carotenoids, carbohydrates and oleanolic acid in the flowers as well as chlorophyll b content, nitrogen, phosphorus and potassium percentage.

Hence, these findings clearly indicated that, organic fertilizers could be used as effective tools instead of chemical fertilization, lowering the productive costs and consequently minimize the pollution of the agriculture environment.

Key words: *Calendula officinalis* L., organic manure, *Azospirillum*, VAM, oleanolic acid

INTRODUCTION

Calendula officinalis L. plant is an important ornamental plant belonging to family Asteraceae. It is cultivated for outdoors winter annual landscaping as a source of color in the gardens and cut flowers. Moreover, it is considered to be one of the valuable medicinal plants, which contains a lot of compounds such as oleanolic acid, phytosterols, glycosides carotenes (tetraterpenes), salicylic acid, phenolic acid, sugars, flavonoids, bitter principies, saponins, chlorogeneic acid, trace of pyrogallol tannins, fatty acids in the seeds and essential oil of antibiotic activity **(Vidal-Ollivier *et al.*, 1989)**. Compounds similar to pyrthins and series of triterpeniods glycosides in the roots **(Rizk and Al-Nowaihi, 1989)** were presented.

The ethanolic extract of *Calendula officinalis* L. plants contains substances that inhibit *Trichomonas vaginalis* fungi **(Samochowiec *et al.*, 1979)**.The plant has nematocidal properties against root-knot nematodes and stem nematodes **(Andreeva, 1975; Goswami *et al.*, 1986).**

Extract of the inflorescence have antimicrobial activity and can be used in cosmetics **(Gora *et al.*, 1980)**. Fraction of the flowers in combination of allantoin markedly stimulates physiological regeneration and epithelization in the wounds of wistar albino rates **(Kloucek-Popova *et al.*, 1982; Carvallo *et al.*, 1991)**. The flowers are effective in controlling bacterial growth **(Hussein and Saas, 1994)**. The petals are used as natural pigment for egg yolk color in laying hens **(Wezyk *et al.*, 1992; Nakajima *et al.*, 1994)**, and to enhance skin and shank color values of broilers **(Galvano and Lanza, 1972, 1973; Erkek *et al.*, 1993)**. *Calendula officinalis* L plant is becoming very important cultivated medicinal plant for the local use and export. The objective of this study is to investigate the effect of organic manure and some bio-fertilizers treatments (*Azosperillium*, *Bacillus* and Mycorrhiza) on vegetative growth, flowering and chemicals composition of *Calendula officinalis* L. plants.

MATERIALS AND METHODS

This investigation was carried out in the Experimental Farm of Horticultural Department, Faculty of Agriculture, Al-Azhar University, Nasr City, Cairo, Egypt, during the two successive seasons 2011/2012 and 2012/2013.

The soil used:

The soil used was Loamy sand soil. Its chemical and physical characteristics are presented in Table (1).

Table (1): Physical and chemical properties of the experimental soil.

A-Physical properties:-

Soil Texture	Clay%	Silt%	Fine sand%	coarse sand %
Loamy sand	16.6	30.4	42.8	10.2

B-Chemical properties:-

Chemical analysis	K	Na	Mg	Ca	SO_4	Cl	HCO_3	SP	pH	E.C
Loamy sand	3.80	2.11	4.3	2.61	2.9	4.4	3.08	40	7.9	31.8

Plant Material:

Calendula officinalis L. seeds were obtained from Horticulture Research Institute of Medicinal and Aromatic Plants Section, Giza, Egypt, then sown in the nursery for beds on October 5th for both seasons. Seedlings were transplanted after 45 days at 20 November to the field. The experiment was carried in plots 1.5 x 2 m. which consisted of 3 rows at 50 cm. a part and at a distance of 30 cm. between the plants. Each treatment contained 3 replicates and each replicate (plot) consisted of 21 plants.

Organic Fertilizer:

Organic fertilization as poultry manure was provided from the Farm of Animal Production Department, Faculty of Agriculture, Al-Azhar University, Nasr City. It was applied at three levels 20, 30 and 40 m^3/fed. The chemical analysis of poultry manure are presented in Table (2).

Table (2): Chemical analysis of poultry manure used in this investigation.

Chemical analysis	pH	E.C. mM	N %	P %	K %	C/N ratio	Fe ppm	Mn ppm	Cu ppm	Zn ppm
Poultry manure	6.69	7.09	4.1	1.78	1.11	9.3:1	149	179	92	111

Bio-Fertilizers:

Cultures of the microorganisms, nitrogen fixer bacteria (*Azospirillum brasilense*) and phosphate solubilizing bacteria (*Bacillus megaterium* var. *phosphaticum*) and potassium solubilizing bacteria (*B. circulans*) were obtained from cultural collection of Agric. Microbiology Dep. National Research Centre, Egypt. They were grown according to **(Abd El-Malek and Ishac, 1968; Dobereiner *et al.*, 1976)**. Each plant was inoculated with 3 ml of bacterial suspension from the three bacteria strains *Azospirillum brasilense*, *Bacillus megaterum* and *B. circulans* after transplanting. Vesicular arbscular mycorrhizal (VAM) fungi, which contained 3 effective strains representing [*Glomus etunicatum*, *Glomus intraradices* and *Glomus fasciculatum*] VAM fungi was used for soil inoculation after transplanting containing about 200 VAM spores/plant.

The experimental design:

The layout of the experiment was a complete randomized blocks design during the two seasons in three replicates for each treatment (16 treatments).

Statistical analysis:

The statistical analysis was performed according to **(Snedecor and Cochran, 1980)** using M-state program version 4. analysis of variance (ANOVA) with Duncan's Multiple Range test ($P \leq 0.05$).

Treatments:

The fertilization treatments were used as follows:

1- Control.

2- Poultry manure at 20 m^3 / fed.

3- Poultry manure at 30 m^3 / fed.

4- Poultry manure at 40 m^3 / fed.

5- Azospirillum + Bacillus. (Azos+Bc).

6- Azospirillum + VAM. (Azos+VAM).

7- Azospirillum + Bacillus + VAM. (Azos+Bc+VAM).

These treatments were carried out in the two successive seasons. The compost was applied at the level of 7.5 ton / fed. as a carrier to bio fertilizers.

6. Data recorded:

The following data were recorded for the two seasons:

1- Plant height (cm), as the main plant stem.

2- Number of branches/ plant.

3- Dry weight (g/plant).

4 - Flowering date, considered at the first opened flowering head.

5 - Number of flowering heads/ plant.

6 - Diameter of flowering head (cm).

7 - Flowering period, recorded from the first opened flowering head until the end of the flowering.

8 - Chlorophyll a, b contents in the fresh leaves (mg/ g) and total carotenoids content in fresh flowering heads (mg/g) were determined using the method of **(Rami and Danporath, 1980)**.

9 - Total carbohydrates (%) was determined by using phenol-sulphuric acid method according to **(Dubois *et al.*, 1956)**.

10-Total nitrogen (%) was determined according to the method described by **(A.O.A.C, 1995)**.

11- Potassium and phosphorus (%) were determined according to **(Cottenie *et al.*, 1982)**.

12- Oleanolic acid content was estimated in the dry flowering heads according to **(El-Gaingihi et al., 1982)**.

RESULTS AND DISCUSSION

1. Effect of organic and bio-fertilizers on some vegetative characters.

The data in Table (3) revealed that, in most cases, the studied vegetative growth characters, plant height (cm.), branches number/ plant and herb dry weight (g) /plant of *Calendula officinalis* L. plants were significantly increased in both seasons due to the use of poultry manure and bio-fertilization in comparison to the untreated plants. Corresponding data showed an increase in plant height due to poultry manure treatments in comparison to bio-fertilizers treatments and to the control especially, when poultry manure was used at the rate of 30 and 40 m^3/fed., which produced 87.47 and 90.73 cm. in the 1st season, 86.50 and 88.43 cm. in the 2nd season, respectively. However, application of poultry manure at 30 m^3/fed. gave the highest values for number of branches (86.73) in the 1st season, while application of poultry manure 40 m^3/fed. gave the highest values for number of branches (93.00) in the 2nd season. Data illustrated showed that, the maximum value of herb dry weight (249.36 g/plant in the 1st season) was obtained as a result of poultry manure 40

m^3/fed. Moreover, treatments of poultry manure at 20, 30 and 40 m^3/fed. gave the highest values of herb dry weight in the 2nd season recording 254.48, 257.35 and 276.94 g/plant, respectively.

The enhancing effects of organic manures on plant height, number of branches and dry weight of herb may be attributed to the role of organic manure in holding moisture and maintaining sufficient pore spaces to permit good air circulation and drainage of the excessive water produced, and composts from residues of plants and animals dropping, is one type of humus, which contributes to the soil fertility **(Schachtschable, 1979)**. Organic fertilizer contains a little or no soluble salt and can be used in high levels without causing root damage, that may occur if the organic fertilizer is utilized to apply corresponding quantities for plant nutrient **(Cooke, 1972)**.

Table (3): Effect of poultry manure, *Azospirillum*, *Bacillus* and VAM on vegetative growth characteristics of *Calendula officinalis* L. plants during 2011/2012 and 2012/2013seasons.

Treatments	Plant height(cm.)		Branches number/plant		Herb dry weight (g/plant)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	37.33^{d}	38.93^{d}	29.30^{e}	28.67^{f}	84.94^{c}	94.41^{d}
Poultry 20 m^3/fed.	72.50^{b}	76.10^{b}	68.37^{bc}	77.67^{c}	210.47^{ab}	254.48^{a}
Poultry 30 m^3/fed.	87.47^{a}	86.50^{a}	86.73^{a}	85.33^{b}	234.84^{ab}	257.35^{a}
Poultry 40 m^3/fed.	90.73^{a}	88.43^{a}	80.40^{ab}	93.00^{a}	249.36^{a}	276.94^{a}
Azos+Bc 3 ml each.	67.63^{b}	64.30^{c}	54.12^{cd}	55.67^{d}	201.09^{ab}	154.62^{c}
Azos+VAM 3 ml each.	56.57^{c}	56.60^{c}	45.97^{de}	46.67^{e}	210.36^{ab}	178.71^{bc}
Azos+ Bc+VAM 3ml each.	66.30^{b}	63.10^{c}	59.03^{cd}	60.33^{d}	186.51^{b}	197.81^{b}

a to f Means having different letters exponents in column are significantly different ($P \leq 0.05$)

The results take the same line with **Hammam (1996)** on *Pimpinella anisum*, **El-Sayed *et al.* (2002)** on *Origanum majoranum*, **Helmy and Zarad (2003)** on *Borago officinalis*, **Atta-Alla *et al.* (2005)** on *Capsicum annuum*.

2. Effect of organic and bio-fertilizers on some flowering aspects.

Concerning the effect of organic and bio-fertilizers on flowering characters, it could be noticed that the studied flowering growth characters; number of flowering heads/plant, flowering head diameter/plant (cm.) (Table (4)), flowering start (days) and flowering period (days) (Table (5)) were significantly increased due to the use of organic and bio-fertilization in both seasons in comparison to the unfertilized plants. Data presented in Table (4) showed that, the highest number of flowering heads (36.33) and diameter of flowering head (6.30 cm.) in the 1st season, when poultry manure at 40 m^3/fed. was applied. The same treatment also resulted in the highest values number of flowering heads (36.33) and diameter of flowering head (6.63 cm.) in the 2nd season.

Table (4): Effect of poultry manure, *Azospirillum*, *Bacillus* and VAM on number of flowering heads and flower diameter (cm.) of *Calendula officinalis*, L. plants during 2011/2012 and 2012/2013 seasons.

Treatments	Number flowering heads / plant		Diameter flowering heads (cm.)	
	1st season	2nd season	1st season	2nd season
Control	5.00^{c}	5.67^{c}	3.50^{c}	3.87^{c}
Poultry 20 m^3/fed.	23.33^{ab}	24.00^{ab}	5.73^{ab}	6.03^{ab}
Poultry 30 m^3/fed.	25.00^{ab}	26.00^{ab}	5.23^{b}	5.63^{ab}
Poultry 40 m^3/fed.	36.33^{a}	36.33^{a}	6.30^{a}	6.63^{a}
Azos+Bc 3 ml each.	13.67^{bc}	12.33^{bc}	5.53^{ab}	5.27^{b}
Azos+VAM 3 ml each.	13.33^{bc}	12.00^{bc}	5.60^{ab}	5.43^{b}
Azos+ Bc+VAM 3ml each.	17.33^{bc}	15.67^{bc}	5.30^{ab}	5.17^{b}

$^{a\ to\ c}$ Means having different letters exponents in column are significantly different ($P \leq 0.05$)

Data in Table (5) reveal that, all applications (poultry manure; 20, 30 and 40 m^3 /fed. and bio-fertilizers; Azos+Bc, Azos+VAM and Azos+Bc+VAM) started to flowering earlier (43, 43, 41, 43, 43, and 43 days) in the 1st season, respectively, versus poultry manure 30 m^3/fed. and Azos+Bc+VAM which recorded 38 days for both in the 2nd season, decreasing the start of flowering with 7-11 days as compared with the untreated plants. The flowering period extended longer time in all treatments (poultry manure; 20, 30 and 40 m^3 /fed. and bio-fertilizers; Azos+Bc, Azos+VAM and Azos+Bc+VAM) that, recorded 124,124,126, 124,124 and 124 days during the 1st

season, respectively, versus poultry manure 30 m^3/fed, AzosBc+VAM which recorded 128 days for both treatments during the 2nd season as compared with untreated plants (117 days).

Increasing the vegetative growth of plants are reflected in increasing flowers yield and improving quality and nutritive value. The enhancement of number of flowers/ plant and flower diameter may be due to beneficial effect of organic manure bacteria and mycorrhiza on the soil properties, in addition to the role of increasing nitrogen in the initiation of new cells. The beneficial effect of N_2-fixers and P- dissolving bacteria on the plants development can be attributed not only to the N_2-fixation and dissolving phosphate process, but also to the production of growth promoting substances. Several soil microorganisms posses the capability to synthesize gibberellins **(Rademacher, 1994)**.

Table (5): Effect of poultry manure, *Azospirillum*, *Bacillus* and VAM on flowering start (days) and flowering period (days) of *Calendula officinalis* L. plants during 2011/2012 and 2012/2013 seasons.

Treatments	Flowering start (days)		Flowering period (days)	
	1st season	2nd season	1st season	2nd season
Control	50^{a}	49^{a}	117^{a}	117^{c}
Poultry 20 m^3/fed.	43^{b}	47^{ab}	124^{b}	119^{bc}
Poultry 30 m^3/fed.	43^{b}	38^{c}	124^{b}	128^{a}
Poultry 40 m^3/fed.	41^{b}	40^{bc}	126^{b}	126^{ab}
Azos+Bc3 3 ml each.	43^{b}	40^{bc}	124^{b}	126^{ab}
Azos+VAM3 3 ml each.	43^{b}	44^{abc}	124^{b}	122^{abc}
Azos+ Bc+VAM 3 ml each.	43^{b}	38^{c}	124^{b}	128^{a}

$^{a\ to\ c}$ Means having different letters exponents in column are significantly different ($P \leq 0.05$)

Our results were in harmony with those found by **El-Maadawy (2007)** on *Tagetes erecta*, **Vieira *et al.* (1999)** on *Calendula officinalis*.

3. Effect of organic and bio-fertilizers on chemical composition.

3.1. Effect of organic and bio-fertilizers on leaves and flowers pigments:

The effect of organic and bio-fertilizers treatments on photosynthetic pigments, carotenoids in the flowers and Chlorophyll a & b in the leaves of marigold plants are displayed in Table (6). The results showed that, photosynthetic pigments (mg/g fresh

weight) were significantly increased due to the application of the organic and bio-fertilization in both seasons, in comparison with the unfertilized plants (control). The highest value of carotenoids in the flowers was 0.98 mg/g fresh weight in the 1st season when poultry manure was applied at 40 m^3/fed., while the highest values of carotenoids in the flowering heads were 0.99 and 0.99 mg/g fresh weight in the 2nd season when poultry manure was 30 and 40 m^3/fed. Moreover, the application of Azos+VAM and Azos+BC+VAM gave the highest values of Chlorophyll a which recorded 3.21and 3.16 mg/g fresh weight in the 1st season, respectively, while, application of Azos+Bc, Azos+VAM and Azos+Bc+VAM resulted in the highest values of Chlorophyll a which recorded 3.09, 3.18 and 3.13 mg/g fresh weight in the 2nd season, respectively. Application of poultry manure at 40 m^3/fed. and Azos+Bc+VAM resulted in the highest content of Chlorophyll b (1.20 and 1.13 mg/g fresh weight) in the 1st season, while it was1.16 and 1.10 mg/g fresh weight, respectively.

From the physiological view, the obtained results could be attributed to the role of the organic fertilizers as a constituent of pyridines, which are in turn constituents of chlorophyll and cytocromes **(Joo *et al.*, 1999; Magda Mostafa, 2002)**.These results were in agreement with those obtained by **Hammam (1996)** on *Pimpinella anisum*, **Jacoup (1999)** on *Thymus vulgaris*, **El-Sherbeny *et al.* (2005)** on *Sideritis montana*, **Swaefy *et al.* (2007)** on peppermint and **Matter (2009)** on *Hibiscus subdariffa* plant.

Table (6): Effect of poultry manure, *Azospirillum*, *Bacillus* and VAM on carotenoids content inthe flowering head and Chlorophlla and b in the leaves (mg/g) of *alendula officinalis* L. plants during 2011/2012 and 2012/2013 seasons.

Treatments	Carotenoid content (mg/g fresh weight)		Cholorophyll a (mg/g fresh weight)		Cholorophyll b (mg/g fresh weight)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	0.87^{c}	0.85^{c}	2.35^{d}	2.29^{c}	0.93^{c}	0.96^{d}
Poultry 20 m^3/fed.	0.90^{bc}	0.91^{bc}	2.78^{c}	2.81^{b}	0.99^{bc}	0.97^{cd}
poultry 30 m^3/fed.	0.96^{ab}	0.99^{a}	2.97^{b}	3.00^{ab}	1.10^{ab}	1.07^{abc}
poultry 40 m^3/fed.	0.98^{a}	0.99^{a}	3.05^{ab}	3.08^{ab}	1.20^{a}	1.16^{a}
Azos+Bc 3ml each.	0.87^{c}	0.89^{bc}	3.05^{ab}	3.09^{a}	0.91^{c}	0.93^{d}
Azos+VAM 3ml each.	0.93^{abc}	0.92^{b}	3.21^{a}	3.18^{a}	0.97^{c}	0.99^{bcd}
Azos+ Bc+VAM 3ml each.	0.92^{abc}	0.90^{bc}	3.16^{a}	3.13^{a}	1.13^{a}	1.10^{ab}

$^{a\ to\ d}$ Means having different letters exponents in column are significantly different ($P \leq 0.05$).

3.2. Effect of organic and bio-fertilizers on carbohydrates percentage (%) and oleanolic acid in the flowering heads (mg/g dry weight):

Carbohydrates percentage and oleanolic acid content in the flowering heads of marigold (Table 7) were greatly and significantly increased in response to organic and bio-fertilizers in comparison to the unfertilized plants in the two seasons. The highest values of carbohydrates percentage were 62.40 and 64.21% in both seasons, respectively; when poultry manure was applied at 40 m^3/fed., which gave the highest values of oleanolic acid in flower (0.43 mg/g dry weight) in the 1st season. Moreover, applications of poultry manure at 30 and 40 m^3/fed. and bio-fertilization with Azos+VAM and Azos+Bc+VAM resulted in the highest values of oleanolic acid in the flowering heads in the 2nd season, which recorded 0.43, 0.44, 0.44 and 0.43 mg/g dry weight, respectively. This may be explained that, organic fertilizers are reknowed for their ability to chelate soil nutrients, improve nutrient uptake, especially phosphorous, sulfur and nitrogen, reduce the need for nitrogen fertilization, remove toxins from soil, stimulate soil biological activity, solubilize minerals, improve soil structure, act as a storehouse of N, P, S and Zn **(Frank and Roeth, 1996)**. Organic manure contains microorganisms for example, *Azotobacter* and *Azosprillum*, which plays an important role to fix nitrogen and release phytohormones such as, IAA, GA and Cytokinins; which promote the growth, content of dry matter and nutrients absorption **(Reynders and Volassak, 1982)**.

Table (7): Effect of poultry manure, *Azospirillum*, *Bacillus* and VAM on carbohydrate percentage and oleanolic acid of *Calendula officinalis* L. plants during 2011/2012 and 2012/2013 seasons.

Treatments	Carbohydrate percentage (%)		Oleanolic acid in flowers (mg/g dry weight)	
	1st season	2nd season	1st season	2nd season
Control.	50.23^{d}	52.10^{e}	0.33^{b}	0.34^{b}
Poultry 20 m^3/fed.	58.01^{b}	58.84^{c}	0.39^{ab}	0.39^{ab}
Poultry 30 m^3/fed.	60.08^{ab}	61.36^{b}	0.41^{ab}	0.43^{a}
Poultry 40 m^3/fed.	62.40^{a}	64.21^{a}	0.43^{a}	0.44^{a}
Azos+Bc 3ml each.	55.11^{c}	56.71^{d}	0.37^{ab}	0.39^{ab}
Azos+VAM 3ml each.	58.91^{b}	60.80^{bc}	0.39^{ab}	0.44^{a}
Azos+Bc+VAM 3ml each.	59.18^{b}	60.00^{bc}	0.41^{ab}	0.43^{a}

$^{a\ to\ e}$ Means having different letters exponents in column are significantly different ($P \leq 0.05$).

3.3. Effect of organic and bio-fertilizers on minerals percentage:

Relevant data in Table (8) showed the percentage of nitrogen, phosphorus and potassium in dry herb of *Calendula officinalis* L. plants as affected by organic and bio-fertilizers. The three elements were significantly increased due to the use of all organic and bio-fertilizers treatments in the two seasons in comparison with control plants. Corresponding data showed an increase in nitrogen percentage due to poultry manures treatments in comparison to bio-fertilizers treatments and to the control. When poultry manure was used at the rates of 20, 30 and 40 m^3/fed. the values of nitrogen percentages were 3.60, 3.75 and 3.79 % in the 1st season, and 3.72, 3.80 and 3.92 % in the 2nd season, respectively. However, application of poultry manure at 40 m^3/fed. gave the highest value of phosphorus (0.35 %) in the 1st season, while applications of poultry manure 20, 30 and 40 m^3/fed. gave the highest values of phosphorus contents (0.32, 0.34 and 0.37 % in the 2nd season, respectively). In case of potassium the maximum values were obtained as a result of poultry manure 30 and 40 m^3/fed. (2.27 and 2.29 % for 1st season) and (2.30 and 2.33 % for 2nd season, respectively).

The previously obtained results were in harmony with those reported by, **Sakr (2001)** on *Menta piperita*, **Abd El-Latif (2002)** on *Carum carvi*, **Haroun and Hussein (2003)** on *Lupinus termis*, **Zaied *et al.* (2003)**, on wheat, **Atta-Alla *et al.* (2005)** on *Capsicum annuum*, **Abdelaziz *et al.* (2007)** on *Rosmarinus officinalis*, **Azzaz and Hassan (2008)** on fennel.

Table (8): Effect of poultry manure, Azospirillum, Bacillus and VAM on nitrogen, phosphorus and potassium percentage in dry herb of *Calendula officinalis* L. plants during 2011/2012 and 2012/2013 seasons.

Treatments	Nitrogen (%)		Phosphorus (%)		Potassium (%)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	1.88^{c}	1.94^{d}	0.19^{c}	0.21^{c}	1.13^{d}	1.16^{d}
Poultry 20 m^3/fed.	3.60^{a}	3.72^{a}	0.30^{ab}	0.32^{a}	1.94^{b}	1.90^{b}
Poultry 30 m^3/fed.	3.75^{a}	3.80^{a}	0.33^{ab}	0.34^{a}	2.27^{a}	2.30^{a}
Poultry 40 m^3/fed.	3.79^{a}	3.92^{a}	0.35^{a}	0.37^{a}	2.29^{a}	2.33^{a}
Azos+Bc 3ml each.	2.48^{b}	2.54^{c}	0.31^{ab}	0.30^{ab}	1.50^{c}	1.44^{c}
Azos+VAM 3ml each.	2.59^{b}	2.73^{bc}	0.25^{bc}	0.24^{bc}	1.23^{cd}	1.35^{c}
Azos+ Bc+VAM 3ml each.	2.66^{b}	2.92^{b}	0.29^{ab}	0.29^{ab}	1.36^{cd}	1.34^{c}

$^{a\ to\ d}$ Means having different letters exponents in column are significantly different ($P \leq 0.05$)

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الملخص العربي

استجابة نبات الاقحوان لبعض انواع الاسمدة العضوية والحيوية

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أجريت هذه الدراسة في قسم البساتين - كلية الزراعة - جامعة الأزهر - مدينة نصر خلال موسمين متتاليين2011/2012 و 2012/2013 بهدف دراسة استجابة نبات الاقحوان لثلاث معدلات من التسميد العضوي (سماد الداوجن 20و 30 و 40 متر^3 / فدان) والتسميد الحيوي بالمخصبات الحيوية المثبتة للنتروجين والميسرة لعنصري الفوفسفور والبوتاسيوم وتاثير هذة الاسمدة على الصفات الخضرية والزهرية والمكونات الكيميائية لنبات الاقحوان.

وأوضحت النتائج ان كل المعاملات العضوية والحيوية ادت الي تحسين في المحصول كما ونوعا مقارنة بالكنترول ويمكن ملاحظة أن الاحتياجات السمادية لنبات الاقحوان مرتفعة، وبناء علية يمكن التوصية بأن التسميد العضوي (سماد الدواجن40 متر^3 / فدان) هى معاملة تفضيلية لإنتاج نبات الاقحوان تحت ظروف التجربة.

وتعتبر الأسمدة العضوية والحيوية مصادر ممتازة من المغذيات لإنتاج المحاصيل الامنة وكذلك قدرتها على تحسين الخصائص الفيزيائية والكيميائية للتربة وتكون مناسبة لظروف ومتطلبات التصدير.