J. Agric. Sci. Mansoura Univ., 31 (11): 7329 - 7345, 2006

EFFECT OF CHEMICAL AND BIO-FERTILIZATION ON GROWTH AND CHEMICAL COMPOSITION OF *Euryops pectinatus* (L.) Cass.

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ABSTRACT

This study aimed at investigating the effect of ammonium sulfate (20.6% N) at 300 Kg/fed, calcium superphosphate (16.5% P_2O_5) at 200 Kg/fed, plant nutrients (Nofatrein) as foliar spray and bio-fertilization (Microbein) on growth and chemical composition of *Euryops pectinatus* (L.) Cass. The treatments were 100% NP (AS CONTROL), 75% NP, Microbein alone, Microbein+ 75% or 50% of soil application, Nofatrein alone, Nofatrein + 75% or 50% of soil application, Microbein+ Nofatrein and Microbein+Nofatrein+50% of soil application. All the treatments received constant dose of potassium sulfate (48% K_2O) at 150 Kg/fed (recommended) but the plants received different percentages of the full NP rate (NP 100%) . The field experiments were carried out during the two successive seasons of 2004/2005 and 2005/2006 at the Experimental Nursery of the Ornamental Horticulture Department, Faculty of Agriculture, Cairo University. There was a significant increase in plant height by using the combination of bio-fertilizer and 75% of the chemical soil application. Also, combining Microbein with 50% of the soil chemical fertilizers and Nofatrein significantly increased plant height and stem diameter. Applying the foliar fertilizer Nofatrein caused the maximum number of branches per plant and stem diameter in both seasons. There were three treatments (viz. Nofatrein alone, the treatment of 75% chemical fertilization combined with Microbein, and the combination of 50% chemical fertilization + Microbein + Nofatrein) that gave the best result in terms of plant fresh and dry weights, with insignificant differences between them. The highest number of flowers per plant, root fresh and dry weights and total chlorophyll content were obtained from plants supplied with 50% chemical soil fertilization, combined with Microbein and Nofatrein.

INTRODUCTION

Euryops, belonging to the Daisy family Asteraceae (Compositae), is known as golden euryops and golden daisy bush. It is also called "large eyes" because of its prominent flowers. It is a small shrub of 25-30 species, native to Africa (mostly South Africa). The flowers are yellow, and the heads have female ray flowers and tubular 5-toothed perfect disk flowers; the receptacle is convex or conical. The little bushes or undershrubs grow from 0.5 to 3 feet, or sometimes 5 feet high. They bloom in the greenhouse, or are grown in the open field in mild climates (Bailey, 1951).

Euryops pectinatus (L.) Cass, belonging to the Daisy family Asteraceae (Compositae), is a commonly cultivated ornamental plant that has been recently introduced in Egypt. The name *Euryops* comes from a greek word meaning large eye (referring to the showy flowers), and the Latin word *pectinatus* (pectinate) meaning with arrow divisions like a comb, referring to the divided leaves. *E. pectinatus* is an evergreen, upright shrub, with deep grey-green leaves setting off large, daisy-like, bright yellow flowers that are

borne nearly all year round, with the main display in spring. It is suitable for borders, rock gardens and slopes. It is fast growing in a full sun position, and needs a moist but well-drained soil [Brickell (1999) and Turner (2001)].

Brickell (1992 and 1999) mentioned that *Euryops* is propagated easily by softwood and stem tip cuttings. *Euryops pectinatus* (L.) Cass is preferred in sheltered sites and, because of its yellow flowers, it looks spectacular in hot sunny positions.

In addition to its importance as a landscape plant, *Euryops pectinatus* (L.) Cass can also be used for medicinal purposes. The essential oil in its consists of 42 compounds; the major compounds are sesquiterpene hydrocarbons (32%). The anti-microbial screening of the essential oil exhibited weak activity against *Bacillus subtilis* and *Staphylococcus aureus*. On the other hand, the essential oil was found to display a potent *in vitro* cytotoxicity against Ehrlich ascites carcinoma cells (EAC) and human brain cells (U251); the oil inhibited the growth of the cancerous cells by 100% (Michel, 2004). So *Euryops pectinatus* (L.) Cass is a very important plant which can be used in landscape in new areas and in medicinal purposes.

During the last few years, the use of bio-fertilizers has become a common agricultural practice in growing several food crops. Biologically-grown agricultural products are considered to be healthier, and cause less risk to the environment. Most of the bio-fertilizers used for growing horticultural crops contain different nitrogen-fixing bacteria. *Azotobacter* are free living bacteria that are capable of fixing nitrogen through their high level of respiration (Burris, 1976). Biological nitrogen fixation accounts for most of the fixation of atmospheric N_2 into ammonium, thus representing the key entry point of molecular nitrogen into the bio-geochemical cycle of nitrogen.

Saber (1993) concluded that bio-fertilizers do not replace mineral fertilizers but significantly reduce their rate of application. He also mentioned that bio-fertilization is the most significant tool for sustainable agriculture, and that it improves the environment within the frame of bio-organic farming systems.

The favourable effect of biofertilizers, with or without chemical fertilization, on the growth and productivity of ornamental and medicinal plants has been reported by several researchers, Jren and Das (1997) studied the effect of N fertilization on turmeric at the rate of 30 and 60 kg/ha alone or mixed with inoculation by *Azotobacter* or *Azospirillum* (alone or together). The best curcumin content was obtained from 30 kg N/ha with *Azotobacter* or *Azospirillum*, Maheshwari *et al.* (1995) on *Cymbopogon maritini (C. martini)* var. motia, found that application of *Azotobacter chroococcum* resulted in 10.3-39.6% and 11.7-35.2% higher herbage and oil yields, respectively, than the control. Ismail and Hasabo (2000) on sunflower studied the effect of microbein containing nitrogen fixing bacteria and Egyptian commercial source of plant nutrients (nofatrein) applied at 3 different rates based lower recommended and higher rate. They found that all treatments significantly increased the plant growth parameters compared with the untreated plants..

In this study, the effect of chemical and bio-fertilization on growth and chemical composition of *Euryops pectinatus* (L.) Cass was investigated.

MATERIALS AND METHODS

This study was conducted at the experimental nursery of the Ornamental Horticulture Department, Faculty of Agriculture, Cairo University, during the two successive seasons of 2004/2005 and 2005/2006. The main purpose of this study was to investigate the effect of chemical fertilizers [NPK and some trace elements(Nofatrein)] and bio-fertilizers on the growth and chemical composition of *Euryops pectinatus* (L.) Cass plants grown in a clay soil. The physical and chemical characteristics of the soil are shown in Table (A).

Table (A): Physical and chemical analysis of the experimental soil

Physical analysis											
Coarse sand %		Fine sand%		Silt%		Clay%		Texture Class			
7.9		50.2		21.7		20.2		Sandy clay loam (S.C.L.)			
Chemical analysis											
pH	*E.C. (ds/m)	Soluble Cations (meq./L.)				Soluble Anions (meq./L.)			Available elements (ppm)		
		Na^+	K+	Ca++	Mg++	HCO_3^- %	Cl^-	SO_4^{--}	N	P	K
7.18	0.84	4,13	2,03	9,50	2,58	4,00	4,50	8,90	70	55.5	180

*E.C.: Electrical conductivity.

Seedlings of *Euryops pectinatus* (L.) Cass (with an average height of 15cm) were obtained from Nimos Farm, El-Mansoureya. On 1st May 2004 and 2005 (in the first and second seasons, respectively), the seedlings were planted directly in the field, in 1 X 1.5 m plots, each including 2 rows (50 cm apart), at a spacing of 50 cm between plants. Thus, each plot contained 6 plants. Each treatment consisted of three replicates (plots), and the layout of the experiment was randomized complete blocks design.

The plants were supplied with the following fertilization treatments:

1- Control [100% Nitrogen Phosphorus (NP)].
2- NP 75%
3- NP 75% + Microbein
4- NP 75% + Nofatrein
5- Microbein
6- Nofatrein
7- Microbein+ Nofatrein
8- NP 50%+Nofatrein
9- NP 50%+Microbein
10- NP 50%+Microbein+Nofatrein

Control plants received NP fertilization, applied as a top dressing on 1st June and 1st December of each season, using 300 kg ammonium sulfate (20.6% N) + 200 Kg calcium superphosphate (16.5% P_2O_5). These rates were considered to be the full recommended rates of chemical fertilization (100% NP). All the treatments received constant dose of potassium using 150 Kg potassium sulphate (48% K_2O)/fed (recommended) also as a top dressing and in the same dates but the plants received different percentages of the full NP rate (NP 100%) .

The commercial fertilizer Nofatrein (containing 5%N, 5%P_2O_5, 5%K_2O, 0.15% EDTA iron, 0.10% EDTA Mn, 0.05% EDTA Zn, 0.05% Bo and 0.02% Mo) was obtained from the (Ministry of Agriculture) , Giza, and was applied to the plants as a foliar spray at the concentration of 2 liters of Nofatrein/300 liters of water. Plants treated with Nofatrein received 4 foliar spray applications/ season (on 1st June, 1stJuly, 1st December and 31st December).

The bio-fertilizer Microbein was obtained from (G.O.A.E.R.), Giza, in bags, each containing 315 gm of the biofertilizer (consisting of peatmoss inoculated with the following bacteria: *Azotobacter sp., Azospirllus sp., Pseudomonas sp., Bacillus megatherium, Rhizobium*). Microbein was used at the rate of 40 gm/plant, and was added on one side of the plant, at a depth of 5 cm under the surface of the soil. In each season, the used Microbein rate was divided into two equal doses (each consisting of 20 gm Microbein/plant), which were applied on the 1st of June and 1st of December.

All plants were irrigated as needed.

Vegetative growth and flowering parameters were recorded twice during each season, after 6 and after 12 months from the first application of chemical NPK (on 15th Dec. and 15th May). The recorded data included plant height (cm), stem diameter at 10 cm above soil surface, number of branches/plant, number of flowers/plant, as well as fresh and dry weights of shoots and roots/plant. At the termination of each season (on 15th Dec. and 15th May. in the two seasons, respectively), chemical analysis of fresh leaf samples was conducted to determine their total chlorophyll content using the method described by Saric *et al.* (1967), while the content of total carbohyderates in dried leaf samples was determined using the method described by Herbert *et al.* (1971). The nutrients were extracted from dried leaves using the method described by Piper (1947), then the nitrogen content in the extract was determined using the modified micro-Kjeldahl method as described by Pregl (1945), while the phosphorus content was estimated using the method recommended by King (1951). A Pye Unicam Model SP 1900 Atomic Absorption Spectrophotometer was used to determine the potassium content.

The data recorded on vegetative growth characteristics were subjected to statistical analysis of varience, and the means were compared using the "Least Significant Difference (L.S.D.)" test at the 5% level, as recommended by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Effect of bio and chemical fertilization on growth characteristics

Plant height

Data presented in Table (1) revealed that, in both seasons, the plant height of *Euryops pectinatus L.* plants was generally increased by all the treatments.

Table (1): Effect of bio- and chemical fertilization at different growth stages on the plant height and number of branches/plant of *Euryops pectinatus (L.)* Cass plants, during 2004/2005 and 2005/2006 seasons.

Characters / Treatments	Plant height (1st stage)	Plant height (2nd stage)	No. of branches (1st stage)	No. of branches (2nd stage)
	1st season		1st season	
NP 100%	31.8	52.7	14.7	19.7
NP 75%	34.0	61.3	14.3	16.0
NP 75%+Microbein	37.7	62.7	18.3	23.2
NP 75%+Nofatrein	37.0	56.3	15.0	22.2
Microbein	37.2	57.0	12.7	16.5
Nofatrein	38.0	56.7	12.3	25.8
Microbein+ Nofatrein	36.8	64.3	8.5	14.3
NP50%+Nofatrein	35.0	58.7	10.7	18.8
NP50%+Microbein	35.0	56.0	6.7	16.3
NP50%+Microbein+Nofatrein	40.8	63.0	12.7	24.2
LSD0.05	**3.7**	**6.4**	**5.8**	**5.3**
	Second season		**Second season**	
NP 100%	30.3	54.0	12.5	14.3
NP 75%	35.3	60.3	13.7	16.3
NP 75%+Microbein	39.0	61.7	17.0	25.2
NP 75%+Nofatrein	37.2	54.7	15.0	24.2
Microbein	37.3	55.7	9.3	18.8
Nofatrein	38.5	57.3	12.3	26.2
Microbein+ Nofatrein	37.8	65.0	8.7	15.5
NP50%+Nofatrein	37.3	58.0	9.7	24.0
NP50%+Microbein	33.0	56.7	10.3	12.0
NP50%+Microbein+Nofatrein	40.2	64.3	12.7	25.3
LSD0.05	**5.1**	**3.5**	**2.6**	**9.2**

In the first stage using the three types of fertilizers (50% of the chemical soil fertilizer + Microbein + Nofatrein) gave the best result in the plant height which were 40.8 and 40.2 cm compared to the control plants which had 31.8 and 30.3 cm in the first and second seasons respectively .

At the flowering stage, significant increases in plant height (compared to the control) were recorded in plants fertilized with 75% of the chemical soil fertilizer, with or without Microbein. Plants fertilized with 75% of the chemical soil fertilizer had heights of 61.3 and 60.3 cm in the first and second seasons, respectively, while plants fertilized with a combination of Microbein and 75% of the chemical soil fertilizer had mean plant heights of 62.7 cm and 61.7 cm in the first season and second seasons, respectively, compared to heights of 52.7 cm and 54.0 cm in control plants in the first and second seasons, respectively.

Among the different treatments, combining Microbein and Nofatrein (with or without chemical soil fertilization) gave the best results in terms of increasing plant height. In both seasons, fertilization with Microbein and Nofatrein gave the tallest plants (64.3, 65.0 cm in the first and second seasons, respectively), followed by fertilization using the three types of fertilizers (50% of the chemical soil fertilizer + Microbein + Nofatrein), giving values of 63.0 and 64.3 cm in the first and second seasons, respectively. No significant difference was detected between these two treatments. Similar results were obtained by Chandrikapure *et al.* (1999) on *Tagetes erecta*

Number of branches per plant

According to the obtained results (Table 1), there were significant decrease on the number of branches per plant (6.7) by using 50% of soil application with bio-fertilizer copared to (14.7) for control plants at the vegetative stage in the first season, while caused insignificant decrease in the second season (10.3) copared to (12.5) for control plants at the same stage.

At the flowering stage it is clear that in the first season most of the treatments had no significant effect on the numbers of branches per plant, with the exception of Nofatrein which gave significantly more branches/plant (25.8 branches/plant) than the control.

Using the combination of 50% of the soil chemical fertilizer, Microbein and Nofatrein significantly increased the number of branches in the second season (giving 25.3 branches/plant) respectively, compared to control plants (which had 14.3 branches/plant). This could be explained by the effect of nitrogen fixed by the bacterial strains, combined with the availability of phosphorus and other elements in the foliar spray and the soil chemical fertilizer. This led to an increase in cell division and photosynthetic processes, resulting in the promotion of branching.

In both seasons, the maximum number of branches (25.8 and 26.2 branches/plant in the first and second seasons, respectively) was recorded with Nofatrein treatment. On the other hand, the lowest number of branches recorded in the first season (14.3 branches/plant) was found on plants fertilized with Microbein and Nofatrein, while the lowest value recorded in the second season (12.0 branches/plant) was obtained from plants fertilized with Microbein and 50% of the chemical soil fertilizer.

The studies of several workers support the results reported here, such as Chandrikapure *et al.* (1999) who found that the greatest plant height, number of leaves and branches of *Tagetes erecta* were caused by the treatment with 100% N + *Azotobacter* + phosphorus solubilizing bacteria (PSB).

Stem diameter

The results shown in Table (2) indicated that the stem diameter in the vegetative stage followed the same trend in response to the different treatments in both seasons.

Using Microbein with 50% of chemical soil application gave significantly thinner stems in the vegetative stage 0.62 and 0.64 cm copared to 0.87 and 0.92 cm for control plants in the first and second seasons respectively . While Microbein with 75% of soil application gave the thickest

stem diameter in the vegetative stage (0.93 and 1.03 cm) compared to control plants in the first and second seasons respectively).

The results shown in Table (2) indicated that at the flowering stage in the first season, using the bio-fertilizer Microbein alone or with 50% of chemical soil application gave insignificantly thinner stems (with diameters of 1.53 and 1.40 cm respectively), compared to those of plants receiving 100% chemical soil application (1.55 cm). However, a thickening of the stem (compared to the control) was recorded in the first season when the foliar Nofatrein spray was combined with Microbein and 50% of chemical soil application (giving diameters of 1.87 cm in the first season) and insignificant increase in the second season(giving diameters of 1.70 cm) compared to control plants.

The obtained results also showed that the use of Nofatrein as a foliar spray had a superior effect in increasing stem diameter, since it gave the thickest stems in both seasons (with diameters of 2.10, 2.05 cm in the first and second seasons, respectively).

A kind of relation could exist between stem diameter and number of branches per plant. It was noticed that with most treatments, the increase in number of branches per plant caused the stem to be thinner, with the exception of the Nofatrein treatment, and the combination of 50% chemical soil application, Microbein and Nofatrein, which gave large numbers of branches per plant and also high stem diameters. In the first season these two treatments gave 25.8 and 24.2 branches/plant, respectively, and had stem diameters of 2.10 and 1.87 cm, respectively, while in the second season, they gave 26.2 and 25.3 branches/plant, and stem diameters of 2.05 and 1.70 cm, respectively.

These results agreed with those obtained by Chandrikapure *et al.* (1999), who found that in *Tagetes erecta*, the best results in terms of diameter of main stem and flower yield/ha were caused by using 75% N+ *Azotobacter* +phosphorus solubilizing bacteria(PSB) , which were significantly higher than the control. Also, the results agreed with the findings of Ismail and Hasabo (2000) on sunflower.

Shoot fresh and dry weights

Shoot fresh weight is considered to be one of the most important parameters recorded, since the aim of this study is to help in the production of one-year-old shrubs that have vigorous vegetative growth, and are ready for sale in the landscape market.

The data shown in Table (2) and Fig. (1) revealed that in the first season, the highest shoot fresh weight was obtained by using Nofatrein as a foliar spray, followed by the combination of 50% of chemical soil fertilization, Microbein and Nofatrein, then the combination of 75% chemical soil fertilization and Microbein (giving fresh weights of 802.7, 775.7 and 711.7 gm/plant, respectively). In the second season, the highest value (966.7 gm) was obtained from plants receiving the combination of 75% chemical soil fertilization and Microbein, followed by plants fertilized with Nofatrein, then plants fertilized with the combination of the three type of fertilizers (with values of 776.3 and 771.0 gm respectively).

Table (2): Effect of bio- and chemical fertilization on the stem diameter and shoot fresh and dry weights of *Euryops pectinatus* (L.) Cass plants, during the 2004/2005 and 2005/2006 seasons.

Treatments	Stem diameter cm (1st stage)	Stem diameter cm (2nd stage)	Shoot fresh weight gm	Shoot dry weight gm
	1st Season			
NP 100%	0.87	1.55	435.0	117.30
NP 75%	0.87	1.49	365.3	59.70
NP 75%+Microbein	0.93	1.60	711.7	177.70
NP 75%+Nofatrein	0.88	1.48	490.7	125.70
Microbein	0.90	1.53	398.0	91.70
Nofatrein	0.87	2.10	802.7	194.30
Microbein+ Nofatrein	0.71	1.73	570.0	144.60
NP50%+Nofatrein	0.86	1.25	336.0	51.40
NP50%+Microbein	0.62	1.40	395.0	86.10
NP50%+Microbein+Nofatrein	0.87	1.87	775.7	201.00
LSD0.05	**0.14**	**0.16**	**275.2**	**59.0**
	2nd Season			
NP 100%	0.92	1.60	495.0	102.60
NP 75%	0.90	1.67	379.7	86.90
NP 75%+Microbein	1.03	1.80	966.7	217.20
NP 75%+Nofatrein	0.85	1.60	492.0	115.50
Microbein	0.92	1.60	345.0	73.60
Nofatrein	0.92	2.05	776.3	172.60
Microbein+ Nofatrein	0.75	1.87	503.0	110.20
NP50%+Nofatrein	0.92	1.53	598.0	131.80
NP50%+Microbein	0.64	1.28	449.7	101.00
NP50%+Microbein+Nofatrein	0.95	1.70	771.0	177.60
LSD 0.05	**0.11**	**0.19**	**298.8**	**55.2**

Regarding the shoot dry weight, addition of 75% NPK fertilizers combined with inoculation using Microbein resulted in significant increases in dry weight in both seasons (giving values of 177.7 and 217.20 gm in the first and second seasons, respectively), also the Nofatrein treatment resulted in significant increases in both seasons (giving values of 194.30 and 172.60 gm in the first and second seasons, respectively), compared to the control (117.30 and 102.60 gm in the first and second seasons, respectively).

On the other hand, using 50% of chemical soil fertilization with Microbein gave insignificantly lower shoot dry weights (86.10 and 101.00 gm in the first and second seasons, respectively) than those of control plants.

The highest dry weight in the first season (201.00 gm) was obtained by combining the three types of fertilizers, while in the second season the highest value (217.20 gm) was obtained by combining 75% of chemical soil fertilization with inoculation using Microbein.

Devlin (1975) found that application of NPK fertilization is necessary for the various biochemical processes, which contribute to good plant growth and normal development. The favorable effect of NPK fertilization is attributed to the roles played by the individual nutrients in the different aspects of plant metabolism. Nitrogen serves as a constituent of many plant cell components, including amino acids and nucleic acids. Phosphorus is an integral component of important compounds of plant cells, including the sugar-phosphate intermediates of respiration and photosynthesis, and the phospholipids that make up plant membranes. It is also a component of DNA and RNA. Potassium plays an important role in regulation of the osmotic potential of plant cells. It also activates many enzymes involved in respiration and photosynthesis (Taiz and Zeiger, 1998).

Jasbir *et al.* (2006) found that plant height was increased when *Lantana camara* was ambended by NPK fertilizer doses 50:50:25 kg/ha.

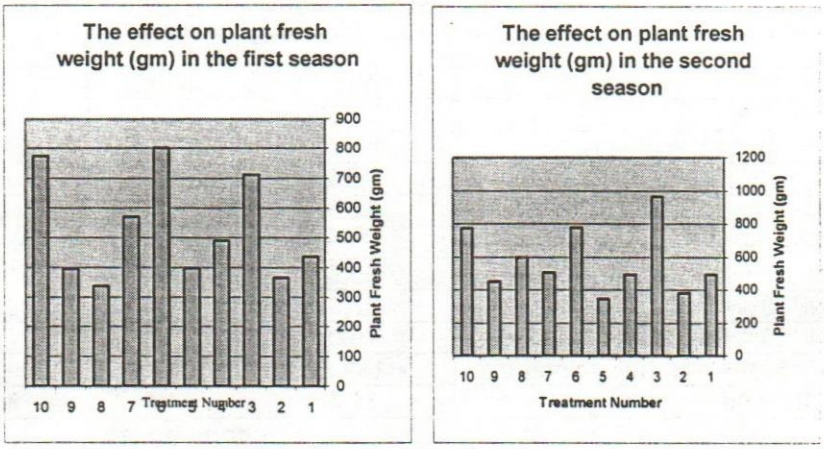

Fig (1) Effect of chemical and bio-fertilization on fresh weight of *Euryops pectinatus L.* plants during the 2004/2005 and 2005/2006 seasons.

Increasing the shoot fresh weight helped the plants in uptaking much water and nutrients. This, in turn, enhanced the plants' ability to produce more assimilates, which was reflected in high biomass.

Similar results were reported by Bhaskaran *et al.* (2002) who found that *Azospirillum* and *Azotobacter* inoculation with application of low levels of chemical nitrogen (50%) to *Tagetes erecta* plants significantly increased growth and yield. The same conclusion was reached by Karuppaiah (2005) on *Tagetes patula*, Maheshwari *et al.* (1995) on *Cymbopogon maritini (C. martini)* and Ismail and Hasabo (2000) on sunflower.

Number of flowers per plant

Data presented in Table (3) reveal that in the first season, there was a general increase in number of flowers per plant with all treatments, compared with plants receiving full fertilizer soil application (control). In the second season, there were insignificant decreases in number of flowers per

plant with some treatments (viz. Microbein alone or combined with 50% NPK, 75% NPK, and Nofatrein + 75% NPK).

The greatest number of flowers per plant was obtained from plants which received 50% of chemical soil fertilizers, combined with Microbein and Nofatrein which reached to 139.3 and 132.0 flowers per plant during the first and second seasons, respectively, compared to 56.0 and 75.0 flowers/plant with control plants in the first and second seasons respectively.

Table (3): Effect of bio- and chemical fertilization on the number of flowers per plant and root fresh and dry weight of *Euryops pictinatus* (L.) Cass plants, during 2004/2005 and 2005/2006 seasons.

Treatments	No. of flowers/ plant	Root fresh weight (gm)	Root dry weight (gm)
	First season		
NP 100%	56.0	37.08	16.11
NP 75%	71.0	76.67	35.20
NP 75%+Microbein	107.3	84.33	39.56
NP 75%+Nofatrein	86.0	82.33	41.93
Microbein	57.0	41.00	19.18
Nofatrein	109.7	96.00	43.00
Microbein+ Nofatrein	85.7	73.33	31.43
NP50%+Nofatrein	87.0	43.28	20.33
NP50%+Microbein	79.0	54.49	27.54
NP50%+Microbein+Nofatrein	139.3	107.79	49.91
LSD0.05	**31.4**	**34.4**	**18.70**
	Second season		
NP 100%	75.0	43.73	20.75
NP 75%	73.7	63.93	31.61
NP 75%+Microbein	98.7	95.23	41.13
NP 75%+Nofatrein	70.0	91.33	42.88
Microbein	59.0	47.58	23.81
Nofatrein	98.7	93.67	43.34
Microbein+ Nofatrein	95.0	71.51	42.78
NP50%+Nofatrein	76.0	63.03	30.34
NP50%+Microbein	64.7	52.15	21.73
NP50%+Microbein+Nofatrein	132.0	108.33	45.90
LSD0.05	**25.5**	**14.4**	**10.70**

Other investigators recorded a similar trend. For example, Wang and Patil (1994) studied the response of tuberose (*Polianthes tuberosa* cv. Single) to biofertilizers, and stated that applying 100 kg N/ha alone or inoculating with an *Azotobacter+ Azospirillum* mixture significantly increased the number of flowers/stalk, bulb yield and the number of flowers and stems. Also, Milad (2003) found that the highest yield of sepals and growth was obtained when

roselle plants (*Hibiscus sabdariffa*) were treated with 50% NPK + 15 ppm kinetin and a bio-fertilizer containing *Azotobacter croococcum*. Chandrikapure *et al.* (1999) on *Tagetes erecta* found that the highest flower yield/ha was caused by using 75% N + *Azotobacter* + phosphorus solubilizing bacteria (PSB) which were significantly higher than the control.

Root fresh and dry weight

The results shown in table (3) indicate that using Nofatrein without adding soil fertilizers gave higher root fresh weights (96.00 and 93.67 gm/plant in the first and second seasons, respectively), compared to those obtained with 75% soil fertilizers + Nofatrein (giving 82.33, 91.33 gm/plant in the two seasons, respectively), or 50% of soil fertilizers + Nofatrein (with values of 43.28 and 63.03 gm/plant in the two seasons, respectively). A different trend was obtained with Microbein, which gave better results when used in combination with 75% or 50% of the soil fertilizers, compared to using Microbein alone. The greatest root fresh weight (107.79 and 108.33 gm in the first and second seasons, respectively) was obtained when using the combination of 50% of soil fertilizers, Microbein and Nofatrein, while control plants gave values of (37.08 and 43.73 gm in the first and second seasons, respectively).

Regarding the root dry weight, the obtained results indicated that most plants were significantly affected by the different treatment. Only three treatments (Microbein alone, Microbein + 50% of soil fertilization, and Noftarein + 50% of soil fertilization) gave insignificant increases in root dry weight in both seasons.

From obtained results, it could also be concluded that the highest root fresh weight was associated with the use of 50% of soil fertilizers, combined with Microbein and Nofatrein. Moreover, this treatment gave the highest root dry weight (49.91 and 45.90 gm in the first and second seasons, respectively), while control plants gave values of 16.11 and 20.75 gm in the two seasons, respectively.

Effect on chemical composition

Leaf pigments

Data presented in table (4) indicated that in both seasons, application of Nofatrein alone gave the highest chlorophyll "a" content (0.83 and 0.79 mg/g f.w. in the first and second seasons, respectively), followed by the combination of 50% of soil fertilizers, Microbein and Nofatrein (which gave chlorophyll "a" contents of 0.81 and 0.78 mg/g f.w. in the two seasons, respectively.

It was also noticed that supplying the plants with the full amount of chemical soil fertilizers gave a higher chlorophyll "a" content than those resulting from most of the tested treatment.

The highest content of chlorophyll "b" in the first season (0.55 mg/g f.w.) was recorded with 75% of soil fertilization, combined with Microbein, while in the second season the highest value (0.50 mg/g f.w.) was recorded with 75% of soil fertilization alone. On the other hand, control plants (receiving the full amount of soil fertilization) had chlorophyll "b" contents of 0.41 and 0.34 mg/g f.w. in the first and second seasons, respectively.

Applying the full amount of chemical soil fertilizers (control) gave higher total chlorophyll contents (1.05 and 1.08 mg/g in the first and second seasons, respectively) than those obtained with most of the treatments. Only three treatments (75% NPK + Microbein, Nofatrein alone, and 50% NPK + Microbein + Nofatrein) gave higher values than the control in both seasons. The highest total chlorophyll content (1.16 and 1.17 mg/g in the first and second seasons, respectively) was found in the leaves of plants fertilized using a mixture of the three types of fertilizers (i.e. 50% NPK + Microbein + Nofatrein).

Concerning the effect of chemical and bio-fertilizers on the carotenoids content in *Euryops* plants, the results presented in Table (4) show that the highest carotenoids contents (0.30 and 0.27 mg/gm F.W. in the first and second seasons, respectively) were obtained as a result of treating the plants with Nofatrein alone (in the first season), or in combination with Microbein (in the second season).

Table (4): Effect of bio- and chemical fertilization on pigments and carbohydrates percentage in *Euryops pectinatus* (L.) Cass leaves during the 2004/2005 and 2005/2006 seasons.

Treatments	Chl.a mg/g F.W.	Chl.b mg/g F.W.	Total chl. mg/g F.W.	Caroten-oids mg/g F.W.	Carbohyd-rates %
	First season				
NP 100%	0.64	0.41	1.05	0.21	20.0
NP 75%	0.63	0.25	0.88	0.22	14.0
NP 75%+Microbein	0.59	0.55	1.14	0.21	24.0
NP 75%+Nofatrein	0.56	0.44	1.00	0.25	15.5
Microbein	0.60	0.45	1.05	0.23	11.0
Nofatrein	0.83	0.26	1.09	0.30	14.5
Microbein+ Nofatrein	0.45	0.19	0.64	0.18	13.5
NP50%+Nofatrein	0.71	0.19	0.90	0.27	11.5
NP50%+Microbein	0.57	0.30	0.87	0.25	11.0
NP50%+Microbein+Nofatrein	0.81	0.35	1.16	0.29	32.0
	Second season				
NP 100%	0.74	0.34	1.08	0.17	20.0
NP 75%	0.56	0.50	1.06	0.20	16.0
NP 75%+Microbein	0.78	0.34	1.12	0.19	22.0
NP 75%+Nofatrein	0.65	0.48	1.13	0.19	20.0
Microbein	0.57	0.23	1.03	0.26	14.0
Nofatrein	0.79	0.32	1.11	0.25	28.0
Microbein+ Nofatrein	0.55	0.26	0.81	0.27	12.7
NP50%+Nofatrein	0.57	0.35	0.92	0.26	15.0
NP50%+Microbein	0.57	0.10	0.67	0.25	9.0
NP50%+Microbein+Nofatrein	0.78	0.39	1.17	0.21	24.0

The results repored by Bhaskaran *et al.* (2002) are in agreement with the present results. They found that addition of *Azospirillum* and *Azotobacter* inoculation with a low level of chemical nitrogen (50%) to *Tagetes erecta* plants significantly increased biochemical attributes (i.e. chlorophyll, total sugar, total free amino acid) over control. Similar results were reported by Karuppaiah (2005) on *Tagetes patula* with the application of *Azospirillum* and phosphobacteria in a combination with FYM at 25 and 37.5 t/ha. Also, the treatment increased the chlorophyll and carotenoids contents.

Carbohydrate percentage:

The data presented in Table (4) indicate that the lowest carbohydrates percentage in leaves of *Euryops pectinatus* (L.) Cass plants (11% and 9% in the first and second season respectively) was caused by using 50% of soil fertilizers in combination with Microbein. On the other hand using 50% NPK + Microbein + Nofatrein gave the highest carbohydrates content in the first season (32%), while the highest value in the second season (28%) was obtained by spraying Nofatrein alone.

Nutrient contents

Nitrogen

Data presented in table (5) showed that, in both seasons, most of the treatments increased the content of nitrogen in leaves of *Euryops pectinatus* L Cass plants, compared to control plants. However, using 75% of the chemical fertilization alone, or using Nofatrein alone, decreased the content of nitrogen in the two seasons, compared to the control. These results are in agreement with the finding of Jain (1983) who stated that raising the level of N in the root medium leads to an increase in the vegetative growth and this may be accompanied by an increase in the absorption of the essential elements.

Table (5): Effect of bio- and chemical fertilization on the nitrogen, phosphorus and potassium contents of *Euryops pectinatus* L. Cass leaves during 2004/2005 and 2005/2006 the seasons.

	N (% D. W.)		P (% D. W.)		K (% D. W.)	
Treatments	**First season**	**Second season**	**First season**	**Second season**	**First season**	**Second season**
NP 100%	3.01	2.31	0.350	0.293	1.24	1.53
NP 75%	3.00	2.29	0.343	0.277	1.22	1.47
NP 75%+Microbein	3.61	2.87	0.363	0.423	1.60	1.49
NP 75%+Nofatrein	3.51	3.57	0.367	0.320	1.63	1.53
Microbein	2.50	2.35	0.323	0.283	1.53	1.45
Nofatrein	1.75	1.89	0.333	0.243	1.24	1.51
Microbein+ Nofatrein	3.51	3.01	0.362	0.390	1.60	1.56
NP50%+Nofatrein	3.50	3.47	0.340	0.313	1.58	1.52
NP50%+Microbein	3.55	2.20	0.353	0.383	1.57	1.48
NP50%+Microbein+Nofatrein	3.59	3.48	0.368	0.397	1.65	1.56

In the first season, the highest content of nitrogen was obtained with 75% of the chemical fertilization + Microbein, followed by using 50% of the chemical fertilization + Microbean + Nofatrein (giving N contents of 3.61 and 3.59%, respectively) compared to 3.01% for control plants. The lowest values were recorded with Nofatrein alone. In the second season, using 75% of the chemical fertilizer + Nofatrein, or 50% of the chemical fertilizer + Nofatrein + Microbein, gave the highest contents of nitrogen (3.57% and 3.48%, respectively), compared to 2.31 % for control plants. The increase in N content as a result of spraying Nofatrein may be attributed to its content of trace elements. A similar conclusion was obtained by Swaefy (2002), who mentioned that spraying Ajowan plants with trace elements increased the content of nitrogen.

Phosphorus

The results presented in Table (5) show that in the two seasons, using 75% of the chemical fertilizer alone, or Microbean alone, or Nofatrein alone, decreased the content of phosphorus. In contrast, most of the other treatments increased the content of phosphorus in the leaves of *Euryops*, compared to the control. In the first season, using 50% of the chemical fertilizer + Microbean + Nofatrein gave the highest P content (0.368%), followed by using 75% of the chemical fertilizer + Nofatrein (giving a P content of 0.367%), then using 75% of the chemical fertilization + Microbein (with a P content of 0.363%), compared to a P content of 0.350% in control plants. In the second season the highest content of phosphorus was recorded in plants receiving 75% of the chemical fertilizer + Microbein, followed by plants supplied with 50% of the chemical fertilizer + Microbein + Nofatrein, then plants receiving Nofatrein + Microbein (with the values of 0.423, 0.397 and 0.390% respectively), compared to a value of 0.293 % in control plants.

Potassium

The results recorded in the two seasons (Table 5) revealed that in the first season, all treatments generally increased the potassium content (compared to the control), except using 75% of the chemical fertilizer alone, which decreased it. The highest K content in the first season (1.65 %) was detected in plants fertilized using 50% of the chemical fertilizer + Microbein + Nofatrein, while control plants had a K content of 1.24 %. In the second season, the same treatment (50 % of the chemical fertilizer + Microbein + Nofatrein), or Microbean + Nofatrein gave the highest values (1.56 and 1.56%) compared to a K content of 1.53 % inr control plants. On the other hand, plants inoculated with Microbein alone had the lowest K content (1.45%).

Conclusion: From the above results, it may be recommended to supply *Euryops pectinatus* plants with 50% of the NPK soil fertilizers, combined with Microbein and Nofatrein. This leads to the production of shrubs with strong root systems, high plant fresh weight, and a great number of flowers per plant, as well as saving 50% of the quantities of chemical fertilizers used, and minimizing the environmental pollution caused by mineral fertilizers.

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تأثير التسميد الكيماوي و الحيوي علـى النمـو و المحتـوى الكيمـاوي لنبـات الايروبس

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يهدف هذا البحث إلى دراسة تأثير التسميد الكيماوي و الحيوي على النمو و المحتوى الكيمـاوي لنبات الايروبس . حيث عوملت النباتات بسماد سلفات الأمونيوم ٢٠,٦% ن بمعدل ٣٠٠ كجم/ف و سـوبر فوسفات الكالسيوم ١٦,٥% فو٢أ٥ بمعدل ٢٠٠ كجم/ف و تمت اضافة سلفات البوتاسيوم ٤٨% بو٢أ بمعـدل ١٥٠كجم/ف البوتاسيوم كجرعة ثابتة (الموصى بها) وذلك لجميع المعاملات بينما تم أضافة نسب مختلفة من المعدل الكامل للنيتروجين والفوسفور (١٠٠ % ن فو). كما تم رش النباتات بالعناصر المغذيـة بإسـتخدام محلول تجاري نوفاترين كما لقحت الشتلات بسماد حيوي ميكروبين بمعدل ٤٠ حم/نبات. و كانت المعاملات كالآتي: ١٠٠% تسميد كيماوي(من النيتروجين و الفوسفور) و هو يمثـل الكنتـرول و ٧٥% مـن كميـة التسميد الكيماوي و ميكروبين منفرد أو + ٥٠ أو ٧٥ % من التسميد الأرضي و نوفاترين منفرداً أو + ٥٠ أو ٧٥ % من التسميد الأرضي و ميكروبين + نوفاترين و معاملة تتضمن ميكروبين + نوفـاترين+ ٥٠% من التسميد الأرضي

أجري هذا البحث في تجربتين حقليتيين بالمشتل التجريبي الخاص بقسم بساتين الزينة كلية الزراعـة جامعـة القاهرة خلال موسمين متتاليين ٢٠٠٤/٢٠٠٥ و ٢٠٠٥/٢٠٠٦ .

سجلت النتائج على ارتفاع النبات، عدد الفروع/نبات، قطر الساق الرئيسي، الـوزن الطـازج و الجاف للنبات ، عدد الأزهار و الوزن الطازج و الجاف للجذور. كذلك تم تقدير المحتـوى الكيمـاوي فـي الأوراق من الكلوروفيلات و الكاروتينات و في العشب من الكربوهيدرات الكلية و العناصر.

أظهر التسميد بمعدل ٧٥% من الكمية الكلية من الأسمدة الأرضية مقترناً بالتسميد الحيوي زيادة معنوية في إرتفاع النبات. كما أدت المعاملة بمعدل ٥٠% من الأسمدة الأرضية مقترناً بالتسميد الحيوي و رش النوفاترين إلى زيادة كبيرة في ارتفاع النبات و قطر الساق الرئيسي. في حين أدى رش النباتات بالعناصر المغذية فقط إلى أكبر عدد فروع/نبات و أكبر قطر للساق الرئيسي خلال الموسمين. و كانت أفضل ثلاث معاملات في صفة الوزن الطازج و الجاف للنبات هي المعاملة بالنوفاترين منفرداً و المعاملة ٧٥% من الأسمدة الأرضية مقترناً بالميكروبين و المعاملة التي استخدم فيها ٥٠% من السماد الأرضي مع الميكروبين و الرش بالمغذيات بدون فروق معنوية بين الثلاث معاملات.

أظهرت المعاملة التي استخدم فيها ٥٠% من السماد الأرضي مع الميكروبين و الرش بالنوفاترين أفضل النتائج في كل من عدد الأزهار و الوزن الطازج و الجاف للجذور و أعلى محتوى من الكلوروفيلات. و عليه فإن النتائج تشير إلى أن هذه المعاملة تعتبر أفضل المعاملات للحصول على شتلات في عمر سنة ذات نمو خضري و زهري عالي مع مجموع جذري قوي و ارتفاع في محتوي الكلوروفيلات.