4. RESULTS AND DISCUSSION

4.1. Effect of different fertilization treatments during two successive seasons 2002/2003 & 2003/2004

4.1.1. Vegetative growth:

4.1.1.1. Plant height (cm):

It is clear from the data in Table (2) and Fig (1) that chamomile plant height was affected due to the different fertilization treatments at the different ages of plant growth. The tallest plants produced when chamomile plants were treated with (ammonium sulphate + calcium superphosphate) at rate of 150.0 + 75.0 kg/fed. followed by those fertilized with ammonium sulphat or calcium superphosphate alone, at rate of 300.0 or 150.0 kg/fed., respectively, but the shortest plants were obtained when the plants were deprived from these elements.

(Ammonium sulphat + calcium superphosphate) treatment produced the tallest plants with mean height of 73.33 cm which was noticed at age of 193 days (at date 15/4) of growth season while the shortest plants at the same age were obtained from control plants with mean height of 60.33 cm.

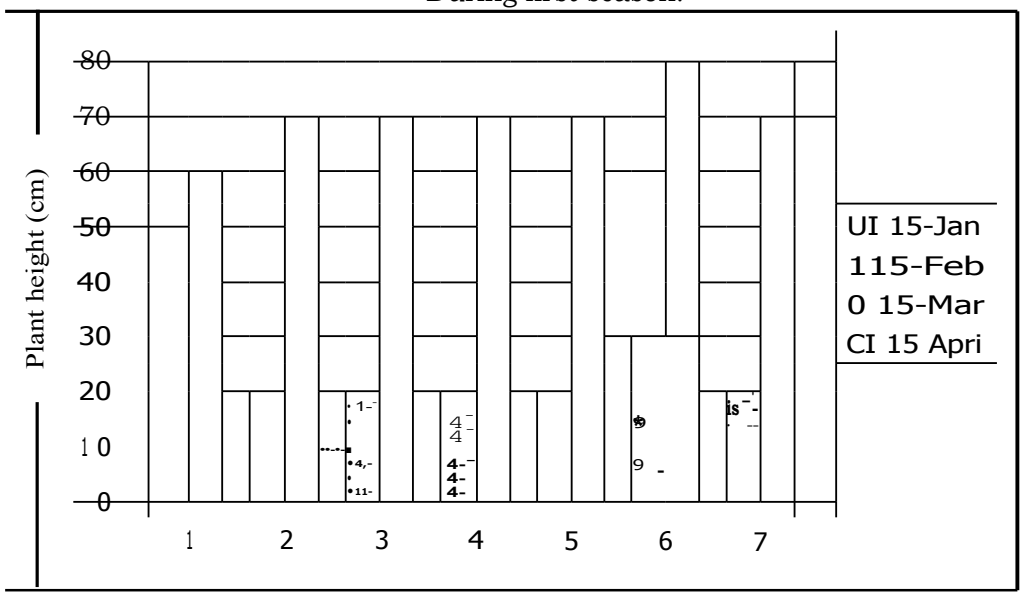
Plant height increased also with all bio fertilization treatments, *Azotobacter + Azospirillum, Bacillus* or *Azotobacter + Azospirillum + Bacillus* the favorable influence

Table (2): Effect of different fertilization treatments on chamomile plant height (cm) during both seasons of 2002/2003 and 2003/2004.

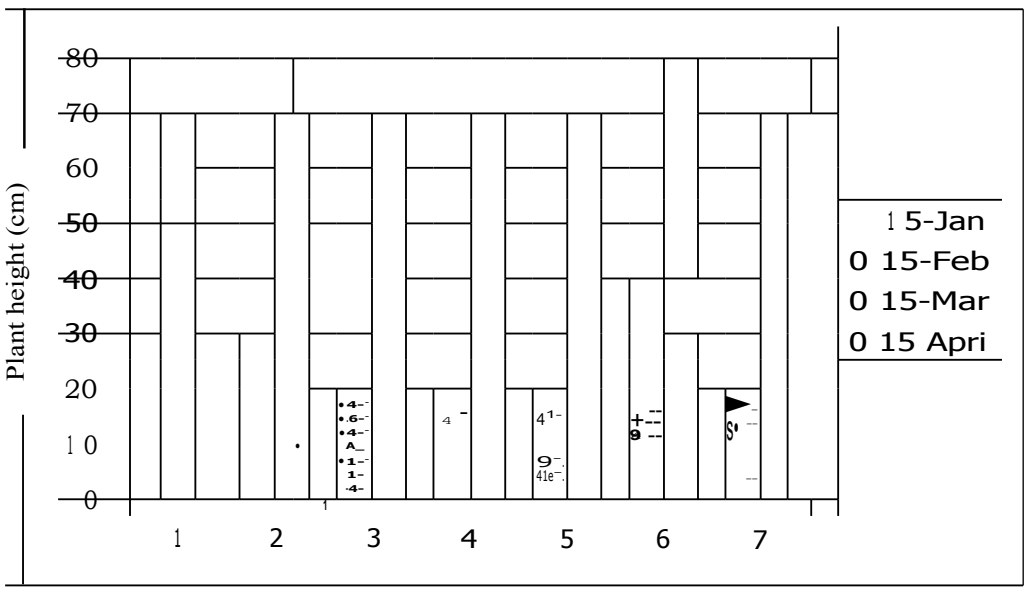
Treatments	First season				Second season			
Date	15/1	15/2	15/3	15/4	15/1	15/2	15/3	15/4
Control	16.50	45.33	59.00	60.33	17.83	46.83	60.50	61.67
Ammonium sulphate 300 kg/fed.	20.00	50.66	69.33	70.67	21.00	55.67		
Calcium superphosphate 150 kg/fed.	**18.83'**	**48.66**	**65.33**	**65.33**	19.67	50.67	66.17	67.17
Azotobacter + *Azospirillum*	**19.16**	50.00	67.00	68.00	20.00	50.67	69.00	69.33
Bacillus polymixa	18.66	47.66	64.33	65.00	19.58	49.33	65.66	66.83
Ammonium sulphate + calcium superphosphate 150 + 75 kg/fed	20.16	54.00	72.33	73.33	22.30	60.83	73.00	74.33
Azotobacter + *Azospirillanz+ Bacillus*	18.00	46.33	62.00	65.00	19.17	48.50	63.33	66.67
L.S.D								
0.5%	3.21	8.63	9.10	N.S	**3.11**	**11.9**	10.99	8.09
0.1%	N.S	N.S	12.77	N.S	**N.S**	**N.S**	N.S	11.29

Fig (1): Effect of different fertilization treatments on chamomile plant height (cm) during first season.

During first season.



During second season.



1-Control
2-Ammonium sulphate
3-Clacium superphosphate
4-Azolobacter + Azospirillum
5- Bacillus polymixa
6- Ammonium sulphate + calcium superphosphate
7- *Azotobacter* + *Azospirillum* + Bacillus *polymixa*

was noticed with nitrogen bio fertilization as *(Azotobacter + Azospirillum).* This treatment improved plant height and was promising than the treatment of Bacillus or *Azotobacter + Azospirillum + Bacillus* or control.

The data showed that *Azotobacter + Azospirillum, Bacillus* and *Azotobacter + Azospirillum + Bacillus* treatments increased plant height character by 8.29%, 7.74% and 7.74%, 8.92%, 8.37% and 8.11% over control plants in the first and second seasons respectively, although these increases were insignificant

Reviewing the mean height of chamomile plants at 193 days as affected by meniral fertilizers it was found that, the best height was obtained when the plants received ammonium sulphate + calcium superphosphate together at rate of 150 + 75 kg/fed. followed by ammonium sulphat at rate of 300 kg/fed. and calcium superphosphate at rate of 150 kg/fed. with the mean height of 73.33, 70.67 and 68.0 cm, respectively.

It is clear also that mineral fertilizers were of superior effect than bio fertilization treatments concerning plant height at different ages of growth for both seasons.

In the second season had nearly the same trend of results which confirmed with the first one. It can be concluded that the fertilization treatments resulted in an increase in (plant height) over control in both seasons with significant differences in some cases. Such increases may be due to that application of fertilizers were play an active role in initiating and development of the new cells and participating in growth

and enlargement of those cells and/or organs, consequently the increase in plant height may also the promoting effect of these elements on cell division and or cell enlargement.

These results confirmed by those obtained by **Mohamed** (1999) who studied the effect of NPK on the growth of *Pelargonium graveolens, P. fragrans* and *P. denticulatium* he, found that,the application of NPK increased plant height, number of branches and leaves/plant, leaf area and fresh and dry weights of leaves. Also **El-Ghawwas *et al.* (2001)** on *Ambrosia maritime* plant showed that a significant increase in plant height, number of branches, fresh and dry weights per plant and per plot was obtained by adding (150 kg/fed. calcium superphosphate 15% P_2O_5). (150 kg/fed ammonium sulphate (20.5%N) and 75Kg/fed. Potassium sulphate (48% K_2O). Also **Gad (2001)** studies the effect of commercial biofertilizer of biogen, nitroben and serialen on the vegetative growth of *Foeniculum vulgare,* Mill and *Anethum graveolens,* L. All biofertilizer treatments increased all growth parameters such as plant height, number of leaves/plant and fresh or dry weights of vegetative growth/plant

4.1.1.2. Fresh weight:

Data recorded in Table (3) and Fig. (2) showed that the average fresh weight of chamomile plant was improved by all fertilization treatments till the age of 163 days (at date 15 th Mar) after that the plant weight was decreased due to the

dryness and lost most of plant leaves and branches due to correlated damages with repeated collection of flower heads at the end of season.

Chemical fertilization treatments were great effects on chamomile plant growth compared with bio fertilization treatments. The combined treatment of (ammonium sulphate + calcium superphosphate) at rate of 150.0 + 75.0 kg/fed. was of superior effect in this concern compared with nitrogen or phosphorous alone at rate of 300.0 kg N/ fed. or 150 kg P/fed. treatments, respectively. It the age of 193 days the heaviest plant fresh weight was obtained from ammonium sulphate + calcium superphosphate, followed by ammonium sulphate then calcium superphosphate treatments with means fresh weight of 149.76, 119.76, and 108.00 g, receptively in the first season.

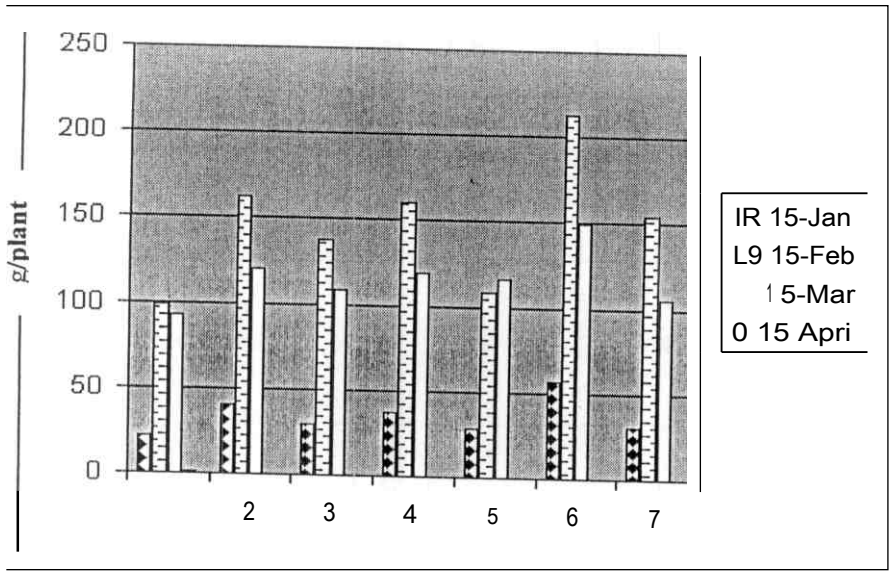
These results are in agreement with those obtained by **El-Ggawwas *et al.* (2001) on** *Ambrosia maritima* plant who observed that significant increases in fresh and dry weights per plant by using different N P K levels. Also **Bonner and Varner (1976)** mentioned that phosphorus plays key role in energy metabolism. It is incorporated into adenosine triphosphate (ATP) which is considered as parcel of the universal energy currency of all living cells of whatever species. Phosphate occurs in phospholipids, nucleic acid and Co-enzymes. Also, phosphorous is essential for cell division and for the development of meristem tissue.

Table (3): Effect of different fertilization treatments on fresh weight of chamomile plants (g) during seasons 2002/2003 &2003/2004.

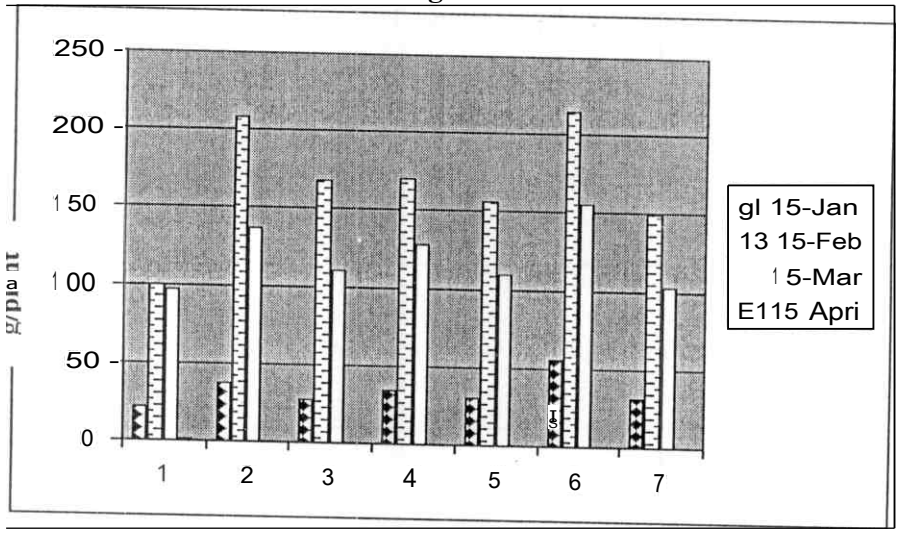
Treatments	First season				Second season			
Date	15/1	15/2	15/3	15/4	15/1	15/2	15/3	15/4
Control	21.67	98.17	228.66	92.76	21.76	99.33	223.67	97.00
Ammonium sulphate 300 kg/fed.	40.17	162.17	384.67	119.76	37.00	208.17	319.00	136.67
Calcium superphosphate 150 kg/fed.	29.67	137.67	260.00	108.00	27.08	168.33	246.67	110.00
Azotobacter + *Azospirillum*	36.66	159.67	341.66	119.00	34.50	17.00	250.00	128.33
Bacillus polyinixa	27.93	108.00	252.33	105.00	30.50	155.83	245.00	109.33
Ammonium sulphate + calcium superphosphate 150 + 75 kg/fed	56.16	213.17	608.00	149.76	55.67	215.00	603.00	155.00
Azotobacter + *Azospirillum*+ *Bacillus*	30.5	154.67	320.00	116.00	31.50	149.00	231.67	102.33
L.S.D 0.05% 0.01%	 17.67 24.74	 98.10 N.S	 167.9 234.4	 53.01 N.S	 10.24 14.35	 49.62 69.56	 50.40 70.65	 56.28 N.S

Fig (2): Effect of different fertilization treatments on fresh weight chamomile plant (g)

During first season



During second season



1-Control
2-Ammonium sulphate
3-Clacium superphosphate
4-Azotobacter + Azospirillum
5 - Bacillus polymixa
6- Ammonium sulphate + calcium superphosphate
7- Azotobacter + Azospirillurn + Bacillus polymixa

Generally, the effect of bio fertilization treatment on the growth of chamomile plant as fresh weight was clearly lowers than that resulted from mineral fertilization although these treatments also increased fresh weight of plant over control one. The most effective treatment in this concern was that used *Azotobacter + Azospirillum* followed by *Bacillus* them *Azotobacter + Azospirillum + Bacillus,* which obtained mean fresh weights of plant as that 119.0, 116.0 and 105.0 for the first season and 128.33, 109.33 and 102.33 g/plant for the second season, respectively for the prementioned treatments in the end growing season (15 April).

The increases due to bio fertilization treatments was always less than those results from mineral fertilization. Also the combined treatment of bio fertilizers bacteria *(Azotobacter + Azospirillum + Bacillus)* was not of more effect on increasing fresh weight/plant as the combined treatment of mineral fertilizers, it was not also of more promicing effect than using each kind of bactena alone. These results were confirmed with those obtained by **Maheshwari *et al.* (1988)** who studied the effect of Azotobacter and nitrogen on herb yield of black henbane *(Hyosyamus niger).*

In this respect increase in plant growth with the increase in nitrogen supply might be attributed.

Ali (2001) found that foliar spraying with the high rate (4.5 g/L) of active dry yeast gave better result of fresh and dry weight of *Calendula officinalis* .

4.1.1.3. Dry weight:

The data of herb dry weight/plant recorded in Table (4) and Fig. (3) indicated that, the average plant dry weight proved to increase till the age (163 days (at date 15th March), after which it decreased at the age of 193 days since it lost some of its leaves and branches due to correlated damaged with repeated collection of flower heads.

Regarding the data of mean dry weight of plant from the beginning of growth (15th Jan.) till the peak of growth (age of 163 days 15 1h March), It is evident that all fertilization treatments increased mean dry weight of plant over control treatment along the growth period. The maximum fresh or dry weigh of plant was attained at the prementiond age and then decreased, so comparing mean dry weight of plant as affected with fertilization treatments; it is evident that all fertilization treatments as mineral or bio fertilization increased dry weight of plant although the increases were insignificant in some cases

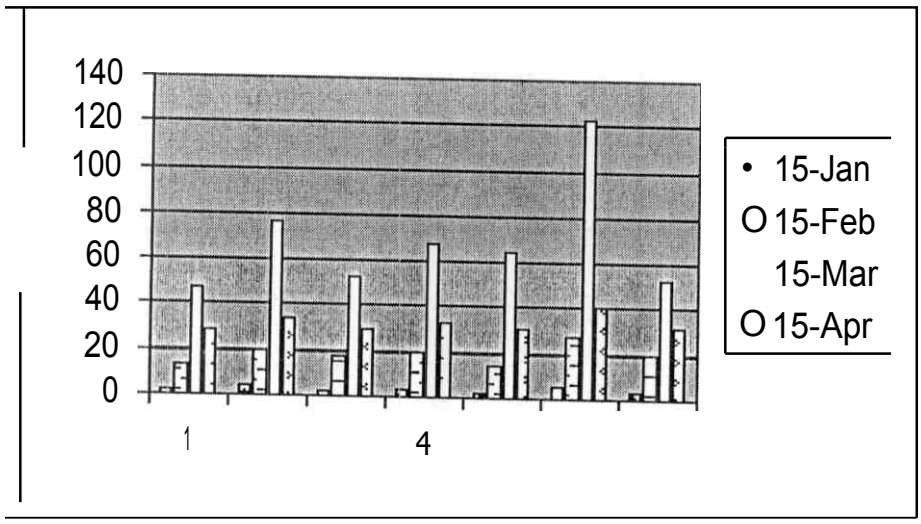
Mineral fertilization showed more effect in this concern than bio fertilization specially when it was added as combined ammonium sulphate and calcium superphosphate, since it produced the highest mean dry weight of plant as 122.00 and 121.33 g for first and second seasons respectively, while ammonium sulphate alone or calcium superphosphate alone produced mean dry weight (of 77.00 & 52.00) and (64.67& 50.33) for both seasons, respectively.

Table (4): Effect of different fertilization treatments on dry weight of chamomile plant (2) in both seasons 2002/2003 & 2003/2004.

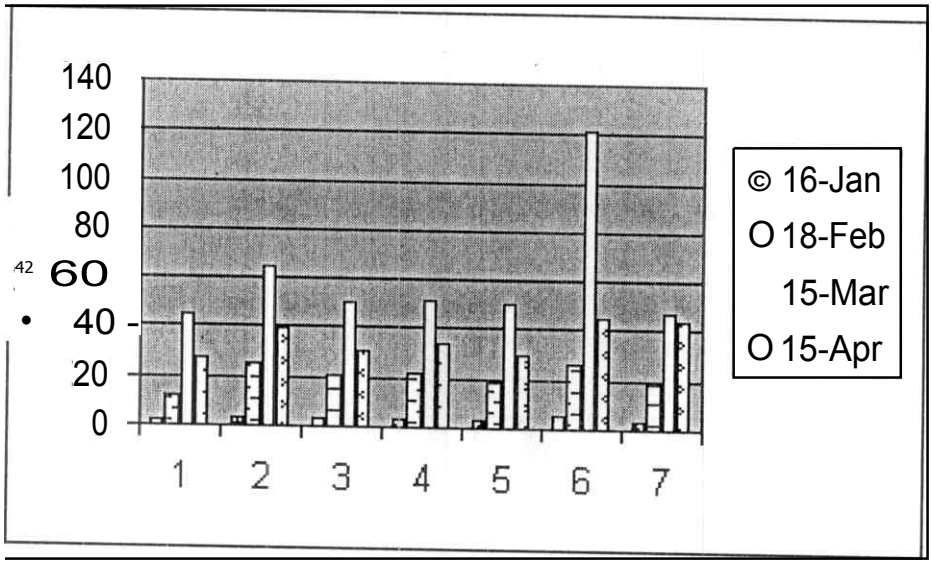
Treatments / Date	First season				Second season			
	15/1						15/3	15/4
Control	2.16						45.00	27.50
Ammonium sulphate 300 kg/fed.	4.50	20.17	77.00	34.33	3.76	25.5	64.67	39.00
Calcium superphosphate 150 kg/fed.	2.66	17.67	52.00	29.33	2.83	20.67	50.33	30.50
Azotobacter + *Azospirilluni*	3.50	20.17	68.00	33.00	3.33	21.33	51.30	34.17
Bacillus polymixa	2.33	14.00	52.00	30.33	3.00	19.00	50.00	29.33
Ammonium sulphate + calcium superphosphate 150 + 75 kg/fed	5.40	27.16	122.00	40.50	5.50	26.50	121.33	43.00
Azotobacter + *Azospirilhun*+ *Bacillus*	3.00	19.5	65.00	31.67	3.08	18.33	47.33	45.75
L.S.D.								
0.05%	1.83	11.90	37.10	11.88	1.09	6.34	10.21	14.00
0.01%	2.57	N.S	53.42	N.S	1.53	8.89	14.34	N.S

Fig. (3): Effect of different fertilization treatments on dry weight/plant (g) of chamomile plants in first season (2002-2003)

During first season



During second season



1-Control
2-Ammonium sulphate
3-Clacium superphosphate
4-Azotobacter + Azospirilhzm
5- Bacillus polynthca
6- Ammonium sulphate + calcium superphosphate
7- Azotobacter + Azospirillunz + Bacillus polymixa

Younis (1998) on *Thymus vulgaris,* L. mentioned that, all fertilization treatments of N, P, and K gave heavier fresh and dry weights of herb than the control.

Bio-fertilization treatments also increased in mean dry weight of chamomile plant over control one, although it was of lower effect than mineral fertilization treatments. The effect of the combined bio fertilization treatment as *Azotobacter* + *Azospirillum* + *Bacillus* was unconstant in both seasons, while it was superior the solitary bio-fertilization as *Azotobacter* + *Azospirillum* or *Bacillus* in the first season, it was lower them in the second season as it clear from the Table (4) and Fig (3).

Dry weights results followed the same trend as that of fresh weights soat the end growth seasons the heaviest dry weights were obtained from chemical fertilization treatments as ammonium sulphate + calcium superphosphate, followed by ammonium sulphate alone then calcium superphosphate respectively. Among this higher weights the combined treatment of ammonium sulphate + calcium superphosphate, is superior than all treatments. On the other side the dry weight character was increased also due to from bio-fertilization treatments such as *Azotobzcter* + *Azospirillum,* followed by *Bacillus* then *Bacillus* + *Azotobzcter* + *Azospirillum.*

Generally, ammonium sulphate + calcium superphosphate treatment was of the most effect for vegetative growth it gave 43.11% and 63.63% in March over control plants for the dry weight of herb in the first and second seasons, respectively. These results are in agreement with

those obtained by **Gad (2001)** studies the effect of commercial biofertilizer of biogen, nitroben and serialen on the vegetative growth of *Foeniculum vulgare,* Mill and *Anethum graveolens,* L. He observed that all used bio-fertilizer treatments increased all growth parameters such as plant height, number of leaves/plant and fresh or dry weight of vegetative growth/plant.

4.1.1.4. Root length:

Concerning the results of the mean length of root recorded in Table (5) and Fig (4) the length of roots was slightly affected with the different fertilization treatments. It is clear that mean length of fresh roots increased progressively with plant age till the end of growth period. The trough measurement of this character which could be considered that which take at great growth period at age of 163 days. Since after that it is impossible to get whole length of root because of as the dryness or hardness of soil and roots .So we can compare the effect of fertilization treatments on roots length through growth period starting from 15 th Jan. till 15th of March.

It is clear that at all ages of chamomile plant, mineral fertilization treatments resulted in taller roots than those produced with bio fertilization treatments or control.

The mean root length at the age (163 days) were 21.67, 20.33, 19.66, 19.17, 19.0, 18.33 and 17.6 g, respectively for ammonium sulphate + calcium superphosphate, ammonium

sulphate, calcium superphosphate, *Azotobacter* + *Azospirillum, Bacillus, Azotobacter* + *Azospirillum* + *Bacillus* and control treatments in the first season.

Ammonium sulphate was more effect in this concern than super phosphate. While combined treatment of ammonium sulphate + calcium superphosphate gave taller roots than when each was used alone although the differences were insignificant in all cases.

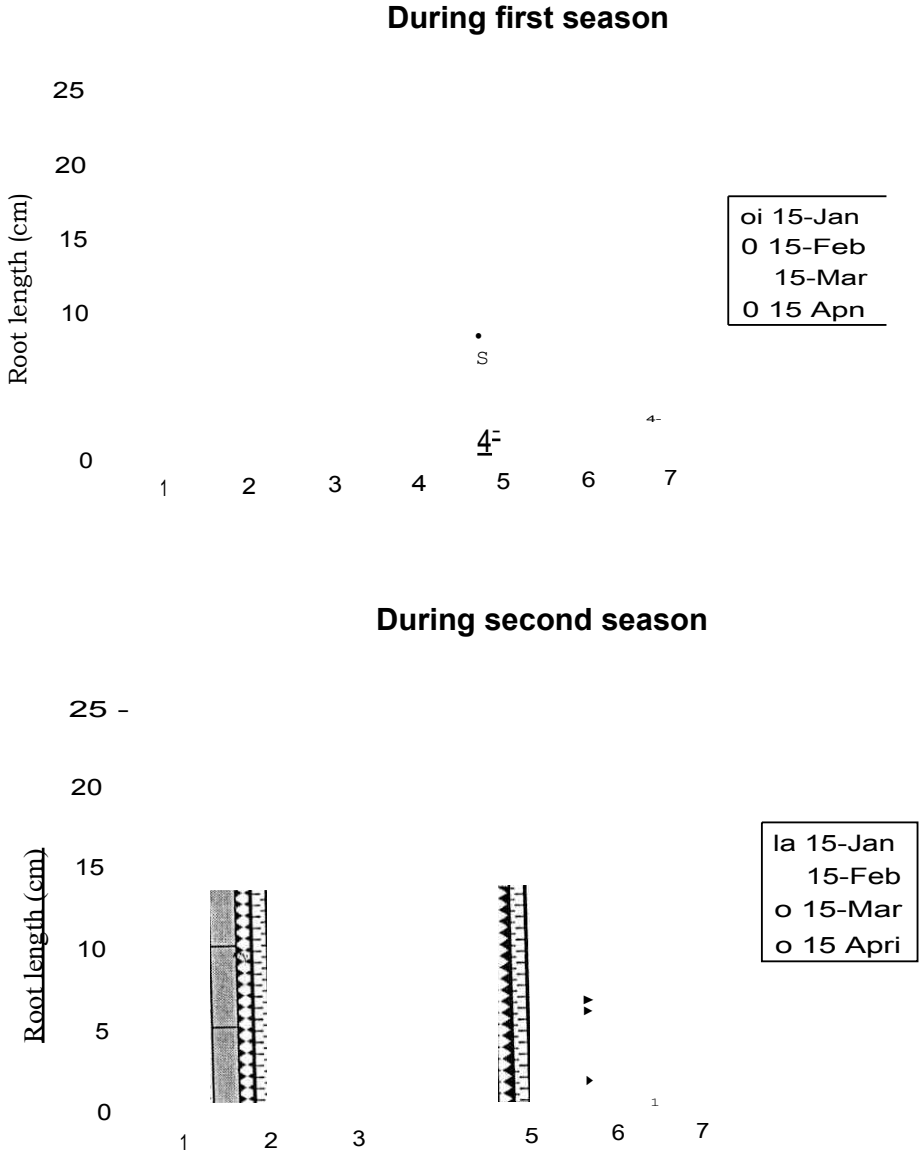
Concerning the effect of bio fertilizer treatments, root length of chamomile plant increased over control with lower values. The combined treatment of bio fertilization observed lower value of root length than when each of bio fertilization treatments was used alone. The trend of results was constant in both seasons.

The root length was most affected with chemical fertilization treatments compared with bio fertilizers ones. Adding nitrogen combined with phosphorus produced statistically significant increases than its omission. These results are in agreement with **Gurubatham *et aL* (1989)** demonstrated that *Azotobacter* inoculation increased bulb yield of *Allium* cepa(onion). Also **El-Nagar and Mahmoud (1994)** reported that inculcation with Azospirillum considerably increased bulb weight of narcissus plant. Also Wang and Patil (1994) reported that applying 100kg nitrogen/ha or inculation with *Azotobacter* + *Aazospirillum* mixture on *Polianthes tuberosa* significantly increased bulbs yield.

Table (5): Effect of different fertilization treatments on root length of chamomile plants (cm) during both seasons 2002/2003 & 2003/2004.

Treatments / Date	First season				Second season			
	15/1	15/2	15/3	15/4	15/1	15/2	15/3	15/4
Control	11.83	17.00	17.60	12.67	12.33	17.17	18.17	12.33
Ammonium sulphate 300 kg/fed.	13.00	19.33	20.33	16.67	13.83	20.17	20.17	17.67
Calcium superphosphate 150 kg/fed.	12.50	18.00	19.17	16.33	13.17	17.67	18.67	17.17
Azotobacter + *Azospirillum*	12.66	18.33	19.66	16.67	13.50	18.67	19.00	17.00
Bacillus polymixa	12.33	17.83	19.00	16.33	13.16	17.50	18.33	17.00
Ammonium sulphate + calcium superphosphate 150 + 75 kg/fed	13.33	19.33	21.67	16.67	14.17	20.33	21.83	17.83
Azotobacter + *Azospirillum*+ *Bacillus*	12.17	17.66	18.33	16.00	13.00	17.33	18.50	16.00
L.S.D 0.5% 0.1%	1.40 1.97	4.20 N.S	3.92 N.S	3.86 5.42	1.52 N.S	2.13 N.S	2.73 N.S	3.87 5.43

Fig. (4): Effect of different fertilization treatments on chamomile plant root length (cm).



1-Control
2-Ammonium sulphate
3-Clacium superphosphate
4-Azotobacter + Azospirilluin
5- *Bacillus polymixa*
6- Ammonium sulphate + calcium superphosphate
7- Azotobacier + Azospirillum + Bacillus polymixa

4.1.1.5. Root fresh weight:

The data in Table (6) and Fig. (5) showed that root fresh weight was proved to increase with the progressive of age till 163 days and then decreased at the age of 193 days.

It is clear from the data recorded in Table (6) that, the different fertilization treatments had slight effect on increasing the mean root fresh weight of chamomile plant with regard to this data, it was clear that the root fresh weight was of higher increase with different mineral fertilization treatments, compared with bio fertilizer ones.

The plants treated with ammonium sulphate + calcium superphosphate, attained the heaviest fresh weight of plant root over each ammonium sulphate or calcium superphosphate treatments when each was used alone. The increasing effect due to these treatments as percentages attained 45.25, 34.73 and 7.36% over control plants in the first season and these increase reached 46.21, 39.60 and 15.23% for the second season, respectively at the age of 163 day.

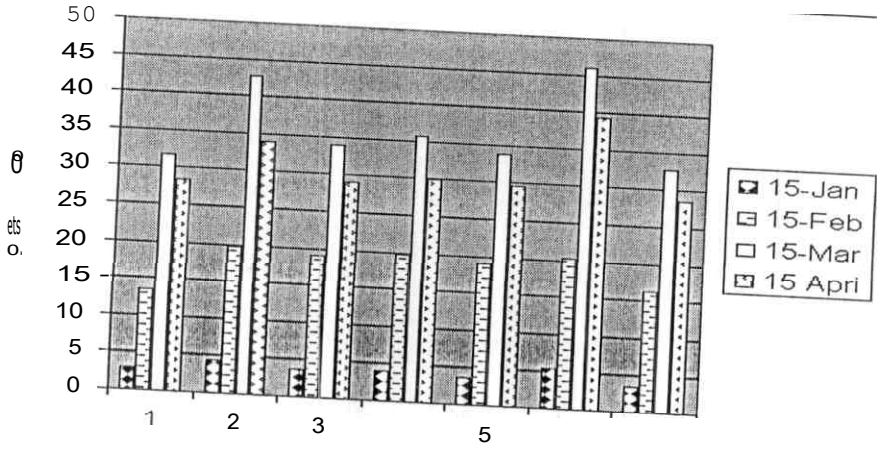
Bio-fertilization treatments also increased root fresh weight of chamomile plant although its effect in this concern was lower than minerals ones. The most effective treatment of bio fertilization was that of *Azotobacter + Azospirillum* which increased mean fresh weight of root since it gave 12.63% over control, while *Bacillus* treatment increased this character by 6.32%and the combined treatment of *Azotobacter + Azospirillum + Bacillus* gave 3.16% over control for first

Table (6): Effect of different fertilization treatments on root fresh weight of chamomile plant (g) during both seasons 2002/2003 &2003/2004.

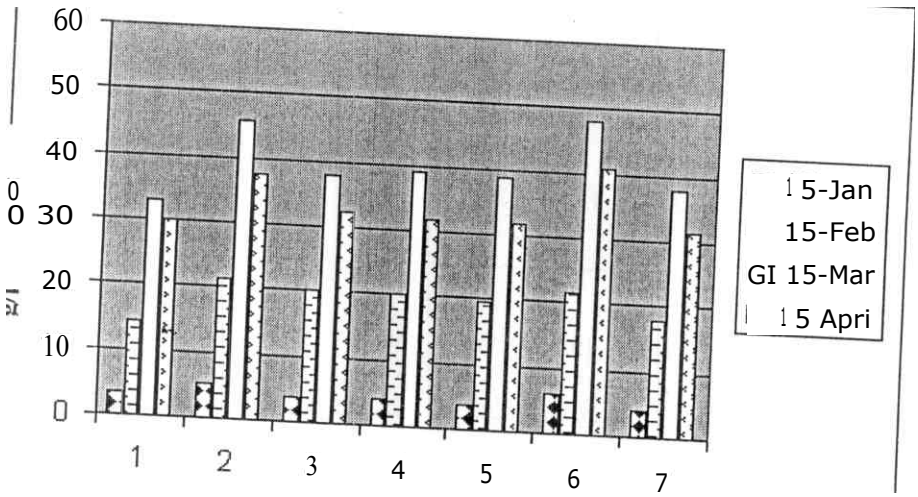
Treatments / Date	First season				Second season			
	15/1	15/2	15/3	15/4	15/1	15/2	15/3	15/4
Control	3.00	13.50	31.67	28.33	3.50	14.33	32.83	30.00
Ammonium sulphate 300 kg/fed.	4.33	19.67	42.67	34.00	5.17	21.30	45.83	37.50
Calcium superphosphate 150 kg/fed.	**3.67**	19.00	34.00	29.00	**3.83**	20.00	37.83	32.33
Azotobacter + *Azospirillu*›	**4.00**	19.67	35.67	29.83	**4.17**	20.00	39.17	31.67
Bacillus polymixa	**3.60**	19.00	33.67	**29.5**	**3.83**	19.50	38.00	31.83
Ammonium sulphate + calcium superphosphate 150 + 75 kg/fed	**5.50**	20.33	46.00	39.33	**6.00**	21.67	48.00	40.83
Azotobacter + *Azospirillum*+ *Bacillus*	**3.50**	16.33	33.67	28.33	**4.00**	17.67	38.83	31.50
L.S.D. 0.05%	2.23	5.32	12.32	8.38	2.19	5.43	6.84	10.63
0.01%	N.S	N.S	N.S	N.S	N.S	N.S	9.59	N.S

Fig. (5): Effect of different fertilization treatments on root fresh weight of chamomile plant (g)

During first season



During second season



1-Control

2-Ammonium sulphate

3- Clacium superphosphate

4- *Azotobacter + Azospirillunt*

5- *Bacillus polymixa*

6- Ammonium sulphate calcium superphosphate

7- Azotobacter + Azospirillum+ Bacillus polynzixa

season and these increases reached 19.31, 18.28 and 15.75% for these treatments respectively for the second season.

It is clear from the data in Table (6) which represent the mean fresh weight of roots chamomile plant during the second season of 2002/2004 that the trend of result was nearly the same for both seasons.

Gurubatham *et al.* (1989) demonstrated that *Azospirillum* inoculation increased bulb yield of *Allium cepa* (onion) from 15.9 t/ha in the unfertilized control to 19.3-20.5 t/ha. Also **El-Nagger and Mahmud (1994)** studied the effect of incorporating different *Azospirillum* strains to different soil types in the presence or absence of nitrogen fertilization on narcissus plant. They reported that inoculation with *Azospirillumm* considerably increased bulb weight, yield and weight of inflorescence scape.

4.1.1.6. Root dry weight:

Regarding the effect of different chemical and bio fertilizers. treatments on the root dry weight, it is evident that the results followed the same trend as that observed with fresh weight. The heaviest dry weight of root at the age of 163 days were produced from ammonium sulphat + calcium super phosphate followed by ammonium sulphate, calcium superphosphate, *Bacillus, Azotobacte* + *Azospirillum,* and *Azotobacter* + *Azospirillum* + *Bacillus* treatments as shown in Table (7) and Fig. (6).

Table (7): Effect of different fertilization treatments on root dry weight of chamomile plants (2) during both seasons 2002/2003 & 2003/2004.

Treatment ---------	First season				Second season			
Date	15/1	15/2	15/3	15/4	15/1	15/2	15/3	15/4
Control	0.73	4.00	10.83	9.67	0.90	4.17	11.17	9.67
Ammonium sulphate 300 kg/fed.	0.93	5.67	14.33	11.17	1.67	6.00	15.33	12.50
Calcium superphosphate 150 kg/fed.	0.93	5.67	11.33	9.83	1.13	5.67	12.50	10.83
Azotobacter + *Azospirillum*	0.93	5.67	12.00	10.17	1.17	5.83	13.00	10.83
Bacillus polymixa	0.867	5.33	11.17	9.83	1.03	5.83	12.50	10.50
Ammonium sulphate + calcium superphosphate 150 + 75 kg/fed	1.40	5.83	15.33	13.17	2.00	6.00	16.00	13.50
Azotobacter + *Azospirillum*+ *Bacillus*	0.83	4.50	11.17	9.67	1.03	5.00	12.50	10.33
L.S.D								
0.5%	0.576	1.54	4.38	2.86	0.658	1.33	2.04	3.29
0.1%	0.808	N.S	N.S	N.S	0.923	N.S	2.86	N.S

Fig. (6): Effect of different fertilization treatments on root dry weight of chamomile plant (g)

During first season

During second season

1-Control **2-Ammonium sulphate**

3-Clacium superphosphate *4-Azotobacter + Azospirillunt*

5- Bacillus polymbca **6- Ammonium sulphate + calcium superphosphate**

7- Azotobacter + Azospirillutn + Bacillus polymixa

The difference between the heaviest and lightest dry weights was statistically significant.

From the results it was evident that ammonium sulphate + calcium super phosphate treatment gave the heaviest root dry weight at any age over all other treatments in both seasons of the experiments. The increases due to this treatment over control reached to 41.16 % and 43.24 % for both seasons respectively at the age 163 days.

In the second season, the results were in accordance with the results of the first season of 2002/2003 and have nearly the same trend. These results were agreement with **Sharaf (1995)** on garlic and **Wange (1996)** on carrot *(Daucus carota)*.

4.2. Flowering:

4.2.1. Flower yield/plot:

Data recorded in Table (8) and Fig. (7) show the effect of mineral and bio fertilization treatments on the mean yield of flower heads/plot through, the successive picks of the tow years of the experiment.

These data revealed that, fresh or dry weight of flower heads gradually increased from the first pick till the fifth and then decreased suddenly. So the forth and fifth picks only produced more than 65% from the total yield of fresh or dry flower heads weights for each year of the experiments. The increase of flowering and the differences due to the effects of different fertilization treatments began to be more clearer starting from the third pick.

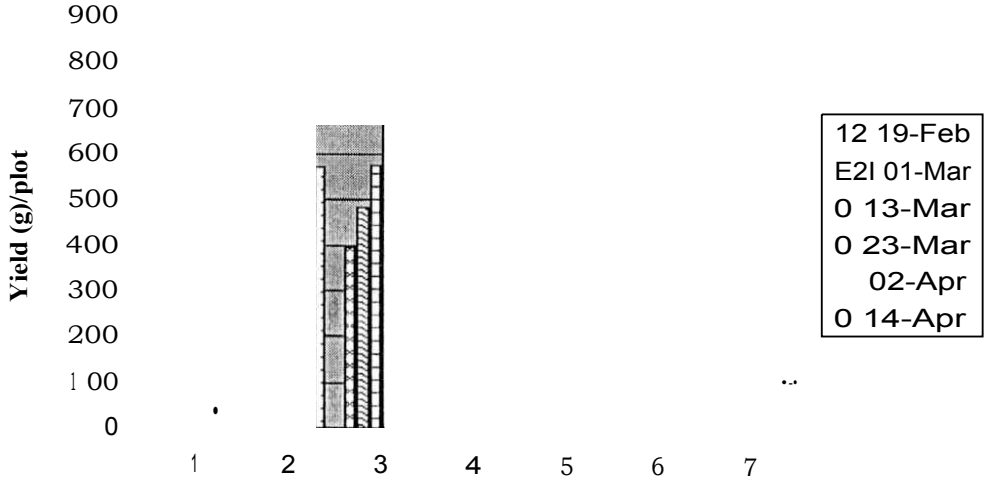
Concerning the fertilization treatments, it is clear that both mineral fertilization treatments with nitrogen or phosphorus increased the fresh and dry weight of flower heads yield/plot throughout the successive picks of both seasons as shown in Table (9) and Fig. (8). These increases reached the level of significance in most cases especially with medium picks (from third to fifth) although the increases due to nitrogen fertilizer was superior those obtained with phosphorus. These results are in agreement with **El-Shafie (1979)** on roselle, mentioned that the high level of ammonium sulphate (400 kg/fed) markedly improved the growth and productivity of plants. Also **Dovjak** (1988) on *Chamomilla*

Table (8): Effect of different fertilization treatments on fresh weigh of flower heads (g)/plot of chamomile plants during two successive seasons 2002/2003 & 2003/2004.

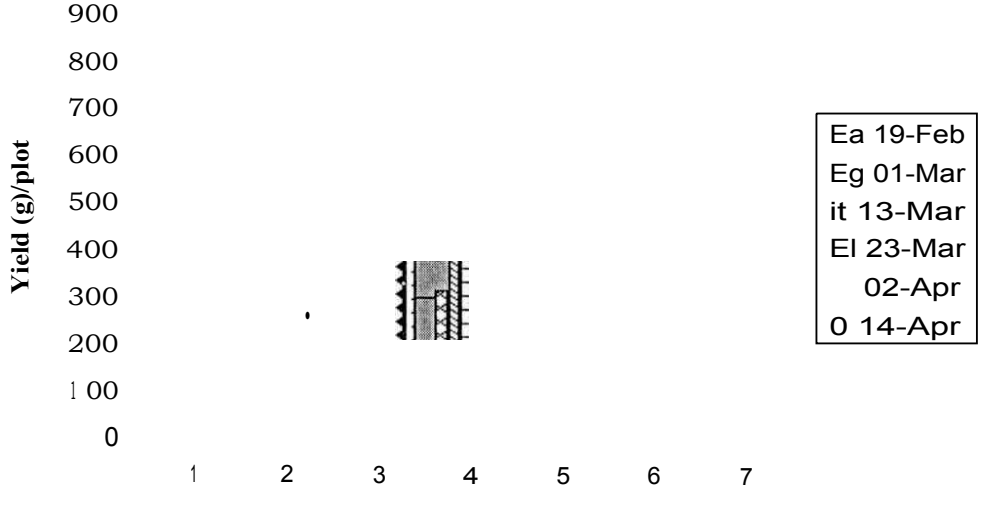
Treatments / Date	First season						Second season					
	19/2	1/3	13/3	23/3	2/4	14/4	21/2	2/3	12/3	22/3	1/4	15/4
Control	292.50	305.00	416.90	660.0(1	670.00	478.35	325.85	341.25	555.00	617.90	629.6(1	471.25
Ammonium sulp hal e 300 kg/fed.	392.50	473.35	596.65	770.00	791.65	572.50	379.15	407.25	605.85	790.00	858.35	545.85
Calcium superphosphate 150 kg/fed.	395.85	485.00	574.15	667.50	720.00	550.00	346.65	343.65	566.65	801.65	841.65	530.00
Azotobacter + Azospirillunt	314.15	410.00	527.50	708.35	743.75	516.65	384.15	352.10	570.00	655.85	691.25	558.75
Bacillus polymixa	351.65	447.90	551.25	617.90	675.00	465.00	300.00	314.85	550.00	700.00	723.35	512.50
Ammonium sulphate + calcium superphosphat e 150 + 75 kg/fed	410.85	509.55	626.65	800.00	843.35	598.35	408.35	485.85	625.00	840.00	900.00	566.65
zolobacter + A zospirillumf Bacillus	316.25	311.65	452.90	677.00	721.65	511.65	327.50	365.65	525.00	616.65	666.25	472.10
L.S.D. 0.05% 0.01%	19.21 N.S	27.01 37.86	23.55 33.02	32.92 N.S	19.58 27.45	22.87 N.S	35.19 N.S	N.S N.S	18.34 N.S	16.64 23.33	18.05 25,30	18.07 N.S

Fig. (7): Effect of different fertilization treatments on fresh weight of flower heads (g)/plot of chamomile plants

During first season



During second season



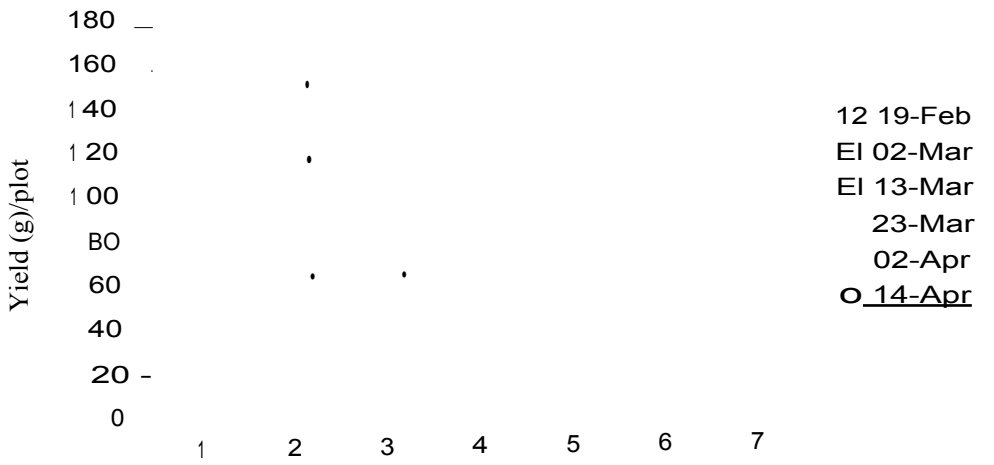
1-Control
2-Ammonium sulphate
3-Clacium superphosphate
4-Azotobacter + Azospirillum
5- *Bacillus polymixa*
6- Ammonium sulphate + calcium superphosphate
7- Azotobacter + Azospirillum + Bacillus polymixa

Table (9): Effect of different fertilization treatments on dry weight of flower heads (g)/plot of chamomile plants during two successive seasons 2002/2003 &2003/2004.

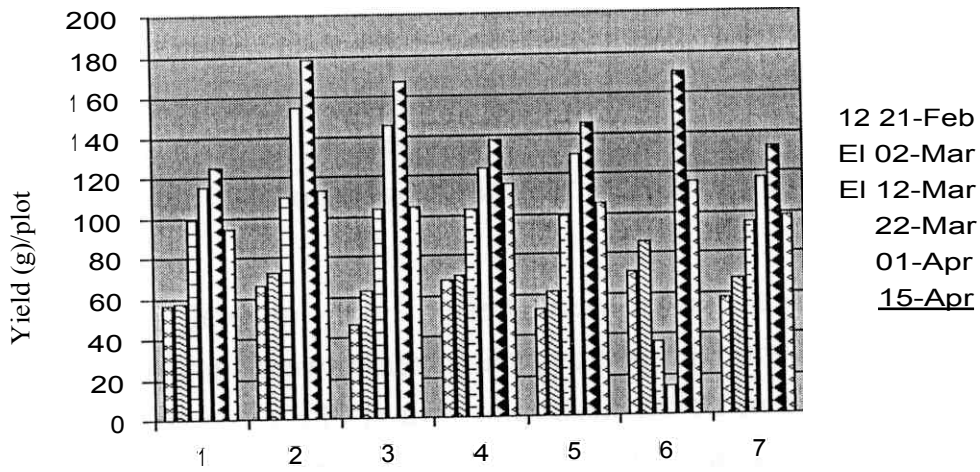
Treatments / Date			First season				Second season					
	19/2	2/3	13/3	23/3	2/4	14/4	21/2	2/3	12/3	22/3	1/4	15/4
Control	52.52	53.24	74.25	121.50	135.00	94.50	56.25	57.24	99.00	115.52	124.52	94.50
Ammonium sulphate 300 kg/fed.	69.75	84.02	105.75	146.25	169.52	114.75	66.02	72.32	109,49	154.49	177.75	113.27
Calcium superphosphate 150 kg/fed.	70.52	86.27	102.02	122.99	145.49	112.50	46.13	62.46	103.50	145,49	167.27	104.27
Azotobacter + *Azospirillum*	55.89	72.00	93.74	131.27	149.99	104.27	67.50	69.75	102.74	122.99	I37.25	115.52
Bacillus polyntixa	62.24	81.00	98.24	113.99	135.77	96.75	52.52	61.07	99.00	129.74	144.77	104.99
Ammonium sulphate + calcium superphosphate 150 + 75 kg/fed	72.77	90.77	116.24	142..62	158.99	120.02	70.52	85.14	35.77	148.50	170.24	115.52
Azotobacter + *Azospirillum*+ *Bacillus*	55.49	54.77	79.52	124.52	145.49	102.74	57.02	66.69	94.90	117.00	132.75	98.24
L.S.D 0.05% 0.01%	5.21 N.S	5.25 7.36	4.65 6.52	6.82 N.S	4.28 6.00	5.01 N.S	N.S N.S	N.S N.S	7.75 N.S	3.78 5.29	4.14 5.81	3.97 N.S

Fig. (8): Effect of different fertilization treatments on dry weight of flower heads (g)/plot of chamomile plants

During first season



During second season



1-Control
2-Ammonium sulphate
3-Clacium superphosphate
4-Azotobacter + Azospirillum
5- *Bacillus polymixa*
6- Ammonium sulphate + calcium superphosphate
7- Azotobacter + Azospirillunt + Bacillus polymixa

recutita reported that NPK increased dry weight of flower heads/plant compared with control.

Bio-fertilization treatments with *Azotobacter* + *Azospirillum* as bio source of nitrogen resulted in a slight increases in fresh and dry weights of flower head yield/plot through the successive pickS of the tow years of this experiment, although these increases dose not reach the level of significance in most picks of each season.

Bacillus polymixa as source of bio phosphorus fertilizer produced an increase in fresh and dry weights of flower heads/plot for different picks through each season, the increase due to bio phosphorus bactiria was proportional with the progressive growth of plant from the third pick till the fifth one, but. these increases were mostly unsignificant and were more clearer with the late picks (from the third to the fifth) It is clear also from these data that both *Azotobacter* + *Azospirillum* or *Bacillus polymixa* each alone was of less effect on increasing fresh or dry yield of flower heads/plot when it compared with mineral nitrogen alone or phosphorus alone.

When plants were treated with mineral nitrogen combined with phosphorus great increases were attained in the mean yield of flower heads/plot with all the successive picks of both seasons. The increases in mean yield of flower heads/plot fresh or dry weight were significant at the level of 5% or height significant in some cases. The combined treatment of mineral nitrogen + phosphorus proved to be the most effective treatment for increasing the fresh and dry

weight of flower heads/plot, over all other treatments or control. These results are in according with the results were in agreement with those obtained by **Johri *et al.* (1992)** on chamomile plants they reported that N application increased flower yields with highest values at 60 kg/ha.

As for the combination of *Azotobacter* + *Azospirillum* + *Bacillus* as effect on the flower yield through different picks, it is clear from the data in Table (9) and Fig. (8) that *Azotobacter* + *Azospirillum* when combined with *Bacillus polymixa* dose not show more effect than when each was used alone. Also no clear increases over control were observed due this combination concerning fresh or dry weight of flower head during the successive picks of both seasons.

It could be said that each kind of bacteria *Azotobacter* + *Azospirillum* or *Bacillus polymixa* was of more effect on increasing flower heads yield /plot when used alone than when used both together this may be due to their fitting for nutrition in soil, or that the propagation of one of them cause weakness for the growth and propagation of the other.

El-Nagar and Mahmoud (1994) on Narcissus plant reported that inoculation with *Azospirillumm* considerably increased bulb weight, yield and weight of inflorescence. Also **Nawar (1994) pointed out that** *Helianthus annus,* **L.** varieties inoculated with a mixture of *Azospirillum* and *Klebssiella* gave a non-significant increment for the plant head diameter and weight of seeds head as compared with uninoculated plants.

4.2.2. Yearly yield of flower heads/plot and/fed (kg):

Data presented in Table (10) show the effect of different fertilization treatments on the yearly yield of fresh and dry flower heads/plot or /Feddan clear that both fresh or dry flower heads yield affected clearly by all fertilization treatments throughout the two season of the experiments.

Mineral fertilization as nitrogen or phosphorus significantly increased yield of fresh or dry flower heads/plot or /Feddan when each was added alone, although nitrogen was superior than phosphorus alone in this concern. The combined treatment with ammonium sulphate + calcium super phosphate resulted in an increase in the yearly yield of fresh or dry flower heads /plot or /feddan reached more than 25% over control in most cases for both seasons, and it was of the most superiority over all other treatments.

These results are in agreement with those obtained by **Wang *et aL* (1995)** who stated that highest flower yield of (tuberose) was obtained by using 150 kg N/ha.

Bio-fertilization treatments as *Azotobacter* + *Azospirillum* or *Bacillus* each alone increased clearly the yield of fresh and dry flower heads/plot or /feddan, but the rat of increases was lower than that obtained with mineral fertilization. Also the treatment with *Azotobacter* + *Azospirillum* was superior that of *Bacillus* in this regard. While the combined treatment with both *Azotobacter* + *Azospirillium* + *Bacillus* observed the lowest effect than when each was used alone.

Table (10): Effect of different fertilization treatments on the yearly yield of flower heads /plot and per fed. (kg) of chamomile plants in both seasons 2002/2003 and 2003/2004.

Treatments	First season				Second season			
	F.F.W./ plot (kg)	F.D.W./ plot (kg)	F.F.W./f ed (kg)	F.D.W./ fed (kg)	F.F.W./ plot (kg)	F.D.W./ plot (kg)	F.F.W./ fed (kg)	F.D.W./ fed (kg)
Control	2.823	0.531	2258.20	424.81	2.941	0.546	235.68	436.82
Ammonium sulphate 300 kg/fed.	3.597	0.690	2877.32	552.05	3.586	0.693	2869.14	554.67
Calcium superphosphate 150 kg/fed.	3.393	0.642	2714.00	513.63	3.430	0.629	2744.20	503.30
Azotobacter + *Azospirillum*	3.220	0.607	2576.32	485.73	3.212	0.616	2569.68	492.60
Bacillus polymixa	3. 109	0.588	2486.98	470.39	3.101	0.592	2480.56	473.672
Ammonium sulphate + calcium superphosphate 150 + 75 kg/fed	3.789	0.701	3031.00	561.05	3.826	0.726	3060.66	580.55
Azotobacter + *Azospirillum*+ *Bacillus*	2.991	0.563	2392.90	450.02	2.973	0.567	2378.52	453.28
L.S.D 0.05% 0.01%	0.098	0.012	0.037	0.022	0.083.13	0.016	0.0 42	0.0 25

F.F.W. = Flower fresl weight

F.D.W. = Flower dry weight

Generally, it could be concluded that fertilization treatments used in this experiment affected clearly the growth parameters of chamomile plants in its all growth periods. It also affected clearly and significantly the production of flower heads/plot or /unit area.

It could be also concluded that the lower effect of bio fertilization when it used with chamomile plant may be due to the short age of this plant this short period which the bacteria cannot reach its complete activity in the soil to complete its role in this concern.

These positive effects occurred through the increases in mineral content of the plant due to addition of mineral or bio fertilization in plant soil which resulted in good condition for vigorous growth to gave more yield of flower head of good quality.

4.3. Chemical composition:

4.3.1. Oil percentage:

It is clear from the data in Table (11) that oil percentages of dry flower heads tended to increase from the beginning to the end of flowering season. The highest oil percent was attained from mid March tel starting of April. This trend of results was constant in both seasons throughout successive picks. It is clear also that all fertilizing treatments affected clearly oil percentages of dry flower heads.

Mineral fertilizers were of more effect in this concern than bio fertilizer ones, although ammonium sulphate was superior than calcium super phosphate. The highest oil percent obtained when ammonium sulphate was used combined with calcium superphosphate.

These results are in agreement with those obtained by **El-Tantawy *et aL* (1992)** on caraway and EI-Shaerbeny *et al.* (1997) on lavender.

Bio-fertilizers increased oil percentage of chamomile flower heads over control through the successive picks of both seasons although *Azotobacter* + *Azospirillum* treatment was of more effect over *Bacillus* treatment when each was used alone.

The combined treatment of both kind of bacteria together obtained higher oil percent than each of them alone. **Gad (2001)** found that, the different commercial bio fertilizers treatments increased oil yield/plant over control of fennel and dill plants.

Table (11): Effect of different fertilization treatments on oil percentage of Flower heads in both seasons 2002/2003 and 2003/2004.

	First season						Second season					
Treatments	19/2	1/3	13/3	23/3	2/4	14/4	21/2	2/3	12/3	22/3	1/4	15/4
Control	0.80	0.85	0.90	0.92	0.90	0.89	0.85	0.87	0.920	0.93	0.98	0.90
Ammonium sulphate 300 kg/fed.	0.97	1.01	1.03	1.08	1.05	1.00	0.98	1.03	1.05	1.09	1.10	1.00
calcium superphosphate 150 kg/fed.	0.88	0.91	0.92	0.95	0.95	0.93	0.90	0.93	0.93	0.95	0.99	0.92
Azotobacter + *Azospirillunt*	0.90	0.94	1.00	1.01	1.03	0.94	0.92	0.96	1.01	1.01	1.05	0.93
Bacillus polymixa	0.95	0.88	0.93	0.95	0.98	0.92	0.89	0.92	0.95	0.97	0.99	0.92
Ammonium sulphate+ calcium superphosphate 150 + 75 kg/fed.	1.14	1.15	1.19	1.24	1.30	0.99	1.15	1.18	1.20	1.25	1.30	0.95
Azotobacter+ *Azospirillum*+ *Bacillus*	1.04	1.01	1.01	1.00	0.98	0.95	1.05	1.03	1.01	1.05	1.06	0.98

Generally, oil percent of chamomile flower heads increased due to both kind of fertilizers regardless as mineral or bio source especially when nitrogen source was combined with phosphorus one. This trend of effects reached it s maximum at mid season (fourth & fifth picks).

4.3.2. Oil yield/plot or/fed.

The data in Table (12) show that, the oil yield/plot or /fed was clearly increased by using different fertilization treatments in both seasons in this experiment, each of ammonium sulphate + calcium super phosphate, ammonium sulphate, and calcium super phosphate treatments obtained highly values in oil yield in both seasons compared with control, these treatments were produced 75.40, 50.50 and 26.50% or 70.60, 45.00 and 18.8% over control in the first and second seasons respectively. **Migahed (1998)** on dill, applied urea at the rate of 150.0 and 300.0 kg/fed he found that essential oil and oil production were increased by all treatments.

Also, bio fertilization treatments as *Azotobacter* + *Azospirillum, Bacillus* and *Azotobacter* + *Azospirillum* + *Bacillus* treatments increased yearily oil yield compared with control treatment in both seasons of this experiment, these treatments peraduced higher increases attained 25.70, 18.20 and 20.30% or 13.80, 9.54 and 17.3% respectively over control plants in the first and second seasons, respectively.

Table (12): Effect of different fertilization treatments on **volatile** oil / **fed (kg)** of chamomile plants in both seasons 2002/2003 & 2003/2004.

Treatments	First season		Second season	
	Oil %	Oil yield/fed (kg)	Oil %	Oil yield/fed (kg)
Control	0.88	3.74	0.90	3.98
Ammonium sulphate 300 kg/fed.	1.02	5.63	1.04	5.77
Calcium superphosphate 150 kg/fed.	0.92	4.73	0.94	4.73
Azotobacter + *Azospirillum*	0.97	4.70	0.98	4.53
Bacillus polymixa	0.94	4.42	0.92	4.36
Ammonium sulphate + calcium superphosphate 150 + 75 kg/fed	1.17	6.56	1.17	6.79
Azotobacter + *Azospirillum*+ *Bacillus*	1.00	4.50	1.03	4.67

These results confirmed with those obtained by Maheshwari *et al.* (1988) reported that the highest essential oil yield of *Cymboopgon martini* var. motia was recorded from applying *Azotobacter chrococcum* at 2 kg P/ha. Maheshwari *et al.* (1991) they stated that average oil yield was raised by 21% with *Azotobacter chrococcum* alone and by 27% with 80 kg nitrogen on *Cymboopgon martini* var. motia. As well as Gad (2001) mentioned that, volatile oil % in the seed, oil yield/plant and per feddan was increased by applying bio fertilizers to fennel and dill plants.

4.3.3. Oil constituents:

4.3.3.1. Nitrogen fertilizer:

Results obtained by GLC analysis for chamomile oil **component as affected by mineral or bio** fertilization treatment **recorded in Table (13)** and Fig. from **(9 to Fig.** 16). These data show that:

4.3.3.1.1. Mineral fertilization:

a) Ammonium sulphate at rate 300kg/fed. as dose dressing on surface ground increased each of chamazulene and fanesene compounds in volatile oil compared with control treatment, the rate of increase in these compound reached to 201.01 and 215.15% respectively.

On the other side (ammonium suphate) decreased each of bisbolene oxide, alfa bisabolol, farnesol and bisbolol oxid in

volatile oil of chamomile plants. The decreasing for these compounds reached to 20.13, 6.35,76.28 and 32.07%, respectively under these of control plants.

Generally, it can be said that fertilizing chamomile plants with ammonium sulphate only increased each of chamazulene and fanesene compound in volatile of that oil but decreased all other compounds which were identificated under this study.

b) Calcium superphosphate at rate of 150 kg/fed. increased chamazulene compound in volatile oil but decreased each of bisabolene oxid, alfa-bisabolol, bisabolol oxide, farnesol and fanesene compounds compared with control treatment in this experiment.

The rate of increase in chamazulene compound reached to 98.62% over control pants. But the rate of decrease for bisbolen oxid reached to 26.80, 3.97, 36.96, 0.92 and 100.0% than control treatment.

As for ammonium sulphate + calcium superphosphate at rate of 150.0 + 75.0 kg/fed. increased each of chamazulene and alfa bisabolol compounds in volatile oil of chamomile plants compared with control, these compound were increased by 137.89 and 17.99% respectively over control. Whereas bisbolene oxid, fanesol, bisabolol oxide and fanesene compounds in volatile oil compared with control, the rate of decreasing reached to 10.72, 59.50, 14.77 and 100%, respectively than control treatment.

Table (13): Effect of different fertilization treatments on the component% of chamomile oil:

Compound	R T	Control	N	P	N+P	A	B	A+B
Unidentified	3.11	0.52	1.06	1.50	2.15	0.72	0.99	1.28
Unidentified	7.39	1.07	_		_	0.93	0.99	0.73
Chamazulene	8.11	10.9	32.81	21.65	25.93	11.16	4.31	28.28
Unidentified	8.38	0.99	3.84			1.15	0.44	3.22
Unidentified	8.56	0.63	3.02	2.93	2.13	0.65		1.60
Unidentified	8.76	0.64	_	_		0.33		1.64
Unidentified	9.57	1.22	1.62	_	1.49	0.63	1.31	_
Unidentified	10.25	1.67	0.99	_	0.95	1.18	1.01	1.83
Bisbolene oxide	10.46	7.65	6.11	5.60	6.83	6.01	7.86	6.98
Alfa-bisabolol	10.76	7.56	7.08	7.26	8.92	9.42	7.06	9.68
Unidentified	11.17	2.26	0.91	1.38	1.32	2. 30	1.53	2.15
Bisabolol oxide	11.58	55.38	37.62	54.87	47.20	56.69	64.39	40.14
Farnesol	12.81	7.63	1.81	4.81	3.09	7.02	7.87	2.46
Farnesen	13.56	0.99	3.12	_	_	0.94	0.73	_
Unidentified	15.09	1.00	_	_	_	0.88	_	_

N = Ammonium sulphate treatment.
P = Calcium super phosphate treatment.
N+ P = Ammonium sulphate + Calcium super phosphate treatment.
A = Azotobacter + Azospirilum treatment.
B = Bacillus treatment.
A + B =Bacillus + Azotobacter + Azospirilum treatment.
RF= Retention time for volatile oil compounds in chamomile plants.

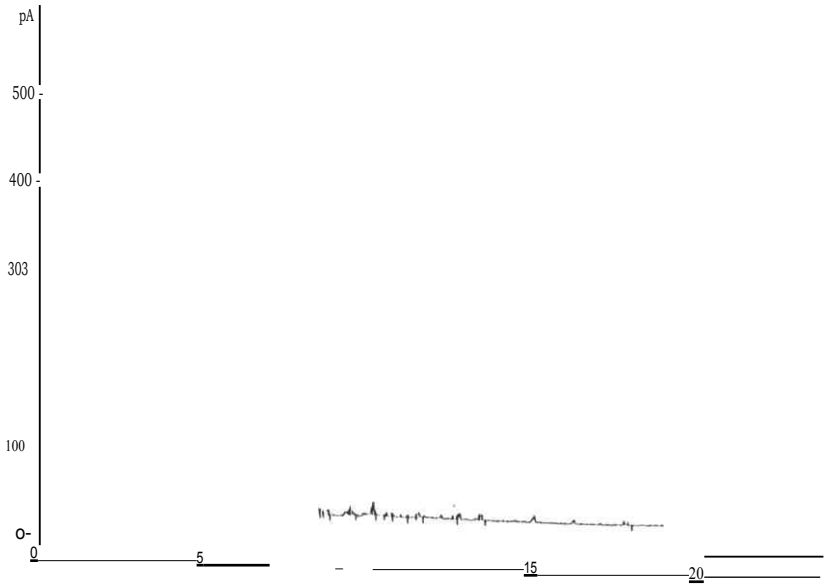


Fig. (9) Standard of chamazoline

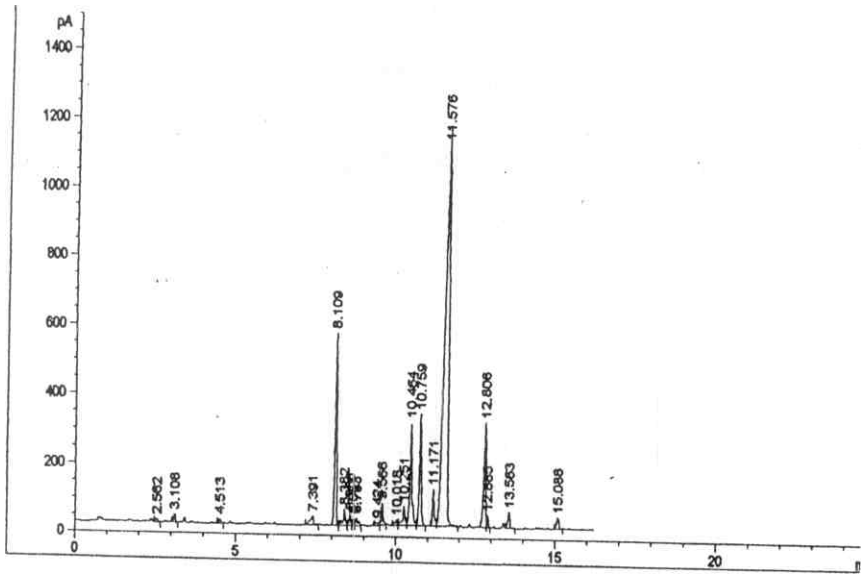


Fig. (10) Oil constituent of control treatment plant.

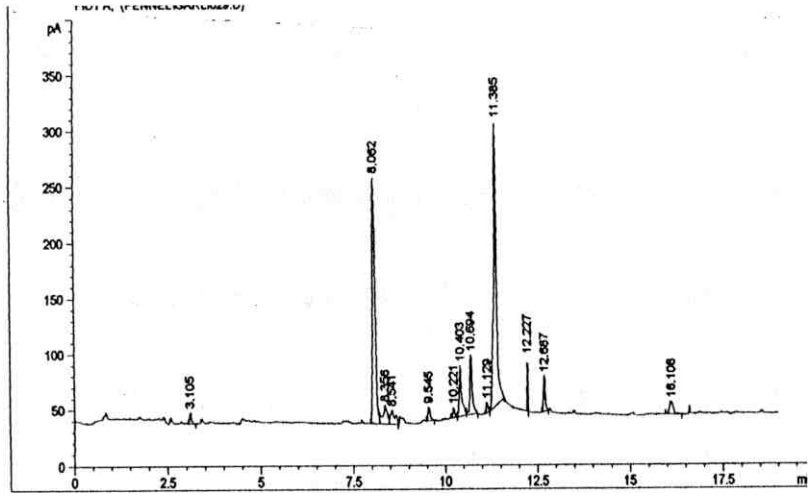


Fig. (11) Effect of ammonium sulphate on oil constituents of chamomile plant

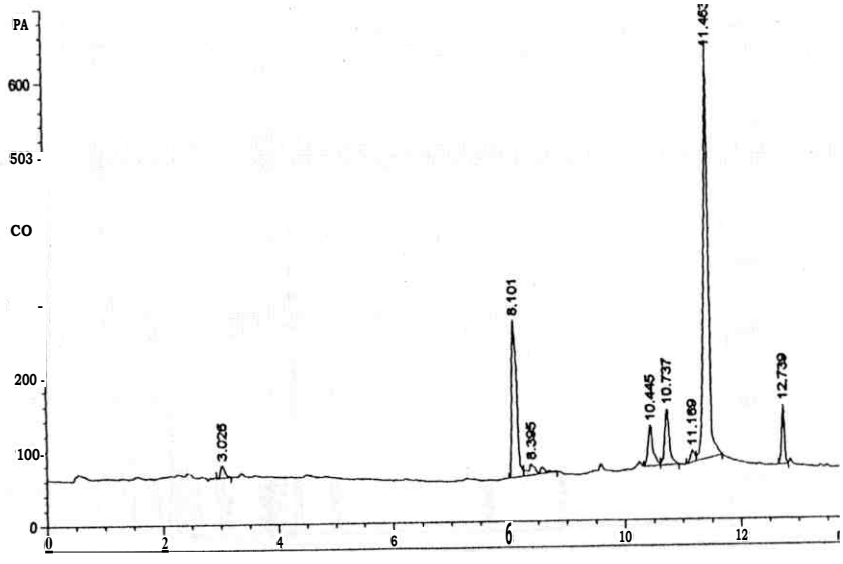


Fig. (12): Effect of calcium super phosphate on oil constituents of chamomile plant.

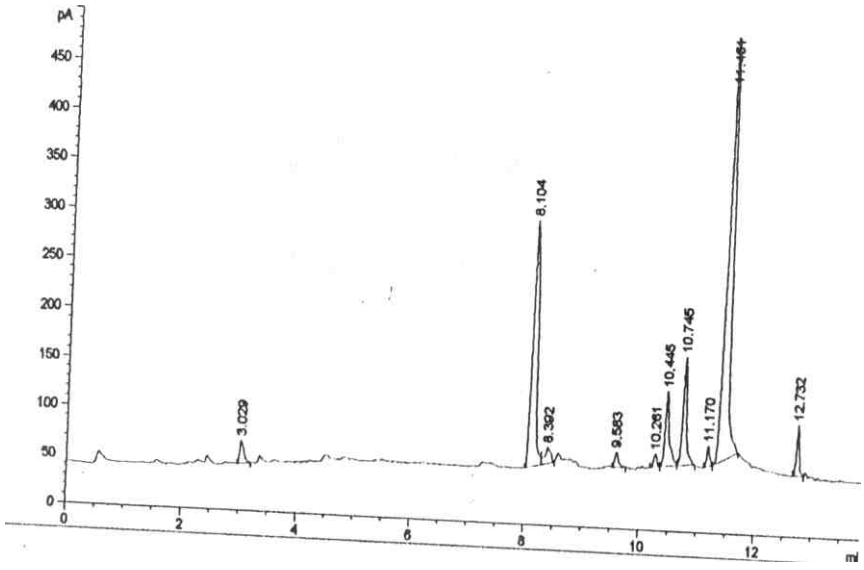


Fig. (13): Effect of ammonium sulphate and calcium superphosphate on oil constituents of chamomile plant

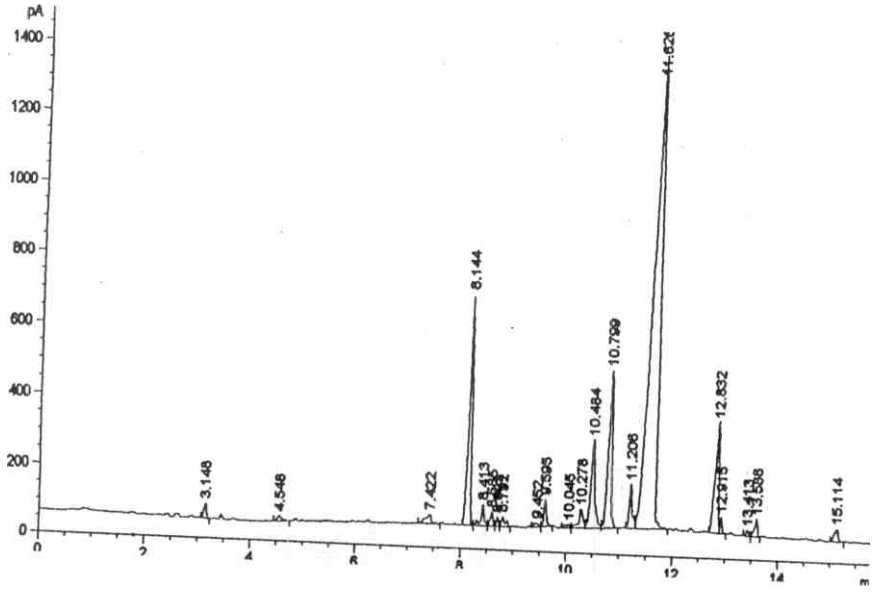


Fig. (14): Effect of *Azotobacter* **and** *Asospirilluni* **on oil constituents of chamomile plant**

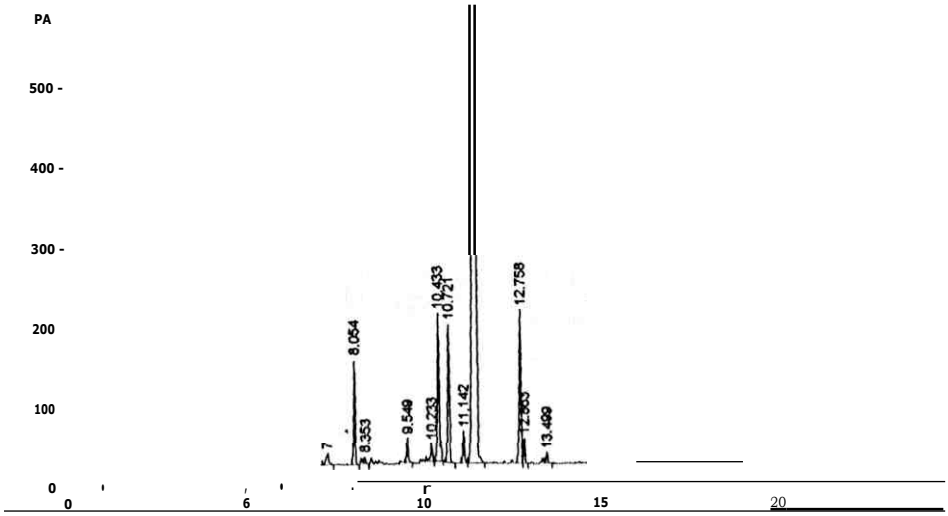


Fig. (15) Effect of *Bacillus* **on oil constituents of chamomile plant**

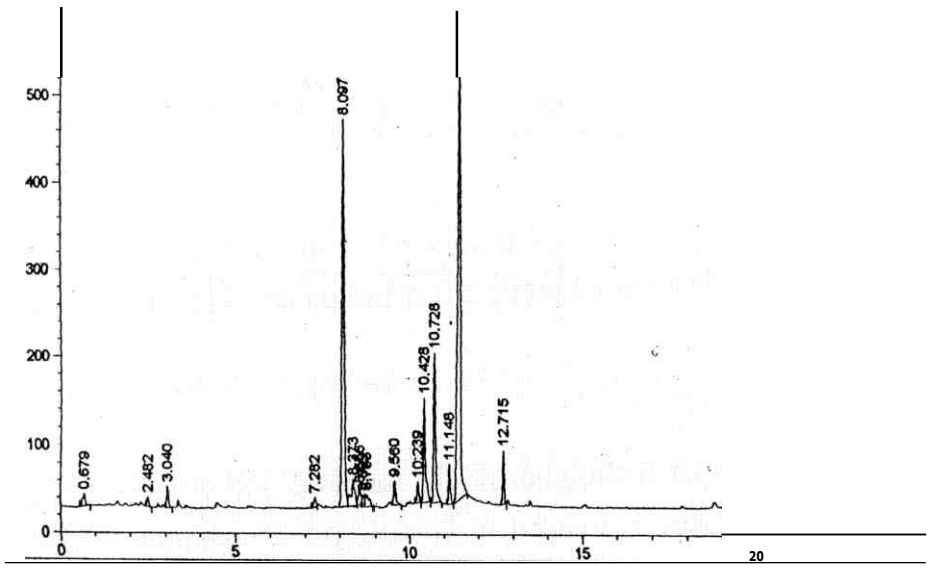


Fig. (16): Effect of *Azotobacter, Asospirillum* **and** *Bacillus* **on oil constituents of chamomile plant**

4.3.3.1.2. Bio-fertilization:

a)- Azotobacter + Azospirillum

Bio-fertilization also affected oil component as shown in Table (13) and Fig (14) from 13 to 16 according to G.L.C. analysis. The effects recorded were treating the seedling of chamomile plants and with *Azotobacter + Azospirillum* led to increase each of chamazulene, alfa bisabolol and bisabolol oxide in volatile oil compared with control, the rate of increase in these compounds reached to 2.39, 24.60, and 2.37% over control respectively, while this treatment decreased each of bisbolene oxide, farnesol and farnesene compound in volatile oil compared in volatile oil, the rate of defilation to these compounds reached to 21.44, 7.99 and 5.05% under control plants.

Comparing the rate of increased in the main important compound (chamazulene) attained with mineral N to that obtained with bio N *(Azotobacter + Azospirillum)* it is clear that mineral N was of more effect in this concern over bio one.

b) *Bacillus* **effects:**

Each of bisbolene oxide, farnesol and bisabolol oxide compound were increased in volatile oil of chamomile flower heads with treating the seed and seedling with *Bacillus,* the rate of increase for these compounds over control plants reached to 2.75, 3.15 and 16.27% respectively. While each of chamazulene, alfa bisabolol and farnesen compounds were decreased in volatile oil compared with control by the rate of

decreased for these compounds reached to 60.46, 6.61 and 26.26%, respectively under the control treatment.

c) As for *Azotobacter* + *Azospirilum* + *Bacillus* effects:

The data in Table (13) and Fig. (16) showed that each of chamazulene and Alfa bisabolol compounds were increased in volatile oil by treating the seed or seedling of chamomile plants with each of *(Azotobacter +Azospirilliuin + Bacillus)* these compounds reached to 159.45 and 28.04%, respectively over control plants in this experiment. But the same treatment led to decrease each of Bisbolene oxide, Farnesol, Bisabolol oxide and Farnesene compounds in volatile oil compared with control. The rate of decreased reached to 8.76, 67.76, 27.52 and 100.0% respectively than the control treatment.

Fertilization treatments as mineral or bio-fertilizer not only affected the yield production of flower heads, but also oil percentages in this yield and consequently total oil yield. Moreover, these treatments affected also oil composition as it play a specific role in increasing one component and decreasing other as shown from the prementioned data.

As regard to chamazulene as the most important consistent in chamomile oil, since it is of the medicinal effect on fever and other medicinal uses of chamomile oil. So we can said that bio or mineral fertilization treatments increased also chamazulene percentage in oil especially as nitrogen fertilizer mineral or bio although the mineral nitrogen was superior bio one in this concern. Also phosphorus fertilizer increased

chamazulene content, but mineral phosphorus was of high superiorly over bio one.

Phosphorus fertilization treatment as mineral or bio also raised chamazulene content while mineral one was of more superiority in this concern.

Both combined treatment (N+P) mineral or bio resulted in highest values for chamazulene content in oil. The increasing values due to these treatments reached more than 100% over control, while bio treatment was superior mineral one in this concern.

4.4. Values of total N, P and K in the nursery soil as influenced by different inoculation treatments after 45 days of sowing.

Values of total N, P and K% of the control medium were 0.019, 96.8 and 0.152, respectively. The corresponding values upon application of *Azotobacter* + *Azospirillum* were 0.059, 72.6 and 0.144, respectively. When *Bacillus* bacteria were added these values became 0.039, 117.9 and 0.133, respectively (Table 14).

The combined application of *Azotobacter* + *Azospirillum* and *Bacillus* resulted in values of total N, total P and total K%, of about 0.049, 98.0 and 0.129, respectively.

The aforementioned results indicated pronounced increases in N due to application of *Azotobacter* + *Azospirillum* or the combined application of *Azotobacter* + *Azospirillum* and *Bacillus.* It application of *Azotobacter* +

Table (14): Values of total N, P, and K in the nursery soil as influenced by different inoculation treatments after 45 days of sowing to season (2003/2004).

Treatments	Total N%	Total P %	Total K%
Control	**0.019**	**96.8**	**0.152**
Azotobacter + **Azospirillum**	**0.059**	**72.6**	**0.144**
Bacillus polymixa	**0.039**	**117.9**	**0.133**
Azotobacter + *Azospirillutn* + *Bacillus*	**0.049**	**98.0**	**0.129**

Azospirillum was of superior effect in this concern over the combined application. of *Azotobacter* + *Azospirillum* and *Bacillus*. Likewise, application of *Bacillus* bacteria seemed to be more pronounced effect on soil content of total phosphorus than the combined application of *Azotobacter* + *Azospirillum* and *Bacillus* however, both attained values were higher than those of the control treatment.

4.5. Mineral content of chamomile plant during 2003/2004 season:-

4.5.1. Nitrogen percentage:

Results presented in Table (15) show that, fertilizing chamomile plants with ammonium sulphate at rate of 300kg/fed. highly increased nitrogen percentage in herb of chamomile plants compared with control treatment, the rate of increase over control plants reached to 27.71%.

Treating plants with calcium superphosphate at rate of 150.00kg/ fed. increased nitrogen percentage in herb of chamomile plants. The increase in N content resulted from adding phosphorus reached 12.05% over control.

Supplying chamomile plants with ammonium sulphate + calcium super phosphate at rate of (150.00 + 75.00kg / fed) resulted in higher increase in nitrogen percentage in plant herb compared with control plants, the increase in nitrogen percentage over control plants reached 25.90%. It is clear that all mineral fertilization treatments clearly affected mineral content of chamomile plant as shown in Table (15)

Table (15): Effect of different fertilization treatments on total N, P, and K in herb of Chamomile

Treatments	N%	P %	K%
Control	1.66	0.29	1.27
Ammonium sulphate 300 kg/fed.	2.12	0.35	1.45
Calcium superphosphate 150 kg/fed.	1.86	0.39	1.35
Azotobacter + Azospirillum	2.09	0.38	1.64
Bacillus polynuxa	1.96	0.35	1.58
Ammonium sulphate + calcium superphosphate 150 + 75 kg/fed	1.79	0.37	1.34
Azotobacter + Azospirilhn+ Bacillus	2.07	0.31	1.47

Treating seeds and seedlings of chamomile plants with *Azotobacter* + *Azospirillum* improved nitrogen percentage in plant herb, this treatment increased nitrogen percentage over control although the increase was less than that obtained with mineral N. The increase in this treatment reached 18.07% over control.

The seeds and seedlings of chamomile plants which treated by *Bacillus* alone increased nitrogen percentage of chamomile herb compared with control, the rate of increase reached 7.83%.

Using combined of *Azotobacter* + *Azospirillum* + *Bacillus* for treating the seeds and seedlings of chamomile plants highly increased nitrogen percentage in the plant herb compared with control plants or other treatments and the increase nitrogen percentage was 24.70% over control plants.

Generally, it could be concluded that, all fertilization treatments (chemical and Bio-fertilizers) increased nitrogen percentage in plant herb compared with control treatment, and the best result for this character was obtained by fertilizing chamomile plants with ammonium sulphate at rate of 300 kg/fed. followed by the combined treatments of both mineral or biofertilizers.

4.5.2. Phosphorus percentage:

The phosphorus percentages in chamomile herb as affected by the different treatments of mineral or bio-fertilization presented in Table (15). Supplying chamomile

plants with ammonium sulphate at rate of 300 kg/fed. increased phosphorus percentage in the plant herb compared with control plants, this treatment gave 20.69% over control plants.

Using calcium super phosphate at rate of 150.0 kg/fed. in fertilizing chamomile plants increased phosphorus percentage in plant herb by 34.43% over control plants.

The combined treatment as ammonium sulphate at 150 kg/fed. + Calcium superphosphate at 75 kg/fed. raised phosphorus percent in plant herb by 31.03% over control.

Phosphorus percent in plant herb affected clearly with mineral phosphorus addition, so the highest phosphorus content was attained with the treatment of super phosphate at 150 kg/fed. followed by the combined treatment of ammonium sulphate + calcium super phosphate then ammonium sulphate alone.

Treating seeds and seedlings of chamomile plant with *Azotobacter + Azospirillum* improved phosphorus percentage in plant herb compared with control plants, this treatment increased phosphorus percentage in plant herb over by 20.69%.

Bacillus as bio P fertilizer resulted an increase in phosphorous content in plant herb reached 27.59% over control. The increase in P content in plant due to mineral phosphorus was higher more than 50% over that attained with bio P *(Bacillus).*

The combined treatment of biofertilizers as *Azotobacter + Azospirillum + Bacillus* increased phosphorus percentage in plant herb by 6.90% over control. This value of increase was less than it was attained with each kind of bacteria when used alone this may be due to the companion of these bacteria for nutrition and propagate which waked their effect than when used each alone.

The highest effect of bio fertilization treatment was attained with the treatment of *Bacillus* followed by *Azotobacter + Azospirillum.*

In this respect it can be said that all fertilization treatments increased phosphorous percentage in the plant herb compared with control plants and the best value was attained by fertilizing chamomile plants with calcium superphosphate at rate of 150.0kg/fed..

4.5.3. Potassium percentage:-

It is clear from the data presented in Table (16) that, fertilizing chamomile plant with mineral nitrogen as ammonium sulphate at rate of 300 kg/fed. or calcium superphosphate at rate 150 kg/fed. increased potassium content in plant herb. The increase in K content due to these treatments reached to 14.17% for the first season and 29.13% over control for the second.

Using calcium superphosphate at rate of 150.0 kg/fed. in fertilizing chamomile plants improved potassium percentage

in plant herb compared with control treatment, the rate of increase reached to 6.30%.

The combined treatment with ammonium sulphate + calcium super phosphate was superior effect in increasing potassium content in plant herb over both ammonium sulphate or calcium superphosphate each alone over control plant.

Nitrogen biofertilizer as *Azotobacter* + *Azospirillum* increased potassium percentage in plant herb compared with control, the rate of increase reached to 24.41%.

Also treating the seeds and seedlings of chamomile plants with separate *Bacillus* or *Bacillus* + *Azotobacter* + *Azospirillum* treatments increased potassium percentage in plant herb compared with control plants, the rate of increased for the previous treatments reached to 5.51 and 15.75%respectively over control.

Generally, can be showing that all mineral or Bio-fertilization treatments increased potassium percentage in the plant herb compared with control plants and the best value for this character was obtained by fertilizing chamomile plants with Ammonium sulphate + Calcium superphosphate at rate of (150.0+ 75.0kg / fed.)These results were in agreement with Abd El-Salam (1994) pointed that treating anise with nitrogen + phosphorus caused an increase in nitrogen, phosphorus and potassium content in the plant herb.

Also **Kandeel *et al.* (2001)** on *Foeniculum vulgare,* reported that inoculation with *Azotobacter* + *Azospirillum* in the presence of full dose of nitrogen, phosphorus and

potassium increased nitrogen, phosphorus and potassium content in the plant herb.