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EFFECT OF CHEMICAL AND BIO-NITROGEN FERTILIZERS ON CHAMOMILE PLANTS (*Matricaria chamomilla,* L.)

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ABSTRACT

This experiment was carried out at Barramoon Experimental Farm in 1999/2000 and 2000/2001 to study the effect of different levels of chemical and bio-nitrogen fertilizers on growth and yield of chamomile plants. Chemical nitrogen fertilizer ammonium sulphate (20.6% N) was added at three levels 0, 200 and 400 kg/fed. Three levels of bio-nitrogen fertilize, i.e. 1, 2 and 4 kg/fed biogein were inoculated in seedling / hold before transplanting the seedling. In addition, combinations between ammonium sulphate and biogein were examined. Chemical nitrogen fertilizer caused significant increases in plant growth, yield of flower-heads and oil content. The highest values were recorded at 400 kg/fed ammonium sulphate. Bio-nitrogen fertilizer produced enhancement in growth characters and yield particularly at the highest rate (4 kg/fed biogein). The best results were recorded with combination between ammonium sulphate at 200 kg/fed and biogein at (2 & 4) kg/fed. It could be concluded that bio-nitrogen fertilizer (biogein) combined with chemical nitrogen fertilizer (ammonium sulphate) caused a reduction in the values of total nitrogen percentage in leaves and flowers of chamomile plants. On the other hand, the highest production of flowers and oil percentage were observed with prementioned treatment.

INTRODUCTION

Chamomile (*Matricaria chamomilla,* L. Fam. Compositae [Asteraceae]) is one of the most valuable medicinal plants, which have been used as adomestic remedy since very early times and have been cultivated four centuries in English gardens (Wallis, 1967).

Chamomiles have a strong, aromatic odour and a bitter taste. The flower-heads contain not less than 0.4 % a blue volatile oil; this consists mainly of the sesquiterpenes α-bisabolol oxide A, α-bisabolol oxide B, α-bisabolone oxide A, chamazulene, farnesene and matricin. Chamazulene itself does not occur in the plant but is formed from a sesquiterpene (matricin) during steam distillation (Evans, 1998).

Matricaria flowers are the mainly part of plant on the continent of Europe and in the USA for their anti-inflammatory and spasmolytic properties, also cutaneous and mucosal affections (skin ointment and cream). Chamomile extract is used topically in the early stages of skin inflammation and for the prevention and treatment of cracked nipples and nappy rash.

Nitrate ion is a well known environmental pollutant owing to its potential role in infant methemoglobinemia associated with the consumption of nitrate-rich waters or vegetables (Alexander, 1977). The formed nitrate presents a toxic hazard both because of the direct toxicity of nitrite and by the formation of carcinogenic N-nitro so compound by reaction with amino compounds.

Accordingly the biological cultivation, in general has a growing importance over the chemical pesticides and fertilizers from the stand-point of environmental safety, quality of products and sustainable agriculture - (Mohamed, 1998).

Therefore, the purpose of this study is to investigate the effect of two different sources of nitrogen fertilizer (chemical and bio) on chamomile productivity with decreasing the amount of nitrate and off environmental pollution.

MATERIALS AND METHODS

Two field experiments were carried out during the two successive seasons of 1999/2000 and 2000/2001 at Barramoon Experimental Farm (Dakahlyia Governorate) to study the response of chamomile growth and oil yield to chemical nitrogen fertilizer (ammonium sulphate 20.6 % N) and bio-fertilizer (Biogein[1]). The study was dealing with growth, flower-heads yield, nitrogen content and essential oil contents. The chemical and physical analysis of the soil farm could be summarized as follows (Table 1) the soils is clayey, poor in nitrogen, suitable P and K, non-saline or alkaline.

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

Seasons	Mechanical analysis %			Chemical analysis					
				Organic Matter %	PPM			PH 1:2.5	E.C mmhos/ cm
	Sand	Silt	Clay		N	P	K		
1999	11.8	33.2	55.0	1.33	21.9	12.2	325	7.8	4.2
2000	11.6	33.8	54.6	1.31	19.8	11.8	341	8.1	4.3

The experiment was designed in split plot system, with three replicates, each of which include (10) plants, where chemical nitrogen fertilizer (0, 200 and 400[2] kg/fed ammonium sulphate), occupied the main plots while sub plots were with three levels (1, 2 and 4 kg/fed) of bio-fertilizer (Biogein) and these treatments were randomly assigned.

The experimental unit dimensions were 3 x 2.5 m, the distance between plants were 30 cm on ridges apart 60 cm, all plots were supplied with calcium superphosphate and potassium sulphate at the rate of 100 kg/fed of both fertilizers during soil preparation.

Chamomile seeds were sown on nursery on September 15,in the two seasons and the seedlings were transplanted to the field experiment after 60 days from sowing (Biogein (1, 2 and 4 kg/fed) was mixed with moist sand for inoculation of seedling/hold before transplanting the seedlings immediately), and directly irrigated after covering the holes. While, nitrogen fertilizer was added in two equal doses at 30 and 60 days after transplanting.

[1] **Biogein : is a commercial bio-fertilizer compound containing active bacteria which is capable to nitrogen fixation.**

[2] **Fertilizer with recommended dose (400 kg/fed Ammonium sulphate)**

Data were recorded at the middle of flowering stage for plant height, number of branches, fresh and dry weights gm/plant and nitrogen percentage in tissues of leaves of vegetative growth. Fresh and dray weights of flower-heads per plants, flower-heads yield/plot and per feddan, nitrogen percentage of flower-heads and essential oil percentage during flowering season. Nitrogen percentage was estimated according to A.O.A.C. (1980). The percentage of essential oil of dry flower-heads were determined by steam water disstillation method according to the British Pharmacopoeia Method (1983). Determination of essential oil constituents was by gas liquid chromatography (G.L.C.).

Conditions of G.L.C.

Information	Conditions
Instrument	Pro-GC PYE Unicam
Column	Packet PEGA 10 %
Flow rate	Nitrogen 30/min; Hydrogen 33/min air 33 %
Column temp.	70 - 190 °C
Rate temp.	4 °C /min
Injection temp.	250 °C
Detector temp.	300 °C

Data were statistically analyzed according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Effect of chemical nitrogen fertilizer on growth characters:

Data in Table (2) showed that chemical nitrogen fertilizer (as ammonium sulphate, 20.6%) caused a significant increase in plant growth as a plant height, number of branches and fresh and dry weights. The highest values were recorded with 400 kg /fed, when compared with the other treatments during the two seasons. These increments in plant growth of chamomile plants could be attributed to nitrogen role, which has many functions in plant life being apart of protein, it is an important constituent of protoplasm and enzymes, it also occurs as nucleo-proteins, amino acids, aminose, polypeptides and many other organic compounds in plant system (Mengel and Kirkby, 1987). Similar results were obtained by Rahman *et al.* (1990); Mohamed (1998) and Abdel-Mouty (2000).

Table (2): Effect of ammonium sulphate levels on vegetative growth of chamomile plants during 1999/2000 and 2000/2001 seasons.

Characters	Plant height (cm)		No. of branches/ plant		Fresh weight (g/plant)		Dry weight (g/plant)	
Ammonium sulphate (kg/fed)	1999/2000	2000/2001	1999/2000	2000/2001	1999/2000	2000/2001	1999/2000	2000/2001
0	50.00	53.33	10.66	11.00	638.41	650.60	204.20	209.60
200	64.66	62.00	14.00	15.66	763.64	778.81	228.19	232.18
400	70.00	69.33	13.33	13.66	809.23	794.50	234.28	229.91
L.S.D. at 5%	1.89	2.15	0.21	0.82	14.11	12.69	7.22	8.51

Effect of bio-nitrogen fertilizer on growth characters:

Data presented in Table (3) indicated that bio-nitrogen (Biogein) levels gave a significant effect on plant growth of chamomile plants. Moreover, increasing the rate of Biogein caused more enhancement in growth characters of plants.

Table (3): Effect of bio-nitrogen fertilizer on growth of chamomile plants during 1999/2000 and 2000/2001 seasons.

Characters / Biogein (kg/fed)	Plant height (cm)		No. of branches/ plant		Fresh weight (g/plant)		Dry weight (g/plant)	
	1999/2000	2000/2001	1999/2000	2000/2001	1999/2000	2000/2001	1999/2000	2000/2001
0	51.33	52.00	11.66	10.00	629.51	636.90	201.87	209.08
1	53.66	55.00	13.00	14.00	756.09	748.10	221.40	218.97
2	62.00	60.66	15.33	14.33	771.16	768.32	227.56	223.51
4	63.33	64.00	15.00	15.66	786.31	790.16	234.28	231.46
L.S.D. at 5%	0.74	2.13	1.18	0.89	16.87	9.08	11.16	7.12

The results revealed that the maximum values of plant height, number of branches per plant and fresh and dry weights of vegetative growth were recorded at 4 kg/fed during two seasons, when compared with untreated plants. The important role of bio-fertilizers is reducing soil pH and increasing N-P soil contents by secreting organic acids such as acetic, propionic, fumaric and succinic, such acids lowered the pH and bring about the dissolution of bands forms of phosphate and render them available for growing plants (Singh *et al.,* 1992). Similar results were mentioned by Senaratne and Ratnsinghe (1995) and Abdel-Mouty (2000).

Effect of interaction between chemical and bio-nitrogen fertilizers:

Combination treatments, Table (4) revealed that Adding nitrogen as chemical fertilizer at rate of 200 kg /fed (Ammonium sulphate 20.6%) with nitrogen as bio-fertilizer (Biogein treatments) recorded superior values when compared with all treatments. Also it was noticed that increasing the rate of Biogein addition with 200 kg /fed (Ammonium sulphate) caused more enhancement in the crtiteria of plant growth. The highest values of plant height, number of branches and fresh and dry weights were obtained from the combination between 200 kg/fed (Ammonium sulphate) and 4 kg/fed (Biogein). These results may be due to the nitrogen supplementary effect of nitrogen fixing bacteria and the role of the bacteria in reducing soil pH and increasing N-P soil contents. Similar results were mentioned by Senaraten and Ratnsinghe (1995); Abdel-Mouty (2000) and Shalan *et al*. (2001).

Fresh and dry weights of flower yield per plant, plot and fed.

The concerned results in Table (5) showed that fresh and dry weights per plant, plot and feddan increased significantly with chemical nitrogen fertilizer (Ammonium sulphate) in all harvest when compared with untreated plants in both seasons. The most increase was occurred with the addition of 400 kg/fed ammonium sulphate during two seasons.

Table (4): Effect of the interaction between chemical and bio-nitrogen fertilizers on growth of chamomile plants during 1999/2000 and 2000/2001 seasons.

Characters		Plant height (cm)		No. of branches/ plant		Fresh weight (g/plant)		Dry weight (g/plant)	
Treatments		1999/2000	2000/2001	1999/2000	2000/2001	1999/2000	2000/2001	1999/2000	2000/2001
Ammonium sulphate 0 kg/fed	1	52.66	50.66	11.00	10.33	646.00	631.66	201.12	203.00
	2	59.00	50.66	12.00	13.00	651.42	690.00	211.07	213.12
	4	62.33	65.33	14.00	14.33	692.00	712.00	217.23	215.27
Ammonium sulphate 200 kg/fed	1	67.00	65.00	15.66	16.00	820.00	846.21	231.00	240.89
	2	68.30	69.60	15.00	15.33	841.25	859.97	240.79	249.11
	4	70.00	74.00	15.33	14.66	869.41	872.35	251.14	252.88
Ammonium sulphate 400 kg/fed	1	72.00	73.80	13.00	12.66	817.26	807.94	228.76	226.96
	2	74.33	75.00	12.33	12.33	809.00	812.21	226.57	235.48
	4	76.33	78.00	12.00	12.66	792.37	780.27	230.68	234.00
L.S.D. at 5%		2.17	3.15	0.27	1.14	29.10	23.08	16.09	19.12

Table (5): Effect of chemical nitrogen fertilizer on fresh and dry weights of chamomile flower-heads during 1999/2000 and 2000/2001 seasons.

Characters	Harvest g/plant						g/ plant	Kg/ plot	Kg/ fed
Treat.	1	2	3	4	5	6			
Ammonium sulphate (kg/fed)	Fresh weight (1999/2000)								
0	20.72	26.15	38.05	47.54	28.30	10.85	171.6	5.19	3397.8
200	12.04	38.92	58.09	59.25	36.14	22.34	226.8	6.80	4490.2
400	---	29.69	76.50	73.04	52.63	12.33	244.8	7.35	4452.8
L.S.D. at 5%	---	0.94	2.12	1.81	0.53	0.62	15.6	0.67	---
	Fresh weight (2000/2001)								
0	15.39	20.71	42.21	35.55	29.58	9.12	153.6	4.61	3040.4
200	9.15	36.46	55.15	65.05	30.60	11.31	207.7	6.23	4112.8
400	---	32.89	54.59	75.40	47.85	16.73	227.5	6.82	4503.7
L.S.D. at 5%	---	0.60	1.17	4.37	1.40	0.80	11.3	0.32	---
	Dry weight (1999/2000)								
0	3.08	4.52	7.01	8.93	5.06	1.97	33.65	1.01	666.27
200	2.19	7.10	10.41	11.05	6.13	5.91	42.79	1.28	847.24
400	---	5.67	14.02	13.93	10.32	2.18	46.12	1.38	913.17
L.S.D. at 5%	---	0.80	0.34	1.63	0.80	0.12	1.59	0.31	---
	Dry weight (2000/2001)								
0	2.96	4.56	8.31	6.97	5.80	2.74	31.34	0.94	620.53
200	1.76	7.15	11.03	13.01	6.12	1.66	40.73	1.22	806.45
400	---	6.45	10.90	15.08	9.37	2.80	44.60	1.34	883.08
L.S.D. at 5%	---	0.68	1.07	1.92	0.70	0.19	2.15	0.78	---

Regarding the effect of bio-nitrogen fertilizer (Table 6), it was found that Biogein level caused increases in fresh and dry weights of flower yield per plant, plot and feddan in all pickings during the two seasons, the increment in the yield of flower-heads tended to be associated with the increment in Biogein doses. The best results were obtained with 4 kg/fed (Biogein).

Table (6): Effect of bio-nitrogen fertilizer on fresh and dry weights of chamomile flower-heads during 1999/2000 and 2000/2001 seasons.

Characters / Biogein (kg/fed)	Harvest g/plant						g/ plant	Kg/ plot	Kg/ fed
	1	2	3	4	5	6			
	Fresh weight (1999/2000)								
Control	18.56	27.36	38.19	39.72	30.95	12.16	166.9	5.01	3305.4
1	20.58	30.65	35.88	41.64	31.92	16.23	176.9	5.31	3502.6
2	26.98	31.31	41.76	41.05	34.43	21.38	196.9	5.91	3898.8
4	24.53	36.87	41.76	46.72	35.65	13.33	198.9	5.97	3937.4
L.S.D. at 5%	1.13	0.58	0.78	0.36	1.08	1.30	3.9	0.25	---
	Fresh weight (2000/2001)								
Control	17.10	28.17	43.25	39.71	26.80	10.64	165.7	4.97	3280.3
1	24.99	29.07	46.80	41.10	27.05	15.10	184.1	5.52	3645.3
2	19.06	32.20	47.55	47.25	32.50	14.61	193.0	5.79	3821.7
4	20.14	35.54	47.58	50.64	30.05	15.91	199.9	6.00	3957.2
L.S.D. at 5%	0.89	1.32	2.14	0.63	1.20	0.57	7.52	0.17	---
	Dry weight (1999/2000)								
Control	3.71	5.40	7.64	7.94	6.19	2.43	33.31	0.99	659.54
1	4.15	6.13	6.90	8.33	6.38	3.25	35.38	1.06	700.52
2	5.19	6.14	8.19	8.21	6.89	4.29	38.61	1.16	764.48
4	4.81	7.23	9.52	9.16	7.13	2.67	38.84	1.17	769.03
L.S.D. at 5%	0.41	0.30	0.12	0.23	0.17	0.25	1.16	0.05	---
	Dry weight (2000/2001)								
Control	3.44	5.63	8.65	7.14	5.36	2.13	34.15	1.02	676.17
1	4.90	5.70	9.36	8.02	5.41	2.71	36.10	1.08	714.78
2	3.81	6.24	9.51	9.25	6.30	2.67	37.12	1.11	734.97
4	4.03	6.97	9.52	9.93	6.01	3.02	39.19	1.18	775.96
L.S.D. at 5%	0.27	0.08	0.16	0.27	0.04	0.17	0.24	0.02	---

As shown in Tables (7 and 8) it could be indicated that the combination between ammonium suplate and bio-fertilizer (Biogein) caused significant increases in the yield of fresh and dry weights of flower-heads. These increments were found to be more than those obtained in cases of chemical nitrogen fertilizer and bio-nitrogen fertilizer alone. But, it was also important to notice that applying ammonium sulphate at 400 kg/fed plus bio-fertilizer (Biogein) gave a relatively less yield of flower-heads, while the lowest rate of ammonium sulphate (200 kg/fed) plus bio-fertilizer (all Biogein levels) caused favorable results. The highest values were obtained with combination between ammonium sulphate at 200 kg/fed and Biogein at 2&4 kg/fed. These results are in agreement with Sattar *et al.* (1996); Mohamed (1998) and Shalan *et al*. (2000).

Table (7): Effect of the interaction between chemical and bio-nitrogen fertilizers on fresh weight of chamomile flower-heads yield during 1999/2000 and 2000/2001 seasons.

Characters / Treat.		Harvest g/plant						g/ plant	Kg/ plot	Kg/ fed
		1	2	3	4	5	6			
Biogein (kg/fed)		1999/2000								
Ammonium sulphate 0 kg/fed	1	19.29	24.87	39.67	40.91	27.69	17.20	169.63	5.09	3358.7
	2	27.24	30.00	42.65	40.15	32.31	20.27	192.62	5.78	3813.9
	4	25.32	34.70	40.78	48.21	34.56	12.22	195.79	5.87	3876.6
Ammonium sulphate 200 kg/fed	1	16.67	32.61	60.65	56.30	46.87	26.60	239.70	7.19	4746.0
	2	15.71	36.46	46.82	55.59	55.20	35.73	245.51	7.37	4861.0
	4	21.84	44.62	60.84	55.10	47.32	21.76	251.48	7.54	4986.4
Ammonium sulphate 400 kg/fed	1	6.19	28.08	55.18	68.49	35.50	30.11	223.55	6.71	4426.2
	2	5.09	31.66	64.77	58.75	32.08	31.13	223.48	6.70	4424.9
	4	---	25.48	51.22	51.76	40.95	41.02	210.43	6.31	4166.5
L.S.D. at 5%		---	1.40	3.27	2.14	6.18	1.20	5.17	0.32	---
		2000/2001								
Ammonium sulphate 0 kg/fed	1	21.16	28.72	35.14	39.13	28.12	10.90	163.17	4.90	3230.8
	2	20.60	31.70	45.27	49.37	34.50	12.16	193.60	5.81	3833.3
	4	23.45	33.46	47.85	45.29	32.19	27.43	209.67	6.29	4151.5
Ammonium sulphate 200 kg/fed	1	15.35	27.23	46.56	62.52	54.35	26.55	232.56	6.98	4604.6
	2	25.01	34.25	53.70	66.20	43.80	26.53	249.49	7.48	4939.9
	4	20.75	40.64	59.25	53.20	49.00	26.76	249.60	7.49	4942.0
Ammonium sulphate 400 kg/fed	1	12.38	34.63	45.05	64.75	56.50	22.36	235.67	7.07	4666.2
	2	---	28.86	41.45	55.15	60.55	29.01	215.02	6.45	4257.3
	4	---	32.25	45.08	57.65	54.55	15.03	204.56	6.14	4050.2
L.S.D. at 5%		---	6.74	2.78	8.22	1.63	2.61	12.94	0.46	---

Table (8): Effect of the interaction between chemical and bio-nitrogen fertilizers on dry weight of chamomile flower-heads yield during 1999/2000 and 2000/2001 seasons.

Characters / Treat.		Harvest g/plant 1	2	3	4	5	6	g plant	Kg/ plot	Kg /fed
Biogein (kg/fed)		1999/2000								
Ammonium sulphate 0 kg/fed	1	3.80	4.97	7.93	8.18	5.62	3.44	33.94	1.02	672.01
	2	5.18	5.70	8.10	7.63	6.14	3.85	36.60	1.10	727.68
	4	4.84	6.63	7.79	9.21	6.60	2.39	37.46	1.12	741.71
Ammonium sulphate 200 kg/fed	1	3.26	6.28	12.13	11.26	9.19	5.82	47.94	1.44	949.21
	2	3.08	7.15	9.18	10.90	11.04	6.79	48.14	1.44	953.17
	4	4.20	8.75	11.93	11.02	9.28	3.95	49.31	1.48	976.34
Ammonium sulphate 400 kg/fed	1	1.19	5.40	10.82	13.43	7.10	6.77	44.71	1.34	885.26
	2	0.98	6.09	12.70	11.52	6.29	6.24	43.82	1.32	867.64
	4	---	4.90	9.85	10.15	8.03	8.33	41.26	1.24	816.95
L.S.D. at 5%		---	0.14	0.79	0.22	0.57	0.13	0.97	0.02	---
		2000/2001								
Ammonium sulphate 0 kg/fed	1	4.23	5.74	7.02	7.83	5.64	2.18	32.62	0.98	645.88
	2	3.91	6.02	8.60	9.38	6.55	2.31	36.77	1.10	728.05
	4	4.48	6.39	9.14	8.65	6.15	5.37	40.18	1.21	795.56
Ammonium sulphate 200 kg/fed	1	3.01	5.34	9.13	12.26	10.87	4.99	45.60	1.37	902.88
	2	4.81	6.52	10.74	13.04	8.56	5.25	48.92	1.47	968.62
	4	4.07	7.97	11.85	10.64	9.80	3.67	48.00	1.44	950.40
Ammonium sulphate 400 kg/fed	1	2.19	6.78	8.81	12.95	10.90	4.57	46.21	1.39	914.16
	2	---	5.66	7.89	10.43	11.98	5.39	41.35	1.24	818.73
	4	---	6.32	8.42	11.53	10.91	2.93	40.11	1.20	794.18
L.S.D. at 5%		---	0.08	0.84	0.75	0.26	0.48	2.07	0.05	---

Chemical analysis:

- Total nitrogen content in chamomile leaves and flower-heads:

Data in Table (9) showed that total nitrogen percentage increased in leaves and flower-heads by adding chemical nitrogen fertilizer (Ammonium sulphate) at 200 and 400 kg /fed while it recorded lower values by bio-nitrogen fertilizer (Biogein) at 1, 2 and 4 kg/fed. In addition it was found that the combination between ammonium sulphate and Biogein induced reduction in the values of total N percentage at all rates, although that was associated with the best growth and production, Hammad and Abdel-Ati (1998) reported that N chemical fertilizer combined with bio-fertilizer induced reduction in the nitrate and nitrite contents and improved the yield quality.

In general, it could be concluded that bio-nitrogen fertilizer (Biogein) plus a low doses of chemical nitrogen fertilizer (Ammonium sulphate 200 kg/fed) gave remarkable effects with regard to plant growth and yield of flower-heads. The obtained results are in harmony with those reported by Walker (1975) who found a close correlation between application of N-fertilizer and accumulation of nitrate; Moheshwari, *et al*. (1995); Wange (1996) and Harridy *et al.* (1998).

Table (9): Effect of chemical, bio-nitrogen fertilizers and their interaction on nitrogen percentage in dry leaves and flower-heads of chamomile plants during 1999/2000 and 2000/2001 seasons.

Characters / Treatments		Total nitrogen content %			
		Leaves	Flower-heads	Leaves	Flower-heads
		1999/2000		2000/2001	
Ammonium sulphate	0	2.92	2.53	2.89	2.59
	200	4.45	2.89	4.24	2.83
	400	4.63	3.20	4.76	3.11
Biogein	1	2.97	2.46	3.11	2.56
	2	3.01	2.57	3.23	2.58
	4	3.15	2.56	3.41	2.63
Ammonium sulphate 200 kg/fed + Biogein	1	3.25	2.63	3.43	2.69
	2	3.62	2.71	3.52	2.77
	4	3.75	2.89	3.58	2.81
Ammonium sulphate 400 kg/fed + Biogein	1	3.76	2.95	3.68	2.90
	2	3.85	2.96	3.79	2.83
	4	3.67	2.98	3.82	2.94

- Volatile oil content:

Table (10) presents the percentage of the essential oil in flower-heads and oil yield per plant during both seasons. Application of ammonium sulphate at 200 and 400 kg/fed showed an increase in the essential oil content of the flower-heads and yield per plant. Also Biogein at 1, 2 and 4 kg/fed induced promotion in the essential oil content and yield per plant. It was worth mentioning that the higher values for essential oil content and yield per plant were recorded with the combination between ammonium sulphate and Biogein at all levels, particularly with the low rate of ammonium sulphate (200 kg /fed) and Biogein (2 and 4 kg/fed) while, the percentages started to decrease when 400 kg/fed of ammonium sulphate combined with Biogein at all levels.

In general, it was clear that ammonium sulphate (at 200 kg/fed) and biogein (at 2 kg/fed) combination promoted oil accumulation, since, maximum values of flower-heads oil percentage and oil yield ml/plant, during two seasons were noticed. Similar results were obtained by Franz (1980); Felklova *et al.* (1981); Kandeel (1982) and Mohamed (1998).

Table (10): Effect of chemical, bio-nitrogen fertilizers and their interaction on the essential oil percentage and yield on dry

flower-heads of chamomile plants during 1999/2000 and 2000/2001 seasons.

Treatments	Characters	Percentage of essential oil of flower-heads			
		Oil %	Oil yield ml/plant	Oil %	Oil yield ml/plant
		1999/2000		2000/2001	
Ammonium sulphate	0	0.62	0.219	0.64	0.201
	200	0.81	0.347	0.80	0.326
	400	0.84	0.387	0.82	0.366
Biogein	1	0.76	0.269	0.73	0.264
	2	0.78	0.301	0.77	0.286
	4	0.80	0.311	0.79	0.310
Ammonium sulphate 200 kg/fed + Biogein	1	0.81	0.388	0.79	0.360
	2	0.88	0.424	0.89	0.345
	4	0.86	0.424	0.88	0.422
Ammonium sulphate 400 kg/fed + Biogein	1	0.81	0.362	0.78	0.360
	2	0.79	0.342	0.78	0.323
	4	0.74	0.305	0.76	0.305

Chemical composition of chamomile essential oil:

Data in Table (11) and Figs (1 and 2) cleared the chemical composition of chamomile oil by G.L.C. were seventeen components. Seven of them were main components such as (Chamazulene, Bisabolol, Beta bisabolene, Bisabolol oxide, Farnesene, Trans Beta Franesene and Camphene).

The data in Table (11) and Figs (1 and 2) showed increases in the content of the main component (Chamazulen) of chamomile oil from all treated plants compared with untreated (control). Plants treated with bio-nitrogen fertilizer (Biogein at 1 and 2 kg/fed) gave the highest values of the main components (Chamazulene and Farnesene). Also, chemical nitrogen fertilizer (ammonium sulphate at 200 and 400 kg/fed) led to the increases of main components. On the other hand, plants treated with ammonium sulphate and Biogein gave a low value of Bisabolol.

Regarding the plants treated with a combination of ammonium sulphate and Biogein tended to preseveration results. The best values were found in plants treated with ammonium sulphate at 200 kg/fed; Biogein at (1 and 2) kg/fed and combination between ammonium sulphate at 400 kg/fed with Biogein at 1 kg/fed especially for the values of Chamazulene and Farnesene.

شكل ١

شكل ٢

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دراسة تأثير مستويات التسميد النيتروجينى الكيماوى والحيوى على نبات البابونج الألمانى

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أجريت هذه التجربة بالمزرعة البحثية التابعة لمعهد بحوث البساتين بالبرامون محافظة الدقهلية بهدف استخدام أقل كمية من التسميد النيتروجينى (الكيماوى) والاستعاضة بالتسميد الحيوى وتحديد أنسب استخدام للتسميد النيتروجينى الكيماوى والحيوى للحصول على أعلى انتاج كما ونوعا بأقل التكاليف.

وقد استخدم فى هذا البحث ثلاثة معدلات من سماد سلفات النشادر (٢٠,٦% ن) هى صفر ، ٢٠٠ ، ٤٠٠ كجم / فدان وأيضا ثلاثة معدلات من التسميد الحيوى (البيوجين) ١ ، ٢ ، ٤ كجم / فدان وكانت أهم النتائج كالآتى:

١ـ أعطى استخدام سماد سلفات النشادر زيادة معنوية كبيرة فى صفات النمو من حيث الطول وعدد الأفرع الجانبية والوزن الطازج والجاف وكذلك الوزن الطازج والجاف للمحصول الزهرى وزيادة فى نسبة الزيت الطيار فى الأزهار مع زيادة المحتوى النيتروجينى فى الأوراق والأزهار.

٢ـ أدى التسميد الحيوى (البيوجين) إلى زيادة معنوية فى النمو الخضرى والمحصول الزهرى ونسبة الزيت فى الأزهار وانخفاض المحتوى النيتروجينى فى الأوراق والأزهار.

٣ـ لوحظ ارتفاع معدلات النمو الخضرى والمحصول الزهرى ونسبة الزيت الطيار فى الأزهار عند استخدام سلفات النشادر مع البيوجين إذا ما قورن باستخدام كلا منهما منفردا وكانت أفضل النتائج عند استخدام سلفات النشادر بمعدل ٢٠٠ كجم / فدان مع ٢ كجم / فدان بيوجين.

٤ـ زيادة نسبة المكونات الرئيسية للزيت وبخاصة الكامازولين والفرنسين عند استخدام سلفات النشادر والبيوجين منفردين وانخفضت نسبة البيسابولول وكانت أفضل النتائج عند استخدام سلفات النشادر بمعدل ٢٠٠ كجم / فدان وكذا البيوجين بمعدل ١، ٢ كجم / فدان، أما عند استخدام سلفات النشادر مشتركا مع البيوجين كانت أفضل النسب للكامازولين والفرنسين عند استخدام سلفات النشادر بمعدل ٤٠٠ كجم/فدان والبيوجين بمعدل ١كجم/فدان.

٥ـ بصفة عامة فإن استخدام السماد الحيوى منفردا أو مشتركا مع السماد الكيماوى يؤدى إلى خفض المحتوى النيتروجينى فى الأزهار والأوراق ويقلل من معدل استخدام الأسمدة الكيماوية والتلوث البيئى.

Table (11): Determination of essential oil components in flowerheads of *Matricaria chamomilla*, L. using GLC analysis.

Peak No.	R.T (min.)	Name of the main components in the essential oil	Ammonium sulphate (kg/fed)			Biogein (kg/fed)			Ammonium sulphate (200 kg/fed)			Ammonium sulphate (400 kg/fed)		
			0	200	400	1	2	4	Biogein 1	Biogein 2	Biogein 4	Biogein 1	Biogein 2	Biogein 4
1	1.900	Alpha pinene	0.362	---	---	---	---	---	---	---	0.394	---	---	---
2	4.483	Cineol	0.575	---	---	---	---	---	---	---	0.919	---	---	---
3	5.450	Undicanol	0.960	---	---	---	---	---	---	---	1.699	---	---	---
4	6.617	Thyjene	1.429	---	---	---	---	---	---	---	2.715	---	---	23.601
5	14.63	Unknown	3.851	4.776	4.699	5.226	0.506	5.943	6.387	2.364	4.527	6.079	6.562	1.771
6	15.27	Unknown	0.887	2.105	2.753	7.832	5.014	2.446	1.978	1.232	1.384	2.456	2.607	1.041
7	15.62	Unknown	2.189	4.435	1.326	---	2.292	5.445	4.645	3.617	3.406	6.890	6.099	3.067
8	17.20	Unknown	0.824	---	1.326	1.209	4.814	---	1.155	1.703	0.768	1.070	0.987	1.515
9	17.82	Camphene	4.285	2.968	7.600	3.443	2.027	4.445	4.043	1.030	2.635	3.469	3.424	0.890
10	18.90	Bisabolol	24.220	22.660	18.944	15.114	19.622	24.105	18.973	23.373	20.145	11.887	18.186	16.426
11	19.63	Farnesene	13.511	21.243	15.248	19.679	16.317	16.800	15.121	17.790	16.757	20.749	16.477	11.372
12	20.70	Trans Beta Farnesene	15.844	14.722	15.440	14.514	13.348	15.020	13.902	18.537	16.689	15.641	12.784	13.498
13	21.10	Chamazulene	17.382	21.261	18.861	23.571	20.979	18.392	16.607	19.378	19.235	22.125	18.768	18.102
14	22.48	Beta bisabolene	0.469	0.283	1.116	0.328	0.233	---	0.013	0.341	0.479	0.261	0.219	0.239
15	25.27	Bisabolol oxide	10.599	3.724	11.671	4.742	9.628	4.944	13.346	7.005	6.797	5.994	11.111	5.790
16	26.70	Delta-cadinene	0.730	0.097	1.176	0.119	---	4.944	1.042	0.845	0.065	---	---	---
17	27.58	Unknown	0.571	---	---	---	---	---	---	---	0.068	---	0.282	---