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INFLUENCE OF BIOFERTILIZER AND NPK RATES ON *Tagetes minuta,* L.

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ABSTRACT

A field experiment was conducted during 2000 and 2001, at Barramoon Experimental Farm Dakahlia Governorate to study the effect of mineral and biofertilizer on growth, yield of leaves and essential oil content. A recommended NPK fertilizer was applied at three rates of 0, 50 and 100 % (41 kg N + 23 kg P_2O_5 + 24 kg K_2O). Three levels of integrated biofertilizer (1:1 Nitrobein and phosphorein) i.e. 0, 4 and 8 kg/fed were inoculated in seedling hold before transplanting the seedling. Also, combinations between mineral and biofertilizers were examined. The results showed that the application of NPK fertilizer at 100 % rate gave high values in plant growth, yield of leaves and oil content. In addition biofertilizer at 8 kg/fed increased plant growth, fresh and dry weights of leaves and oil percentage. The highest results were recorded with combination between NPK fertilizer and biofertilizer at all rates. It was important to note that superiority values were obtained with NPK (50 %) and biofertilizer at 8 kg/fed. From the analysis it was noticed that mineral application and biofertilizers individually induced reduction in the percentage of dihydrotageton and B-Ocimene while limonene and tageton percentages were increased. On the other hand, combination between NPK fertilizer and biofertilizer caused increases in the percentage of dihydrotagetone, since the highest percentage was 86.352 % with NPK fertilizer (50 %) combined with integrate biofertilizer 4 kg/fed.

INTRODUCTION

Tagetes minuta, L. Family. Asteraceae (Compositae) is an annual plant, about 1.5-2 m height according to Tackholm (1974), it is grown in the open field and as a back ground for the summer annual flowers and as an aromatic plant in Egypt. The main values of *Tagetes minuta,* L. is the herb and volatile oil which is used in soups, perfumary, cosmetic and pharmaceutical industries. It is very valuable enter crop for controlling plant parasitic nematoda as recorded by Basu and Roy (1975).

The main volatile oil of *Tagetes minuta* contains limonene (10.0 %), β-ocimene (17.34 %), dihydrotagetone (30.62 %), cis-tagetone (22.73 %) and cis-tagetenone (0.3-31 %) Ibrahim *et al.* (1996).

The important role of biofertilizers is in 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 as prementioned by many workers such as Ibrahim and Abdel-Aziz (1977), Singh *et al.* (1992) and El-Masry (1995).

Biofertilization with the different strains of bacteria induced significant increases in plant growth expressed as fresh and dry weight of different organs as well as number of leaves and branches (Radwan, 1983). Also, Awad (1998), using 50 % and Hewedy (1999), using 75 % from tomato NPK recommended combination with biofertilizers and obtained better significant results on plant growth including plant height, number of leaves and branches per plant as well as dry matter comparing with chemical or biofertilizer in single application.

The present investigation was carried out to study the application of biofertilizer in individual application or combined with mineral fertilizer on *Tagetes minuta,* L. plant in a trial to obtain the best yield of leaves and quantity and quality improvement of essential oil contents.

MATERIALS AND METHODS

Two field experiments were conducted at Barramoon Experimental Farm, Dakahlyia Govermorate during two seasons of 2000 and 2001 on *Tagetes minuta,* L. to study the effect of biofertilizer inoculation, NPK rates and their combinations on growth and essential oil contents.

The experimental soil characteristics were as follows, sand 12.7 %, silt 31.1 %, clay 56.2 %, $CaCo_3$ 3.4 %, pH 8.1, available N 24.3 ppm, available P 11.6 ppm and available K 328 ppm. The experiment was designed in split plot system with three replicates, where NPK[1] rates were (0, 50 % and 100 %) occupied the main plots and those of inoculation were (0, 4 and 8 kg/fed biofertilizer)[2] allocated at random in sub-plots.

All treatments were compared with recommended according to Abo-Zied (1988) as a chemical fertilizer (control). The plot area was 7.5 m^2 and included 3 rows, each row was 3 m in length, the distance between the rows 60 cm and 30 cm between plants (30 plant per plot).

The seeds were sown in the nursery on 15th February and transplanting took place on 1st April, then biofertilizers were mixed with moist sand to inoculate the seedling/hold before transplanting the seedling. Ammonium sulphate was added in two equal doses at 30 and 60 days after transplanting. While calcium superphosphate and potassium sulphate were added during soil preparation.

Data for plant height, number of main branches, fresh and dry weights of vegetative growth per plant, fresh and dry weights of leaves per plant, per plot and per feddan) were recorded at the beginning of flowering stage. In vegetative growth dried material, content of nitrogen, phosphorous and potassium were estimated according to A.O.A.C., 1980; Jackson, 1967 and Peterbugski, 1968, respectively.

The percentage of essential oil in dry leaves was determined by steam water distillation method according to the British Pharmacopoeia method (1983). Determination of essential oil constitutes was by gas liquid chromatography (G.L.C).

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[1] NPK recommended chemical fertilizer (200 kg/fed Ammonium sulphate 20.6 % N + 150 kg/fed Calcium superphosphate 15.5 % P_2O_5 + 50 kg/fed potassium sulphate 48 % K_2O).

[2] Biofertilizer = mixture 1:1 Nitrobien and phosphorien.

The data were statistically analysed according to Snedecor and Cochran (1967).

Condition 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
Dtector temp.	300 °C

RESULTS AND DISCUSSION

I. Effect of biofertilizer and NPK rates on *Tagetes minuta* growth.

I.1 Plant height:

Data presented in Table (1) revealed that application of biofertilizer and NPK rates caused a significant increases in plant height.

The higher values for plant height were recorded with interaction between NPK (50 and 100 %) rates and biofertilizer (4 and 8 kg/fed) levels, particularly with the low rate of NPK (50 %) and biofertilizer (8 kg/fed), when compared with high (100 % NPK) rate. These results may be due to the role of NPK fertilizer and biofertilizer. The obtained results were in agreement with those reported by Dawa *et al.* (2000) and El-Ghawwas *et al.* (2001).

Table (1): Effect of biofertilizer and NPK rates on plant height (cm) of *Tagetes minuta*, L. plant in 2000 and 2001 seasons.

Seasons / Treatments	Biofertilizer kg / fed (B) 2000: 0	4	8	Mean (A)	2001: 0	4	8	Mean (A)
NPK rates (A)								
0 %	179.3	195.6	200.3	191.7	177.3	191.3	201.6	190.1
50 %	195.6	208.6	213.6	205.9	183.0	211.6	215.0	210.9
100 %	200.3	205.0	199.8	201.7	197.0	201.3	198.6	198.9
Mean (B)	191.7	203.1	204.6		198.8	201.4	205.1	
LSD 5%								
NPK rates (A)	3.4				2.1			
Biofertilizer(B)	1.6				1.3			
Interaction AxB	2.8				3.8			

I.2 Number of main branches:

Data in Table (2) indicated that number of main branches per plant was significantly increased, when compared with untreated plants. The highest values were obtained with high level (8 kg/fed). Also, NPK rates caused stimulation of number of main branches. On the other hand, biofertilizer levels combined with NPK (50 %) gave the highest number increase of main branches per plant, while, it was reduced when biofertilizer levels were combined with NPK (100 % recommended).

These results were in agreement with those obtained by Dawa *et al.* (2000).

Table (2): Effect of biofertilizer and NPK rates on number of main branches per plant of *Tagetes minuta* plant in 2000 and 2001 seasons.

Seasons / Treatments	Biofertilizer kg / fed (B)							
	2000			Mean	2001			Mean
	0	4	8	(A)	0	4	8	(A)
NPK rates (A)								
0 %	9.00	9.66	12.66	10.44	8.66	10.66	10.33	9.88
50 %	11.00	11.00	12.66	11.55	10.33	12.00	11.66	11.33
100 %	10.66	10.66	10.33	10.55	10.66	10.00	10.33	10.33
Mean (B)	10.22	10.43	11.88		9.88	10.88	10.77	
LSD 5%								
NPK rates (A)	0.05				0.11			
Biofertilizer(B)	0.02				0.07			
Interaction AxB	0.13				0.16			

I.3 Fresh and dry weight per plant:

The results in Tables (3 & 4) cleared that NPK and biofertilizer at all rates, increased significantly fresh and dry weights gm/plant, during the two growing seasons, the increments tended to correlate with the increasing rates. Also, combination between NPK and biofertilizer caused a superior increase in fresh and dry weights. The highest values were obtained with NPK (50 %) and biofertilizer 8 kg/fed. Nitrogen is a constituent of the building materials (protoplasm) from which plants are made, potassium is necessary for the synthesis of carbohydrates and proteins, and phosphorus is a component of the phospholipide and nucleic acids in the meristematic tissues. These materials mentioned above are necessary for producing improvement, besides the role of biofertilizer may be due to superiority in fresh and dry weights. Similar results were mentioned by El-Hawary *et al.* (1998) who reported that bacterial inoculation significantly increased plant growth, as well as interaction between bacterial inoculation and N-fertilization, caused a maximum results of wheat plants.

Table (3): Effect of biofertilizer and NPK rates on vegetative fresh weight gm/plant of *Tagetes minuta* plant in 2000 and 2001 seasons.

Seasons / Treatments	Biofertilizer kg / fed (B)							
	2000			Mean	2001			Mean
	0	4	8	(A)	0	4	8	(A)
NPK rates (A)								
0 %	375.6	425.3	475.3	425.4	366.6	460.0	480.0	435.5
50 %	587.5	660.0	700.6	649.3	556.0	646.6	713.3	638.6
100 %	615.3	650.0	679.0	648.1	626.6	660.0	683.3	656.6
Mean (B)	526.1	578.4	618.3		516.4	588.8	625.5	
LSD 5%								
NPK rates (A)	26.1				14.6			
Biofertilizer(B)	23.3				21.4			
Interaction AxB	17.7				28.5			

Table (4): Effect of biofertilizer and NPK rates on vegetative dry weight gm/plant of *Tagetes minuta* plant in 2000 and 2001 seasons.

Seasons / Treatments	Biofertilizer kg / fed (B)							
	2000			Mean	2001			Mean
	0	4	8	(A)	0	4	8	(A)
NPK rates (A)								
0 %	112.7	123.3	142.6	126.2	110.0	138.0	144.0	130.7
50 %	170.4	190.7	203.2	188.1	161.2	187.5	206.9	185.2
100 %	178.4	185.3	194.2	185.9	179.2	188.1	195.4	187.6
Mean (B)	153.8	166.4	180.0		150.1	171.2	182.1	
LSD 5%								
NPK rates (A)	8.20				12.46			
Biofertilizer(B)	9.01				8.07			
Interaction AxB	16.13				17.05			

I.4 Fresh and dry weights of leaves yield per plant, plot and feddan:

Data in Tables (5 and 6) revealed that fresh and dry weights of leaves per plant, per plot and per feddan were increased significantly with NPK rates and biofertilizer in individual application or their combination. These increments were tended to the increasing of NPK rates and biofertilizer doses, while the superiority in fresh and dry weights of leaves was with combination between NPK (50 %) and biofertilizer (8 kg/fed). These results were in agreement with those obtained by Zuh-Peili *et al.* (2000) who reported that the NPK application produced the highest yield on *Mentha arvensis* (almost 30 % higher than the control).

2- Chemical analysis:

2.1. N, P and K concentration:

Data in Table (7) showed N, P and K in dry leaves tissue of *Tagetes minuta* plant as affected by mineral and biofertilizer in both seasons. It was noticed that NPK rates caused an increase in the percent of N, P and K in leaves tissue. These increments tended to be in relationship with the increasing rates of NPK fertilizer. The increment in N, P and K concentration in leaves might be due to the increase in the available N, P and K soil composition (Dawa *et al.,* 2000).

In the same Table (7), it was found that biofertilizer individually or combined with NPK fertilizer had stimulated the percent of N, P and K in leaves tissue in both seasons. These results may be due to the role of N fixing bacteria as well as the role of phosphate dissolving bacteria in converting P fixed form to be soluble ready available for plant nutrition. These results are in agreement with those obtained by Ibrahim (2000) on fennel plants and Abdel-Mouty (2000) on cowpea plant, since they found that biofertilizers caused an increase in the percent of N, P and K in plant tissue.

Table (5): Effect of biofertilizer and NPK rates on fresh weight of leaves yield g/plant, kg/plot and ton/fed of *Tagetes minuta* plant during two seasons 2000 and 2001.

Treatments	Biofertilizer kg/fed (B)											
	0	4	8	Mean	0	4	8	Mean	0	4	8	Mean
	Leaves yield (gm/plant)			(A)	Leaves yield (kg/plot)			(A)	Leaves yield (ton/fed)			(A)
2000												
NPK rates (A)												
0 %	153.66	178.62	197.24	176.51	4.61	5.36	5.92	5.29	2.46	2.86	3.16	2.83
50 %	246.75	265.20	294.25	268.73	7.40	7.96	8.83	8.06	3.95	4.26	4.71	4.13
100 %	258.42	273.00	285.18	272.20	7.75	8.19	8.55	8.16	4.13	4.37	4.56	4.35
Mean (B)	219.61	238.94	258.89		6.58	1.17	7.77		3.51	3.83	4.14	
LSD at 5 %												
NPK rates (A)	1.29				0.03							
Biofertilizer(B)	3.98				0.43							
Interaction AxB	11.40				1.02							
2001												
NPK rates (A)												
0 %	146.64	190.90	201.60	179.71	4.34	5.73	6.05	5.37	2.31	3.06	3.23	2.87
50 %	227.96	271.57	299.58	266.37	6.84	8.15	6.89	7.29	3.65	4.35	3.67	3.89
100 %	272.20	277.20	286.98	278.79	8.17	8.32	8.61	8.37	4.36	4.44	4.59	4.46
Mean (B)	215.60	246.55	262.72		6.45	7.40	7.18		3.44	3.95	3.83	
LSD at 5 %												
NPK rates (A)	7.20				0.19							
Biofertilizer(B)	2.64				0.13							
Interaction AxB	9.15				0.11							

Table (6): Effect of biofertilizer and NPK rates on dry weight of leaves yield g/plant, kg/plot and ton/fed of *Tagetes minuta* plant during two seasons 2000 and 2001.

Treatments	Biofertilizer kg/fed (B)											
	0	4	8	Mean (A)	0	4	8	Mean (A)	0	4	8	Mean (A)
	Leaves yield(gm/plant)				Leaves yield (kg/plot)				Leaves yield (ton/fed)			
2000												
NPK rates (A)												
0 %	33.09	37.62	42.93	37.88	0.993	1.129	1.288	1.137	0.529	0.602	0.687	0.606
50 %	51.16	60.81	64.23	58.73	1.535	1.824	1.927	1.762	0.819	0.973	1.028	0.940
100 %	56.83	60.04	62.22	59.70	1.705	1.801	1.867	1.791	0.909	0.996	0.996	0.967
Mean (B)	47.03	50.82	56.46		1.411	1.585	1.694		0.752	0.857	0.904	
LSD at 5 %												
NPK rates (A)		1.17				0.12						
Biofertilizer(B)		2.09				0.14						
Interaction AxB		6.51				0.57						
2001												
NPK rates (A)												
0 %	32.56	41.69	43.91	39.39	0.977	1.251	1.317	1.182	0.521	0.667	0.702	0.630
50 %	49.82	59.83	65.68	58.44	1.495	1.795	1.970	1.753	0.797	0.957	1.051	0.935
100 %	59.88	60.70	63.78	61.45	1.796	1.821	1.913	1.843	0.958	0.971	1.020	0.983
Mean (B)	49.42	54.07	57.79		1.423	1.622	1.733		0.759	0.865	0.924	
LSD at 5 %												
NPK rates (A)		0.82				0.71						
Biofertilizer(B)		0.59				0.46						
Interaction AxB		3.08				0.21						

Table (7): Effect of biofertilizer and mineral (NPK) rates on N, P and K content in dry leaves tissue of *Tagetes minuta* plant in 2000 and 2001 seasons.

Treatments	Biofertilizer kg/fed								
	0			4			8		
	N %	P %	K %	N %	P %	K %	N %	P %	K %
2000									
NPK rates (A)									
0 %	2.28	0.25	1.87	2.76	0.36	2.17	2.94	0.41	2.27
50 %	3.37	0.32	2.13	3.18	0.41	2.15	3.27	0.43	2.81
100 %	3.43	0.37	2.17	3.28	0.39	2.16	3.38	0.47	2.93
2001									
NPK rates (A)									
0 %	2.12	0.28	1.76	2.19	0.39	2.11	2.87	0.44	2.16
50 %	3.17	0.32	2.15	3.27	0.42	2.13	3.19	0.49	2.64
100 %	3.46	0.36	2.29	3.11	0.41	2.16	3.17	0.46	2.53

2.2. Essential oil content:

It was found from Table (8) that NPK rates increased essential oil percentage and oil yield significantly when compared with the untreated plants. The highest values were obtained with NPK at 100 %. Also, biofertilizer levels caused an increase in oil percentage and oil yield with the increasing levels when compared with the untreated plants. The maximum values were recorded at 8 kg/fed (biofertilizers). Concerning the interaction effect between NPK and biofertilizer in the same Table (8), it was observed that the highest increases in oil percentage and oil yield were obtained in some cases. These increments were more than those obtained in the cases of NPK rates and biofertilizer each of them applied lonely.

The higher essential oil content and oil yield may be due to the increases of growth and the large increases in yield of dry weight of leaves that resulted from NPK and biofertilizer applications. These results were in agreement with Ghosh *et al.* (1993) who reported that, increasing NPK was the most effective treatment for increasing essential oil content of *Mentha ssp.*

2.3. Essential oil components:

Data in Table (9) and Fig. (1) revealed that the chemical composition of *Tagetes minuta* essential oil by G.L.C were nine components and limonene, beta-ocimene, dihydrotagetone and cis-tagetone were the main constituents. The recorded results in Table (9) and Fig. (1) indicated that NPK rates and biofertilizer applications slightly reduced B-ocimene and dihydrotagetone percentages, while the percentages of limonene (10.188 % at 50 % NPK) and cis-tagetone (19.208% at 4 kg/fed biofertilizer) were increased, when compared with the untreated plants.

As regarding the plants treated with a combination of NPK rates and biofertilizer levels passed increases in the percentages of dihydrotagetone (86.352 % at 5 % NPK with 4 kg/fed biofertilizer) and cis-tagetone (15.474 % at 100 % NPK with 8 kg/fed biofertilizer), but the percentages of limonene and B-ocimene were reduced. Similar results were obtained by Graven *et al.*

Table (8): Effect of biofertilizer and NPK rates on oil percentage, ml/plant and oil yield (kg/fed) of *Tagetes minuta* plant during two seasons 2000 and 2001.

Treatments	Biofertilizer kg/fed (B) 0	4	8	Mean (A)	0	4	8	Mean (A)	0	4	8	Mean (A)
	Oil percentage				Oil ml/plant				Oil yield (kg/fed)			
2000												
NPK rates (A)												
0 %	1.34	1.35	1.51	1.40	0.44	0.51	0.65	0.53	7.09	8.13	10.37	8.53
50 %	1.41	1.76	1.90	1.69	0.72	1.07	1.22	1.00	11.54	17.12	19.53	16.06
100 %	1.80	1.92	1.82	1.85	1.02	1.15	1.13	1.10	16.37	18.44	18.12	17.64
Mean (B)	1.52	1.68	1.74		0.73	0.91	1.00		11.67	14.56	16.01	
LSD at 5 %												
NPK rates (A)	0.07				0.04							
Biofertilizer(B)	0.09				0.05							
Interaction AxB	0.06				0.11							
2001												
NPK rates (A)												
0 %	1.32	1.50	1.63	1.33	0.43	0.63	0.72	0.59	6.88	10.01	11.45	9.45
50 %	1.36	1.94	1.89	1.66	0.68	1.16	1.24	1.03	10.84	18.57	19.86	16.42
100 %	1.78	1.91	1.90	1.83	1.07	1.16	1.21	1.15	17.05	18.55	19.39	18.33
Mean (B)	1.49	1.76	1.76		0.73	0.98	1.06		11.59	15.71	16.90	
LSD at 5 %												
NPK rates (A)	0.06				0.03							
Biofertilizer(B)	0.08				0.12							
Interaction AxB	0.15				0.10							

Table (9): Effect of biofertilizer and NPK rates on the percentage of main components in essential oil of *Tagetes minuta* plant in 2000 and 2001 seasons.

No.	RT	Name of the main components in the essential oil	Treatments								
			NPK			Integrated bio.		50 % NPK		100 % NPK	
			0 %	50 %	100 %	4 kg/fed	8 kg/fed	4 kg/fed	8 kg/fed	4 kg/fed	8 kg/fed
1	2.650	Beta-pinene				0.061	0.986		0.649	0.455	0.570
2	2.933	Limonene	7.362	10.188	6.587	0.979	9.107		5.530	4.863	5.450
3	4.233	B-ocimene	12.359	9.783	8.463	8.148	7.919	1.242	3.152	2.596	7.409
4	7.933	Dihydrotagetone	74.937	69.134	73.117	57.703	66.554	86.352	76.330	82.047	70.356
5	8.017	Cis-Tagetone		10.895	11.834	19.208	13.753		12.801	9.494	15.474
6	8.75	Cisd-Tagetenone				0.125	0.102		0.103		0.202
7	9.983	Unknown				0.242	0.177		0.237		0.124
8	12.233	Carvon	5.341			0.236	0.686	12.406	0.468	0.280	0.108
9	12.817	Unknown				1.119	0.716		0.730	0.266	0.306

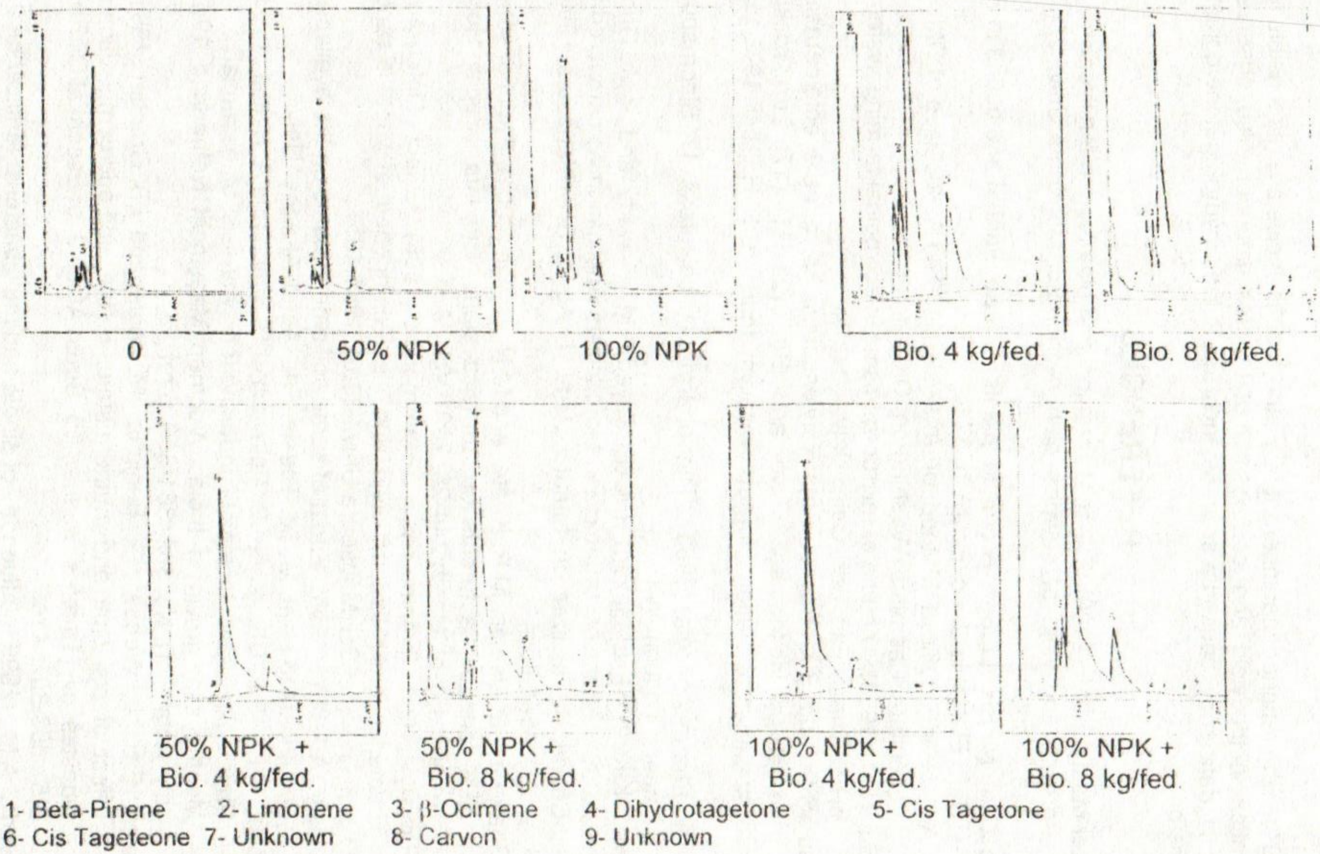

Fig (1): Chromatogram of essential oil components in leaves of Tagetes minuta as affected by mineral and biofertilizers.

(1991) who reported that inherent N, P and K deficiencies are responsible for variation in the yield and composition of *Tagetes minuta* oil. Also, observed that N deficiency caused a dramatic increase in the dihydrotagetone content of the oil.

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دراسة تأثير التسميد المعدنى والحيوى على نبات القطيفة العطرية

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أجريت هذه التجربة بالمزرعة البحثية بالبرامون محافظة الدقهلية والتابعة لمعهد بحوث البساتين بوزارة الزراعة بهدف استخدام التسميد المعدنى والحيوى وأثره على النمو الخضرى والمحصول الورقى وكمية الزيت ومكوناته والوصول إلى الحد الأمثل من التسميد المعدنى والحيوى للحصول على أعلى انتاج وجودة فى نبات القطيفة.

وقد استخدم فى البحث السماد المعدنى الموصى به (٤١ كجم نيتروجين + ٢٣ كجم فو$_2$أ$_5$ + ٢٤ كجم بو$_2$أ) بنسب (صفر ، ٥٠ % ، ١٠٠ %) كياوجرام للفدان واستخدم فى التسميد الحيوى النيتروبين مخلوطا مع الفوسفورين بنسبة ١:١ بمعدل (صفر ، ٤ ، ٨) كيلوجرام/فدان. وكانت أهم النتائج كالآتى:

١ـ عند استخدام التسميد المعدنى منفردا (نيتروجين + فوسفور + بوتاسيوم) كانت أفضل النتائج فى النمو الخضرى من حيث طول النبات وعدد الفروع والوزن الطازج والجاف ومحصول الأوراق وكذا النسبة المئوية للزيت الطيار عند النسبة ١٠٠ %.

٢ـ أعطى التسميد الحيوى المتكامل منفردا زيادة فى صفات النمو والمحصول الورقى وأيضا النسبة المئوية للزيت وكانت هذه الزيادة تتناسب طرديا مع معدل الإضافة وكانت أعلى النتائج عند استخدام التسميد الحيوى بمعدل ٨ كجم / فدان ولكن لوحظ أنها كانت أقل من نتائج التسميد المعدنى الموصى به (١٠٠ %).

٣ـ أحدث التسميد المعدنى والحيوى معا زيادة كبيرة ومتضاعفة فى الوزن الطازج والجاف ومحصول الأوراق أيضا زيادة فى نسبة الزيت بالأوراق إذا ما قورن باستخدام كلا منها منفردا وكانت أفضل النتائج عند استخدام التسميد المعدنى بنسبة ٥٠ % مع التسميد الحيبوى بمعدل ٨ كجم/فدان.

٤ـ أدى استخدام التسميد المعدنى والحيوى منفردين إلى خفض نسبة كلا من بيتا ـ أوثيمين ، داى هيدروتاجيتون فى الزيت الطيار وزيادة نسبة الليمونين والتاجيتونين ، أما عند استخدام التسميد المعدنى والحيوى معا زادت نسبة داى هيدروتاجيتون إلى ٨٦ % عند استخدام التسميد المعدنى بنسبة ٥٠ % مع التسميد الحيوى بمعدل ٤ كجم / فدان.