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EFFECT OF DIFFERENT FERTILIZERS ON THE CHEMICAL COMPOSITION OF *TAGETES ERECTA*, L. PLANT

BY

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ABSTRACT

A field experiment was carried out to investigate the effect of some chemical (NPK) and organic (poultry, cattle, rabbit and horse) fertilizers on some constituents of *Tagetes erecta*,L plant. NPK and organic fertilizer treatments increased the dry weight of petals, chlorophyll a, b and total carotenoids in leaves, essential oil, carbohydrate, xanthophyll and lutein in petals of flowers. Generally, the best results of the dry weight of ray florets(petals), volatile oil and pigment contents were obtained from plants fertilized with NPK at the rate 400kg/fed., poultry manure (PM) at 20 and 30, cattle manure at the rates 40 or 60 m^3/fed.

INTRODUCTION

Marigold (*Tagetes erecta*, L. Fam. Astraceae) is one of the most important ornamental plants grown in Egypt, which uses as aromatic and colorant plants .African marigold (*Tagetes erecta*,L.) flower pigments can be extracted and used as a natural food additive to colour egg yolks orange and poultry skin yellow. Marigold can serve as natural sources of xanthophylls. Lutein is the primary xanthophylls pigment that produces the orange colour in marigold flowers, comprising roughly 90% of the petals identified pigments (Quackenbush and Miller, 1972). Marigold has been most commonly used by the poultry industry to augment the xanthophyll present in corn and alfalfa feed to standardize the feed's xanthophylls content (Delgado-Vargas *et al.*, 1998). Xanthophylls are one of two classes of carotenoid pigments which are also beneficial as a natural pigment source and have many commercial applications.

Carotenoid pigments have shown positive benefits in slowing the growth of induced skin tumors, treating dermatological diseases, and lowering the overall risk of cancer in human beings (Mathews-Roth, 1982).

Lutein has special pharmacological use as an ophthalmologic ointment with the trade name Adaptionol (Gau *et al.*, 1983). Thus, the potential for broad commercial use of carotenoids should generate further interest in marigold as an alternative crop (Theresa *et al*, 2003).

Several studies have been conducted to find out the plant response to different levels of fertilizers application. Saleh and Abd El-Fattah (1997) noticed that the slow release of nutrients from FYM makes timing of nutrient availability more suitable than that from chemical fertilizer.

El- Gengaihi and Wahba (1995) found that the addition of 100 Kg N/fed. (as ammonium nitrate) significantly increased the dry weight of the whole dragonhead plant by 32-35% compared to the control. Alam *et al.* (2003) found that the maximum value of maize yield was at the level 180kg/ha nitrogen fertilizer. Although, of all these advantages, chemical (NPK) fertilizers are costly and causes pollution, so there was a renewed interest in the use of organic manure to supply part or all of plant need. On sweet basil and thyme plant, Jacoub (1999) found that organic fertilizers, especially poultry manure at all levels were the most effective treatments as regard to plant growth, oil percent, chlorophyll a,b and carbohydrates. Sakr (2001) found that the best results of fresh and air dried herb yield and essential oil yield were obtained from plants fertilized with NPK at 900 Kg/fed, poultry manure at $20m^3$/fed or sheep manure at $30m^3$/fed.

Aziz and El- Sherbeny (2003) on dragon head, showed that plant growth and volatile oil percent were gradually increased by increasing the cattle manure at the rate of 6 tons/fed.

The objective of this work was to study the influence of chemical and organic fertilizers on the volatile oil in leaves and pigments in petals of *Tagetes erecta* L. plant.

MATERIALS AND METHODS

Cultivation process:-

An experiment was carried out during the two seasons of 1998 and 1999 at the experimental farm,/Kafr EL-Gabal, National Organization for Drug Control and Research (NODCAR), Giza.

Seeds of *Tagets erecta*, L. were sown in the nursery beds on Feb 27th .and transplanted to the experimental plots (2x3m) 45 days later. The distances between the plants were 35 cm and 60 cm between the raw.

The plants were fertilized with the following:

- Mixture of nitrogen, phosphorous and potassium fertilizers at a ratio of 5:2:2 (NPK) using 200,400 and 600kg/fed. ammonium sulfate (20.5%N),calcium super phosphate (15.5%P_2O_5) and potassium sulphate (48%K_2O). The NPK mixture was divided into two equal doses, which added as a basal dressing. The first dose was applied one month after transplanting (May) and the second one was applied after one month from the first fertilizer (June).
- Poultry and rabbit manures at the rates of 10, 20 and$30m^3$/fed.
- Cattle and horse manures at the rates of 20,40 and $60m^3$ /fed The organic fertilizers were divided into two doses, the first dose was added two weeks before planting and the second dose was applied as a basal dressing after 45 days from transplanting.

The treatments were complete randomized distributed blocks. The flowering heads were collected weekly during the flowering period starting after 57 days from transplanting.

The ray florets (petals) were dried at room temperature in shade and then the dry weight was recorded for each treatment, then ground the petals to fine powder for extraction of the pigments.

Chemical analysis:-

- Dry weight of the petals was determined according to A.O.A.C. (1990).
- Chlorophyll a,b and carotenoids were determined in the leaves as described by Saric *et al.* (1967)
- Total carbohydrate content was estimated in both of leaves and petals as described by Herbert et at. (1971).
- Essential oil percentages in each of fresh leaves and flowers were determined as described by British pharmacopoeia(2000).
- Essential oil components of leaves were analyzed using GLC, as described by Bunzen *et al* (1969).
- Total xanthophyll content in petals of *Tagetes erecta* was determined by Sadler *et al.* (1990).
- Quantitative analysis of lutein esters in petals was done by high performance liquid chromatography(HPLC) as described by Gau *et al.* (1983).
- Statistically analyzed by the use of homoginteity test (Bartlett's test) according to Snedecor and Cochran (1976) to compare between different means using Duncan's according to procedure reported by Gomez and Gomez (1976).

RESULTS AND DISCUSSION

1- Effect of different fertilizers on dried petals yield per plant:

The petals are the first source for the carotenoid pigments production. The full bloom was recorded at 57 days up to 114 days after transplanting for both 1998 and 1999 Seasons (Table 1). The petals production per plant was higher in 1999 than in 1998 seasons with total of 44.08 to 81.98 and 53.61 to 113.87 g/plant, respectively. The yield of petals was affected greatly by the fertilization treatments. The highest petals production was obtained from fertilization with NPK at 400kg, followed by RM at 20, CM at 40 then PM at30m^3/fed in the first season. While in the second season it was obtained from NPK at 400 kg/fed, followed by HM at60, PM at all levels, then CM at 60 m^3/fed. The increases in total yield of dry petals were 85.9 and 90.5% for two seasons, respectively, at the application of 400kg/fed.NPK. While fertilization with RM at 20 or CM at 40m^3/ fed increased 79.3 and 53.9% over control respectively for the first season. Whereas, in the second season, the increases in total yield of the dry petals were 112.4, 99.4 and 92.1% obtained by application the organic fertilizers at (HM at 60, PM at 20 and CM at 60m^3/fed).These results are in agreement with those obtained by Baldwin *et al.*(1993), they noticed that the addition of ammonium nitrate (28Kg /ha) after the first two harvests improved subsequent harvests. Pigments yield was increased most by after three nitrogen applications

in a single season, Farid *et al.*(1994) on roselle plant, Rao *et al.* (1997)on *Artemisia pallens*, El Seoud *et al.*(1997), Yadav and Singh (1997) on *Tagetes erecta*. and Singh *et al.* (1999) on *Capsicum annum* found similar trend.

Table (1): Effect of some chemical and organic fertilizers on dry weight of petals (g/plant) of marigold *(Tagetes erecta,*L.) plant, during1998 and 1999 seasons.

Treatments	Dry weight of petals(g /plant)				
	First season (1998)				
	Time after transplanting (days)				Total
	57 days	78 days	99 days	114 days	
Control	1.81 de	12.11 b	17.97 b	12.19 b	44.08 c
NPK (200Kg/fed.)	1.79 de	17.43 ab	26.05 ab	20.01 ab	65.28 ab
NPK (400 Kg/fed.)	3.23 bc	19.95 a	30.95 a	27.85 a	81.98 a
NPK (600 Kg/fed.)	0.88 e	14.47 ab	19.97 ab	17.66 ab	52.98 abc
PM (10 m^3/fed.)	0.97 e	13.87 ab	16.99 b	20.96 ab	52.79 abc
PM (20 m^3/fed.)	5.43 ab	17.83 a	19.36 ab	19.85 ab	62.47 abc
PM (30 m^3/fed.)	6.29 a	17.83 a	21.48 ab	21.72 ab	67.32 ab
RM (10 m^3/fed.)	1.44 de	13.66 ab	23.80 ab	19.25 ab	58.15 abc
RM (20 m^3/fed.)	3.14 b-c	18.29 a	32.36 a	25.24 ab	79.03 ab
RM (30 m^3/fed.)	5.31 ab	18.42 a	20.51 ab	20.82 ab	65.06 abc
CM (20 m^3/fed.)	3.44 be	12.50 ab	20.25 ab	19.88 ab	56.07 abc
CM (40 m^3/fed.)	2.64 c-e	18.10 a	26.49 ab	20.60 ab	67.83 ab
CM (60 m^3/fed.)	4.45 a-c	17.01 ab	20.57 ab	12.76 ab	56.79 abc
HM (20 m^3/fed.)	1.41 de	15.20 ab	19.88 ab	16.95 ab	53.44 abc
HM (40 m^3/fed.)	2.56 c-e	14.25 ab	20.31 ab	16.53 ab	53.65 abc
HM (60 m^3/fed.)	3.69 bc	13.50 ab	20.06 ab	14.61 ab	51.86 abc
	Second Season (1999)				
Control	1.38 ab	13.99 a	23.39 b	14.85 b	53.61 c
NPK (200Kg/fed.)	0.77 b	16.21 a	42.30 ab	30.30 ab	89.58 abc
NPK (400 Kg/fed.)	2.68 a	16.70 a	40.02 ab	42.71 a	102.11 ab
NPK (600 Kg/fed.)	1.18 ab	17.93 a	37.70 ab	32.66 ab	89.47 abc
PM (10 m^3/fed.)	0.97 b	21.97 a	43.04 a	39.59 a	105.57 ab
PM (20 m^3/fed.)	1.17 ab	22.16 a	47.23 a	36.36 a	106.92 a
PM (30 m^3/fed.)	1.20 ab	22.07 a	40.25 ab	37.49 a	101.01 ab
RM (10 m^3/fed.)	0.25 b	16.64 a	31.96 ab	20.19 ab	69.04 bc
RM (20 m^3/fed.)	0.39 b	16.02 a	45.03 a	27.60 ab	89.04 abc
RM (30 m^3/fed.)	1.29 ab	16.30 a	34.94 ab	32.94 a	85.47 abc
CM (20 m^3/fed.)	1.07 b	17.19 a	39.06 ab	35.81 a	93.13 abc
CM (40 m^3/fed.)	0.49 b	18.29 a	38.22 ab	34.43 a	91.43 abc
CM (60 m^3/fed.)	1.22 ab	18.69 a	47.53 a	35.57 a	103.01 ab
HM (20 m^3/fed.)	1.45 ab	22.47 a	35.36 ab	30.69 ab	89.97 abc
HM (40 m^3/fed.)	1.43 ab	18.42 a	47.68 a	29.51 ab	97.04 ab
HM (60 m^3/fed.)	0.79 b	18.99 a	56.11 a	37.98 a	113.87 a

Each column, any two means having a common letters are not significant different at the 5% level.

PM: Poultry Manure; RM: Rabbit Manure; CM: Cattle Manure; HM: Horse Manure;

2 - Effect of different fertilizers on chlorophyll and carotenoid content:

One of the main factors controlling carbohydrate metabolism in plants is the chlorophyll content. Yet, the study of the effect of NPK and organic fertilizers on chlorophyll content is of major importance to plant physiologists. Data obtained in the present study of chlorophyll a, b and carotenoid contents expressed as mg/fresh weight of leaves, are shown in Table (2). Results revealed that fertilization with NPK at 600 or 400 kg/fed. increased of both chlorophyll a and b in leaves of first and second seasons, respectively. While the highest values of chlorophyll a or b were in plants fertilized with CM or HM at 60 and 40 m^3/fed respectively in the first season.

Carotenoid content in leaves showed similar trend to that previously shown for chlorophyll a and b.

The highest carotenoid content was obtained by adding NPK at the levels 600 and 400 kg/fed, for the two seasons, respectively. However, all the levels of organic fertilizers increased the total carotenoid in the leaves for the both seasons, the highest increases of total carotenoid content in the leaves were 74.7 followed by 57.8 then 54.9% over control. Our results are in agreement with those obtained by Hammam (1996) on *Pimpinella anisum* plants of treatments CM at the rates 60, 40 and HM at 60m^3/fed in the second season. and Jacoub (1999) on *Ocimum basilicum* and *Thymus vulgaris.*

3 - Effect of different fertilizers on total carbohydrate content:

Data in Table (3) clear that all levels of NPK and organic fertilizers increased the total carbohydrate percentage in both leaves and petals. The highest total carbohydrate content in the leaves of plants treated with the higher levels of different organic manures, the maximum carbohydrate percentage was observed with CM at 40m^3/fed.. Also, data in Table (3) showed that the fertilization with PM at the level 10m^3/fed. gave the highest percentage of the total carbohydrate content in the petals of *Tagets erecta* followed by plants received HM at 60m^3.These results agreed with those obtained by El Khayat (1987) on *Tagetes patula,* Aly *et al.* (1995) on *Polyanthus tuberose* and Hamniam (1996) on *Pimpinella anisum.*

4 -Effect of different fertilizers on essential oil percentage:

The results in Table (3) indicate that application of NPK fertilization increased the oil percentages in both the leaves and flowers compared to the control plants. The most effective treatments was NPK at 400kg/fed.of leaves and followed by 600kg/fed.of flowers. The increases reached 25.7% and 30.0% over control, respectively. The application of different organic fertilizers increase the volatile oil percent in both the leaves and flowers compared to the control plant. The increases of essential oil percent was parallel to the increase in the rate of the applied fertilizer. The most effective treatments was the medium rate of CM and the highest rates of PM or HM as they increased the oil. These results are in agreement with those obtained by Emongor and Chweya (1992) on chamomile flowers, Aly *et al* (1995) on *Polyanthus tuberose*, El-Saeid *et al* (1996) on *Tagetes patula* and El-Gendy *et al.* (2000)on *Ocemum basilicum.*

Table (2): Effect of some chemical and organic fertilizers on chlorophyll a, b and carotenoids content (mg/g fresh Weight) in leaves of marigold (*Tagetes erecta*, L.) plants, during 1998 and 1999 season.

Treatments	First season (1998)		
	Chlorophyll a	Chlorophyll b	Carotenoids
Control	0.909	0.292	0.518
NPK (200Kg/fed.)	0.984	0.306	0.531
NPK (400 Kg/fed.)	1.202	0.393	0.642
NPK (600 Kg/fed.)	1.401	0.448	0.718
PM (10 m^3/fed.)	0.990	0.363	0.626
PM (20 m^3/fed.)	1.015	0.358	0.592
PM (30 m^3/fed.)	0.980	0.289	0.577
RM (10 m^3/fed.)	0.969	0.338	0.659
RM (20 m^3/fed.)	1.054	0.343	0.673
RM (30 m^3/fed.)	1.071	0.304	0.886
CM (20 m^3/fed.)	0.984	0.247	0.650
CM (40 m^3/fed.)	1.076	0.327	0.792
CM (60 m^3/fed.)	1.235	0.385	0.713
HM (20 m^3/fed.)	1.002	0.294	0.569
HM (40 m^3/fed.)	1.113	0.362	0.531
HM (60 m^3/fed.)	1.066	0.343	0.741
	Second season (1999)		
Control	0.869	0.342	0.554
NPK (200Kg/fed.)	1.096	0.361	0.675
NPK (400 Kg/fed.)	1.254	0.470	0.780
NPK (600 Kg/fed.)	1.207	0.380	0.692
PM (10 m^3/fed.)	0.960	0.299	0.649
PM (20 m^3/fed.)	0.977	0.381	0.627
PM (30 m^3/fed.)	0.932	0.316	0.538
RM (10 m^3/fed.)	0.967	0.317	0.507
RM (20 m^3/fed.)	0.901	0.332	0.552
RM (30 m^3/fed.)	0.909	0.229	0.593
CM (20 m^3/fed.)	1.013	0.308	0.661
CM (40 m^3/fed.)	1.152	0.314	0.874
CM (60 m^3/fed.)	1.176	0.361	0.968
HM (20 m^3/fed.)	1.201	0.348	0.774
HM (40 m^3/fed.)	1.132	0.353	0.643
HM (60 m^3/fed.)	1.316	0.397	0.856

PM: Poultry Manure; RM: Rabbit Manure; CM: Cattle Manure; HM: Horse Man

4- Effect of different fertilizers on essential oil components in leaves:

Data in Table (4) reveal that the piperetone was the main ketone component of Tagetes oil, also, a number of compounds such as limonene, ocimene, α- terpinolene and P-cymene-8.ol etc. were found in considerable amounts.

Table (3): Effect of some chemical and organic fertilizers on percentages of carbohydrate and the essential oil in leaves and flowers of marigold (*Tagetes erecta*, L.), during the second season (1999)

Treatments	Carbohydrates % (dry matter basis)		Percentage of essential oil	
	Leaves	Flowers	Leaves	Flowers
Control	9.94	25.58	0.140	0.010
NPK (200Kg/fed.)	11.75	27.77	0.140	0.010
NPK (400 Kg/fed.)	13.32	25.73	0.176	0.011
NPK (600 Kg/fed.)	12.88	25.93	0.154	0.013
PM (10 m^3/fed.)	11.98	30.93	0.146	0.010
PM (20 m^3/fed.)	14.54	30.10	0.155	0.010
PM (30 m^3/fed.)	13.46	29.51	0.185	0.013
RM (10 m^3/fed.)	13.68	27.09	0.140	0.007
RM (20 m^3/fed.)	16.45	25.52	0.143	0.010
RM (30 m^3/fed.)	16.77	26.83	0.156	0.013
CM (20 m^3/fed.)	13.05	27.77	0.167	0.010
CM (40 m^3/fed.)	16.89	29.58	0.187	0.013
CM (60 m^3/fed.)	16.44	30.52	0.185	0.016
HM (20 m^3/fed.)	12.17	25.39	0.145	0.010
HM (40 m^3/fed.)	16.01	29.55	0.180	0.015
HM (60 m^3/fed.)	15.51	30.63	0.185	0.017

PM: Poultry Manure; RM: Rabbit Manure; CM: Cattle Manure; HM: Horse Manure;

These results agreed with those reported by EL-Tantawy *et al*, (1994) and Machado et. al (1994) on *Tagetes erecta* leaves oil.

The data presented in Table (4) show that the favorable effect of NPK and organic fertilization on pipretone synthesis and accumulation was clear. NPK at 200 kg/fed. slightly increased this component content. While organic fertilizers of RM at three levels, CM at 20m^3/fed and HM at the rates of 20 and 40m^3/fed increased pipretone, the highest pipretone content was 46.21% in the leaves oil of plants received RM at 10m^3/fed.(this increase reached 21.4% over control).

Data in the same table showed that all levels of different organic fertilizers increased limonene percentage than control, the highest percentage of increase was found in plants which were treated by CM followed by HM at the levels 40 or 60m^3/fed which gave the highest percentage of increase 59.98% over control. Also, fertilizing NPK at the rate 400kg/fed.caused a pronounced increase in α-terpinolene percentage by 30.08%, while CM at The rate 40m^3/fed.increased it to 76.3% over control.

The fertilizing treatments; NPK at the level of 400kg/fed.,CMat 40m^3/fed and HM at 60m^3/fed increased p-cymene .8. ol to 15.1, 20.9 and 143.8%, respectively over control.

Table (4): Effect of some chemical and organic fertilizers on the percentage of the different components of the essential oil in leaves of marigold (*Tagetes erecta*, L.) plants, during the second season (1999).

Treatments	The essential oil components %					
	Pipre-tone	Limo-nene	α-Terpino-lene	Sabinene	Ocimene	P-Cymen -8-ol
Control	38.06	13.17	10.97	1.41	4.20	5.36
NPK (200Kg/fed.)	38.90	15.12	10.43	1.53	5.35	4.49
NPK (400 Kg/fed.)	36.44	18.92	14.27	1.99	6.07	6.17
NPK (600 Kg/fed.)	35.15	13.42	9.07	1.03	7.45	5.98
PM (10 m^3/fed.)	30.23	18.93	8.34	1.88	8.39	1.89
PM (20 m^3/fed.)	28.45	18.48	11.05	2.09	6.85	1.52
PM (30 m^3/fed.)	29.02	19.24	12.81	2.14	3.35	1.96
RM (10 m^3/fed.)	46.21	18.51	7.54	1.08	6.89	2.83
RM (20 m^3/fed.)	38.08	18.78	5.93	1.29	6.03	3.27
RM (30 m^3/fed.)	42.83	19.57	5.04	1.49	2.07	4.11
CM (20 m^3/fed.)	30.66	17.29	16.47	1.73	5.45	3.73
CM (40 m^3/fed.)	36.69	21.07	19.34	2.26	6.20	6.48
CM (60 m^3/fed.)	34.64	19.43	15.86	2.36	6.67	4.19
HM (20 m^3/fed.)	39.91	13.74	11.98	1.93	2.49	7.91
HM (40 m^3/fed.)	37.33	15.36	10.93	2.04	4.17	10.34
HM (60 m^3/fed.)	30.99	21.05	16.08	1.83	4.21	13.07

PM: Poultry Manure; RM: Rabbit Manure; CM: Cattle Manure; HM: Horse Manure;

Generally, it was noticed that the highest percentage of ocimene component was recorded when Tagetes plants fertilized with NPK at 600kg/fed.followed by PM at 10m^3/fed.

The best results with regard to sabinene were obtained by fertilizing NPK at the rate 400kg/fed, CM at the rate 40 or 60m^3/fed. Similar results were reported by Aly *et al.* (1995)on *Polyanthus tuberose*

5 - Effect of different fertilizers on total xanthophylls content in petals:

Results in Table (5), indicated that NPK application at the rate 400 kg/fed increased total xanthophylls content. Also, all organic fertilizers at the different levels increased total xanthophylls content. The highest value was 155.8mg/g. dry weight in ray florets of plants received CM at 40 m^3/fed compared to the control plants. This increase was 38.86% over untreated plants (control).Concerning the effect of NPK on xanthophylls yield/plant data, in Table (5) show that all levels increased xanthophylls yield, but the rate of NPK (400kg/fed.) produced the best effect.

In addition, data indicate that fertilization with the different organic manures increased these pigments content in plants. The highest values of

xanthophylls content were recorded for plants fertilized by CM at $60m^3$/fed.followed by PM at 10 or $20m^3$/fed.Similar results were accordance by Philip and Berry(1975) on *Tagetes erecta.*

6- Effect of different fertilizers on lutein content mg/g dry weight of petals:

Results in Table (5) represent that the lutein values were decreased when plants fertilized with the different levels of NPK. From the other side, the organic fertilizers increased lutein content in the ray florets of *Tagetes erecta* plant. Baldwin *et al.* (1993) on *Tagetes erecta*, found that pigment yield increased most after three nitrogen applications (ammonium nitrate at 28kg/ha each time) within a single season.

The highest values of lutein content were 47.63 and 46.5 mg/g dry petals of plants received PM or the rates CM at the rates 10 and $40m^3$/fed, respectively, (These increases reached 32.4 and 29.3% over control, respectively).Similar results were obtained by El Khayat (1987) on *Tagetes patula.*

7 -Effect of different fertilizers on lutein components content:

Data in Table (5) demonstrate that the petals are rich sources of lutein which acylated with fatty acids. The lutein contains the following fractions: lutein dipalmetate is (the major ester in *Tagetes erecta* petals), lutein myristate palmitate,_lutein dimyristate and 3,3m dihydroxy- alpha- carotene (Philip and Berry, 1975 and Gau *et al.*, 1983)

Data in Table (5) show that the highest lutein dipalme ate content of plants was received by NPK at 200kg/fed followed by CM at 6 $)m^3$/fed. These treatments increased this component (28.5 and 22.2 %, respectively over control plant). Data in Table (5) indicate that NPK at 400 kg/fed increased contents of both lutein myristate palmitate and lutein dimerystate compared to unfertilized plants, (control). In concerning the effect of organic fertilizers on these previous components, the highest values were 29.3 and 36.33% in the flowers petals of plants received RM at $20m^3$ and HM at $60m^3$/fed compared to control plants, respectively.

Data in (Table 5) show that NPK at 200 kg/fed increased 3,3, di hydroxy α-carotene, while the highest value of this component in petals of plants fertilized with PM at $30m^3$/fed. In general, chemical and organic fertilizers increased carotenoids in petals of *Tagetes erecta.*

Generally, the best results of the dry weight of ray florets volatile oil and pigment contents were obtained from plants fertilized with NPK at the rate of 400 kg/fed., poultry manure at 20 and 30 m^3/fed and cattle manure at the rate of 40 or $60m^3$/fed.

Table (5): Effect of some chemical and organic fertilizers on xanthophylls, lutein contents and lutein constituents % (dry weight basis) in petals of marigold (*Tagetes erecta, L.*) plants, during the second season (1999).

Treatments	Total xanthophylls content (mg/g.)	Xanthophylls yield (g./plant)	Lutein (mg/g.)	Lutein dipalmitate %	Carotenoids constituents%			
					Lutein myristate palmitate %	Lutein dimyristate %	3,3, dihydroxy α-carotene	Total %
Control	112.20	6.02	35.97	30.62	26.01	18.52	3.22	78.37
NPK (200Kg/fed.)	116.20	10.41	31.50	39.35	24.13	20.44	15.98	99.90
NPK (400 Kg/fed.)	143.03	14.62	32.63	29.28	31.13	28.97	10.00	99.38
NPK (600 Kg/fed.)	111.76	10.00	30.90	36.41	25.90	21.17	9.44	92.92
PM (10 m^3/fed.)	137.67	14.53	47.63	32.68	26.03	28.28	12.90	99.89
PM (20 m^3/fed.)	135.71	14.51	36.07	35.18	24.71	30.32	9.06	99.27
PM (30 m^3/fed.)	113.01	11.42	34.83	23.22	17.81	15.31	42.74	99.08
RM (10 m^3/fed.)	133.76	9.24	36.45	31.97	27.83	30.41	9.69	99.90
RM (20 m^3/fed.)	125.49	11.17	37.55	30.90	29.30	29.56	9.88	99.64
RM (30 m^3/fed.)	124.62	10.65	42.28	31.88	26.09	33.13	8.86	99.96
CM (20 m^3/fed.)	129.42	10.76	39.13	33.94	28.84	20.44	10.26	93.48
CM (40 m^3/fed.)	155.80	13.78	46.50	37.14	26.67	28.74	7.32	99.87
CM (60 m^3/fed.)	142.28	14.66	45.15	37.42	24.77	25.82	11.85	99.86
HM (20 m^3/fed.)	128.10	11.53	46.40	23.72	26.86	29.70	6.30	86.58
HM (40 m^3/fed.)	119.67	11.61	30.83	35.69	26.26	22.12	9.78	93.85
HM (60 m^3/fed.)	115.38	11.99	35.13	31.80	26.46	36.33	5.01	99.60

PM: Poultry Manure; **RM:** Rabbit Manure; **CM:** Cattle Manure; **HM:** Horse Manure;

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تأثير الأسمدة المختلفة على التركيب الكيماوى لنبات القطيفة

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أجريت هذه التجربة لدراسة تأثير بعض الأسـمدة الكيميائيـة (نيتروجينيـة، فوسفاتيه، بوتاسيه) والعضوية (سماد الدواجن، الأرانـب، الماشـية، الخيـول) علـى التركيب الكيماوى لنبات القطيفه.

وجد أن كل معاملات التسميد الكيميائية والعضوية تؤدى الى زيـادة الـوزن الجاف للأزهار الشعاعية (البتلات)/نبات ــ الكلوروفيل والكاروتينات فـى الأوراق ــ النسبة المئوية للزيت الطيـار ــ الكربوهيـدرات ــ الزانثـوفيلات ــ النـاتج الكلـى للزانثوفيلات/ انبات ، نسبة صبغة الليوتين فى البتلات. وجـد أن أكثـر المعـاملات السمادية الكيميـنية تأثيرا هى التسميد بمعدل ٤٠٠ كجم للفدان والتسميد العضوى بمعدل ٢٠، ٣٠م٣/للفدان لسماد الدواجن و ٤٠ أو ٦٠ م٣ للفدان لسماد الماشية.