RESULTS AND DISCUSSION

EFFECT OF GROWTH REGULATORS ON VEGETATIVE GROWTH, FLOWERING AND CHEMICAL COMPOSITION OF TAGETES PATULA PLANT:

A. Effect of Kinetin B-Nine

1. On vegetative growth:

a. Plant height:

Although Tagetes patula plant is one of the dwarf plants, the effect of growth regulators on the plant height can be noticed as shown in Table (1). Spraying plants with kinetin at 25, 50, 75 and 100 ppm increased plant height in both seasons although not significant. The differences in plant height observed as a result of raising the concentrations were very slight and were not constant in the two years of experiments. Carpenter and Carlson (1972) reported that spraying chrysanthemum at pinching time with PBA (200 ppm) increased branching and inhibited stem elongation.

b. Number of main branches:

The number of branches per plant was not affected by the the different rates of kinetin sprayed on plants in both seasons. Since the mean number of branches per plant was 4.7, 4.0, 4.3 for plants treated with 25, 50 and 100 ppm respectively compared with 4.3 for control plants in the first season, and it was 5.7, 5.0, 5.0 and 5.3 for plants treated with 25, 50, 75 and 100 ppm respectively compared with 5.3 for control plants in the second season. It is

Table (1): Effect of Growth Regulators Treatments on Vegetative Growth of Tagetes patula plants During 1984 and 1985 seasons.

Treatments	Height of plant in (cm)		No. of main branches / plant		Fresh weight of root in (gm)		Dry weight of root in (gm)		Fresh weight of stems in (gm)		Dry weight of stems in (gm)	
	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985
Control	38.70	46.30	4.30	5.30	9.53	9.53	3.11	3.27	290.0	302.7	60.67	61.42
Kinetin 25 ppm	38.70	50.30	4.70	5.70	9.78	12.02	3.43	3.73	336.0	357.3	65.79	66.57
Kinetin 50 ppm	40.00	48.70	4.00	5.00	11.12	12.40	3.48	3.83	346.7	365.7	67.89	71.92
Kinetin 75 ppm	-	52.00	-	5.00	-	14.82	-	3.98	-	371.7	-	76.19
Kin. 100 ppm	39.70	52.30	4.30	5.30	11.36	13.03	3.65	3.75	365.3	385.7	69.52	76.40
B_9 500 ppm	-	48.00	-	4.70	-	12.68	-	3.83	-	409.0	-	78.80
B_9 1000 ppm	38.70	45.30	4.70	6.00	12.68	12.31	3.40	3.43	358.3	375.3	69.69	75.82
B_9 2000 ppm	35.70	44.00	4.30	6.30	11.55	10.26	3.01	3.32	346.7	355.7	63.67	72.21
B_9 3000 ppm	36.00	43.70	5.70	6.00	12.31	11.55	3.06	3.61	290.7	320.3	62.48	70.56
L.S.D. 5%	1.98	6.05	2.25	1.38	4.53	5.71	1.24	1.86	54.72	56.31	5.98	7.80
1%	2.78	8.33	3.15	1.90	6.37	7.85	1.74	2.57	76.81	77.56	8.39	10.70

clear that the number of branches per plant in this case was not affected by the different concentrations of kinetin used in this work. While on Ammi visnaga Reda(1982) found that number of branches significantly increased by kinetine at 40 ppm.

c. Weight of stems:

The fresh weight of stem increased by spraying kinetin at different concentration and the increases were significant with the high concentrations of 50, 75 and 100 ppm in the two years of experiment. It is clear also from the data presented in table (1) that the increase in plant stem weight was proportion with the increase of kinetine concentration. So the highest concentration of kinetin resulted in the highest fresh and dry weight .

Poole (1970), reported that the growth of Scindapsus aureus plants responded to PBA at 100-400 ppm.

d. Weight of root:

The fresh and dry weights of root represented no significant differences when plants were sprayed with different concentrations of kinetine. But in spite of the

fresh and dry weights of roots as a result of kinetin treatments with the high concentrations of 75 and 100 ppm which gave fresh weights of 14.82 and 13.03 gm compared with 9.53 gm for control plants and dry weights of 3.98 and 3.75 compared with 3.27 gm for control. Fries (1960) on lupinus found that kinetin at higher concentration accelerated growth rate of the shoots and lateral roots and resulted in a great increase in dry weight of all parts of the plants.

2. Effect of kinetin on flowering:

a. Number of flowers per plant:

Data presented in Table (2) indicate that the number of flowers per plant increased with spraying Tagetes plants with kinetin at different concentrations. The high concentrations of 50, 75 and 100 ppm resulted in significant increases of the main number of flowers per plant over control. The number of flower per plant increased as the kinetin concentration increased. The highest number of flowers per plant was obtained with the highest concentration of kinetin 100 ppm. These results came with the same trend of vegetative growth results, since the high concentrations of kinetin produced the plants with high fresh and dry weights. So it is concepted to gave the high number of flowers carried by this growth. Catrino (1964) on Bryophyllum crenatum indicated that spraying plants with 50 ppm kinetin solution at intervals increased the size of the flowering shoot and bracts and increased the number of flowers per plant.

b. Weight of flowers per plant:

The yearly yield of flowers per plant increased when plants were treated with kinetin at different rates. The

Table (2): Effect of Growth Regulators Treatments on the Flowering of *Tagetes patula* plants During 1984 and 1985 seasons.

Treatments	No. of flowers per plant		Weight of flowers/plant		Fresh weight of petals/Plant		Dry weight of petals / Plant	
	1984	1985	1984	1985	1984	1985	1984	1985
Control	262.00	382.33	406.00	613.00	168.00	278.18	22.25	35.31
Kinetin 25 ppm	299.67	463.67	417.00	688.67	172.00	301.48	23.59	38.30
Kinetin 50 ppm	341.33	501.00	430.00	724.67	176.00	321.66	23.83	40.22
Kinetin 75 ppm	-	552.00	-	716.00	-	306.53	-	38.97
Kinetin 100 ppm	385.00	498.67	540.00	702.00	221.00	291.77	29.71	37.32
B-nine 500 ppm	-	566.00	-	734.33	-	308.70	-	38.82
B-nine 1000 ppm	427.33	510.00	462.00	727.00	193.00	292.50	27.35	38.16
B-nine 2000 ppm	327.67	481.00	434.00	662.67	178.00	302.61	24.73	36.49
B-nine 3000 ppm	280.33	468.33	424.00	653.00	175.00	282.18	23.89	35.11
L.S.D. 5%	69.74	58.85	46.15	78.86	16.61	47.40	2.51	4.11
1%	96.29	81.06	63.72	108.62	22.94	65.29	3.46	5.66

increase in the yield of flower per plant was significant with high concentration only in the first season. While it was significant with all kinetin treatments in the second season except low level. The highest yield of flowers per plant was obtained with kinetin treatment of 100 ppm in the first season and 50 ppm in the second season. The differences between the results of the two years might be due to the different Planting date in both seasons ; since the Planting date in the first year was later . So the results of the second season might be more actual in comparing the effect of different treatments. Abou-El-Ghait (1985), on carnation reported that PBA, spraying had more promising and direct effects on increasing number of branches and flowers per plant. She added that PBA at 100 ppm produced highest number and better quality of flowers.

c. Weight of petals per plant:

The mean yield of petals per plant also increased with spraying kinetin at different concentrations. The maximum increases in the mean fresh and dry weights of petals per plant were obtained from plants treated with 100 ppm kinetin in first season and plants treated with 50 ppm in the second season. These treatments produced fresh yield of petals increased with 32% and 16% respectively over control. While the same treatments obtained dry yield of petals increased by 34% and 14% over control. These treatments followed by 50 and 75 ppm kinetin for first and second year results respectively. It is clear that the trend of result is not constant for the two years concerning the effect of kinetin on the yield of flowers or petals per plant. But comparing the data of the two seasons it could be observed that the medium concentrations of 50 and 75 ppm kinetin are the most effective on the flowering of Tagetes plants. So there is no need for using higher concentrations of kinetin for improving flowering of this plant.

On *Ammi visnaga* Reda (1982) demonstrated that dry weight of flowers and rays of flower umbels increased by treatment of 40 ppm kinetin.

3. Effect of kinetin on chemical composition:

a. Total carbohydrate percentage:

1. Leaves:

Data in Table (3) showed that spraying kinetin at different concentrations increased total carbohydrate content of plant leaves except with the highest concentration of 100 ppm. The moderate concentrations of 50 and 75 ppm gave the highest percentages (14.45%) of carbohydrate. The lowest concentration (25 ppm) produced carbohydrate percent of 12.52% compared with 11.56 for control plant. This explain the encouraged effects of kinetin on plant biosynthesis. These results were in agreement with Abou-El-Ghait (1985) who mentioned that cytokinins especially PBA at 50 ppm increased the carbohydrate content in the leaves of carnation. Wahba (1983), revealed that

Table (3): Effect of Growth Regulators Treatments on the Chemical Composition of plant organs (leaves and stems) during 1985 season.

Treatments	N%		P%		K%		Total Carbohydrate %	
	Leaves	Stems	Leaves	Stems	Leaves	Stems	Leaves	Stems
Control	2.13	1.23	0.275	0.233	1.65	2.00	11.56	17.34
Kinetin 25 ppm	2.11	1.17	0.299	0.287	1.75	2.05	12.52	17.34
Kin. 50	2.04	1.25	0.317	0.287	1.80	2.10	14.45	16.37
Kin. 75	2.30	1.35	0.293	0.275	1.80	2.05	14.45	17.34
Kin. 100	2.14	1.25	0.281	0.245	1.65	1.75	10.60	14.45
B_9 500 ppm	2.12	1.37	0.275	0.245	1.80	2.20	14.45	17.34
B_9 1000	2.09	1.46	0.287	0.293	1.85	2.45	13.48	15.41
B_9 2000	2.35	1.46	0.293	0.251	1.75	2.20	11.56	15.41
B_9 3000	2.04	1.58	0.305	0.293	1.60	2.05	10.60	15.41

PBA application increased carbohydrate percentages in leaves of capsicum plant.

2. Stems:

In concern with total carbohydrate percent of Tagetes stems data in Table (3) indicate that no clear trend was observed for the effect of kinetin. So no differences in the carbohydrate percentages were observed when kinetin was sprayed at both 25 or 75 ppm concentrations or control plants. While 50 ppm concentration slightly decreased carbohydrate percent of plant stem. This means that kinetin have no promocing effect on carbohydrate content in plant stem. This result agree with Hassanin (1985) on Pelargonium graveolens who found that BA treatments decreased the total carbohydrate contents in the stems.

b. Minerals content:

1. In leaves:

Data of chemical analysis presented in Table (3) show that there were slight increases in nitrogen percent of plant leaves when kinetin was sprayed on plants at the low concentrations usud in this investigation (25,50and 75PPm). While slight decreased in this respect was obtained with high concentration of (100PPm) . Hassanain (1985), mentioned that BA treatments had no constant trend in the mineral contents in leaves and stems of geranium plants.

On other side phosphorous percent in plant leaves increased by all kinetin treatments especially with low levels of 25 and 50 ppm. While the increases in phosphorous percentages were lower with high concentrations of 75 and 100 ppm.

Also kinetin treatments increased potassium percent in plant leaves except with the highest concentration of 100 ppm which gave the same value of potassium percent as control plant.

2. In stems:

Kinetin treatments affected minerals percentages of plant stem nearly by the same way as it affected it in plant leaves. Since the same trend of results previously observed with nitrogen, phosphorous and potassium percentages in plant leaves could be noticed with its percentages in plant stems as shown in Table (3). Also the highest level of kinetin 100 ppm resulted in slight decrease in potassium percent of stems as it gave the same value of control plant concerning potassium percent of plant leaves and was the least effective concentration in this respect. From the previous data it could be concluded that kinetin play an important role in improving activity of many vital processes in plant which reflect good growth of more vegetative growth and flowers. Accordingly chemical constituents of plant parts must be affected by the activation of such processes. So total carbohydrate and minerals percentages of plant leaves and stems increased as a result of kinetin treatments.

c. Oil percent:

Data of volatile oil percent as well as its production per individual plant and feddan linked with the anow regulator were tabulated in Table (4).

Visual acceleration in the oil excretion had been realized due to spraying the plant with 50 and 75 ppm kinetin. Assuming that the oil percent against the abovemention concentrations form a straight line. The yield of the oil per plant is reflected by the response of the plant growth to the different growth substance concentrations. Further concentration of kinetin up 100 ppm diminished both the oil percentage and its yield/plant. However, the increase percent in the oil production per plant or feddan due to increment concentrations of kinetin applied in the present study in comparison with the control treatment were 7.8 % 35.9, 29.7 and 4. 7% respectively .

Fig. (1) shows the gas-liquid chromatogram of the volatile oil of T.patula cultivar Tangarine (identified by Prof. E. C. Wassink, Agric. Univ. Wageningen, Holland) with the 5% carbowax 20 M (PEG) column, which gave the best fractionation under standard conditions.

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Table (4): Effect of Growth Regulator Treatments on on accumulation in Tagetes Flowers During 1985 season.

Treatments	Oil percentages	Oil yield/ plant in gms	Oil yield/fe in kgs.
Control	0.181	0.064	3.072
Kinetin 25 ppm	0.181	0.069	3.312
Kinetin 50 ppm	0.216	0.087	4.176
Kinetin 75 ppm	0.212	0.083	3.984
Kinetin 100 ppm	0.180	0.067	3.216
B-nine 500 ppm	0.183	0.071	3.408
B-nine 1000 ppm	0.176	0.067	3.216
B-nine 2000 ppm	0.224	0.082	3.936
B-nine 3000 ppm	0.185	0.065	3.120

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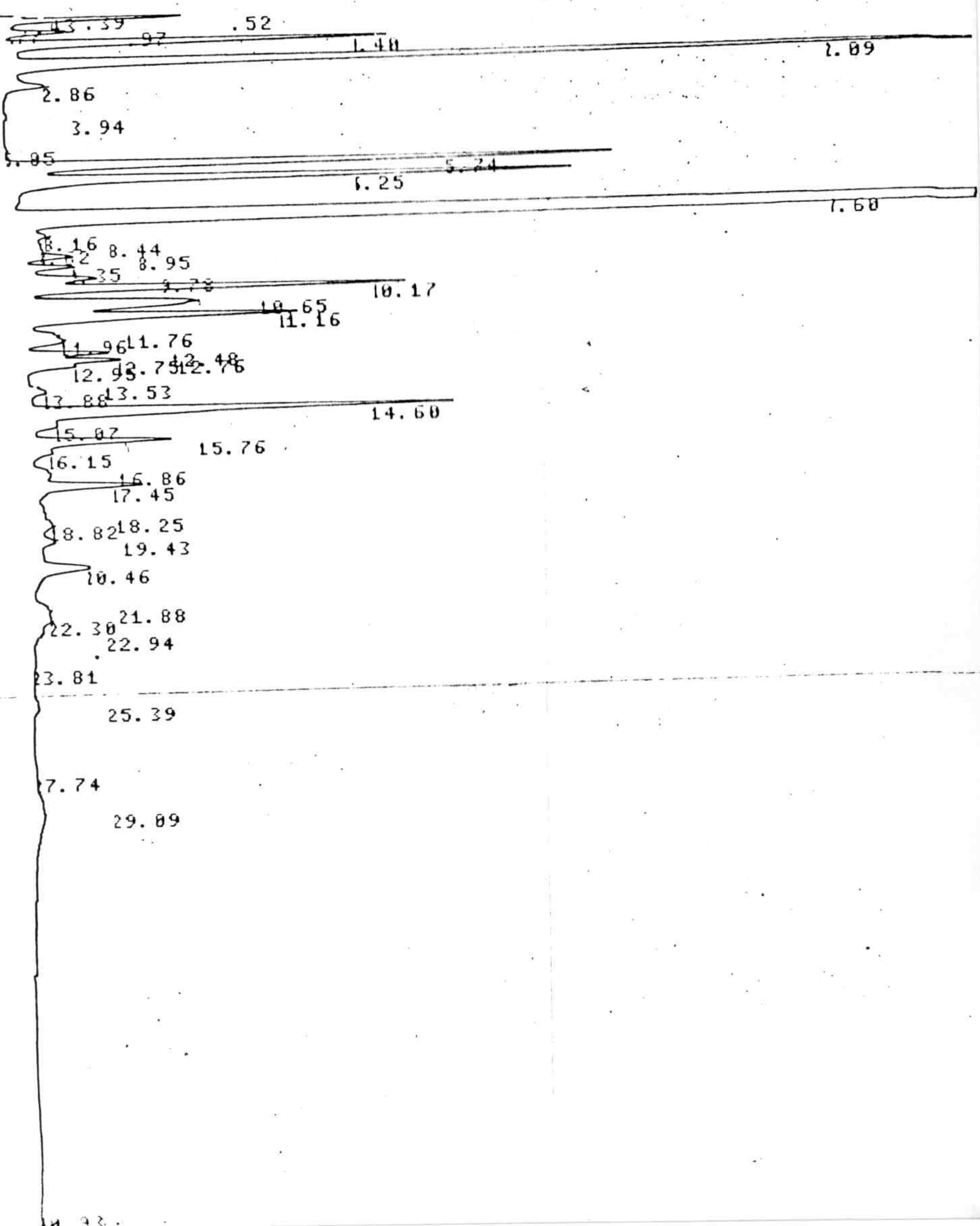

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EAK#	AREA%	RT	AREA	BC	Substance
1	0.027	0.39	273	02	
2	0.066	0.43	662	02	α-pinene
3	1.197	0.52	12009	02	
4	0.031	0.77	310	02	
5	0.593	0.97	5990	02	Camphene
6	3.331	1.4	33646	02	B-pinene
7	9.67	2.09	97692	08	Sabinene
8	0.477	2.86	4817	05	
9	0.058	3.94	588	01	
10	0.035	5.05	351	02	Myrcene
11	5.503	5.74	55596	02	α-Terpinene
12	5.427	6.25	54826	03	Limonene
13	44.332	7.6	447849	02	
14	0.381	8.16	3847	02	
15	0.218	8.44	2206	02	
16	0.235	8.62	2375	02	B-phellandrene
17	0.617	8.95	6238	02	γ-terpinene
18	0.521	9.35	5264	02	
19	0.927	9.78	9360	02	Cis-B-ocimene
20	3.533	10.17	35688	02	Trans-B-ocimene
21	3.	10.65	30309	02	P-cymene
22	3.065	11.16	30959	02	
23	0.325	11.76	3283	02	
24	0.563	11.96	5692	02	
25	0.688	12.48	6954	02	
26	0.429	12.75	4337	02	
27	0.419	12.76	4229	02	
28	0.373	12.95	3770	03	
29	0.021	13.53	214	02	
30	0.266	13.88	2690	02	B-Borborene
31	4.742	14.6	47907	02	
32	0.376	15.07	3799	02	Geranyl acetate
33	1.555	15.76	15707	02	
34	0.278	16.15	2812	02	
35	0.42	16.86	4247	02	Humulene
36	1.42	17.45	14350	02	
37	0.383	18.25	3873	02	
38	0.445	18.82	4491	02	
39	0.446	19.43	4503	02	Caryophyllene oxide
40	1.249	20.46	12620	03	
41	0.292	21.88	2953	02	
42	0.443	22.3	4473	02	
43	0.033	22.94	333	03	
44	0.085	23.81	858	01	
45	0.168	25.39	1694	01	
46	0.116	27.74	1172	02	
47	0.772	29.09	7803	03	
48	0.336	40.93	3395	01	
49	0.109	50.4	1106	01	
TOTAL	100.		1010208		

The oil contains high percentage of limonene 44.332% giving the oil the advantage for many industrial preparations. Analysis of the volatile oil on the packed column indicates that much peaks are mono and sesqui-hydrocarbons mainly B-Pinene (9.67%) myrcene (5.50%), α-terpinene (5.43%). B-borborene (4.74%), cis-B-ocimene (3.53%), camphene (3.33%) and trans-B-ocimene (3.00%).

d. Pigment:

The quality of beding and of cutting flowers may be defined as the sequence of changes in colour, flavour and texture which lead to the state at which the flower is acceptable for marketing. The readily apparent phenomena associated with the quality definition of the majority of beding flowers include colour intensity which involves the synthesis of pigments and the variability of different dyes constituents accumulate in the flower tissues, beside changes in acidity, astringency, phenols, sugars and volatiles, which are due to a series of basic changes in the composition and metabolism.

In recent years, beding and cutting flowers quality control have expended much energy in an attempt to distinguish the influence of different physiological and edaphic factors on the flower dyes from their quantitative and qualitative points of view.

The formation of isopentenyl pyrophosphate (IPP), the universal biological isoprenoid precursor, from acetyl CoA via mevalonic acid is now well established. To produce higher molecules, IPP is isomerized to dimethylallyl pyrophosphate which acts as starter for chain elongation. This process proceeds by sequential addition of molecules of IPP to form geranyl geranyl pyrophosphate. Geranylgeranyl pyrophosphate is converted into phytoene. The stepwise desaturation of phytoene to phytofluene has considerable circumstantial support in which carotenogenesis and lower isoprengenesis are directed by compounds such as growth regulators or by certain edaphic factors i.e. soil fertility.

HPLC analysis revealed that the Tagetes patula pigment contains high percentage of lutein (33-dihydroxy-α-carotene) as a main constituent followed by antheraxanthin (5,6-expxy (3-3-dihydroxy-B-carotene), α-cryptoxanthin (3-hydroxy- α-carotene), B-carotene, α-carotene and phytofluene respectively.

1. Chemical variability in relation to growth regulators:

Values of the percentages of different carotenoids of T.petals either in the crude pigment or in the flower-petals (based on the dry weight) as well as yield/plant are listed in Tables (5,6,7) and illustrated in Figures (2,3) As revealed by these data the percentage of the colourless carotenoid (phytofluene) attained its maximum peak due treating the plant with lowest concentration of kinetin

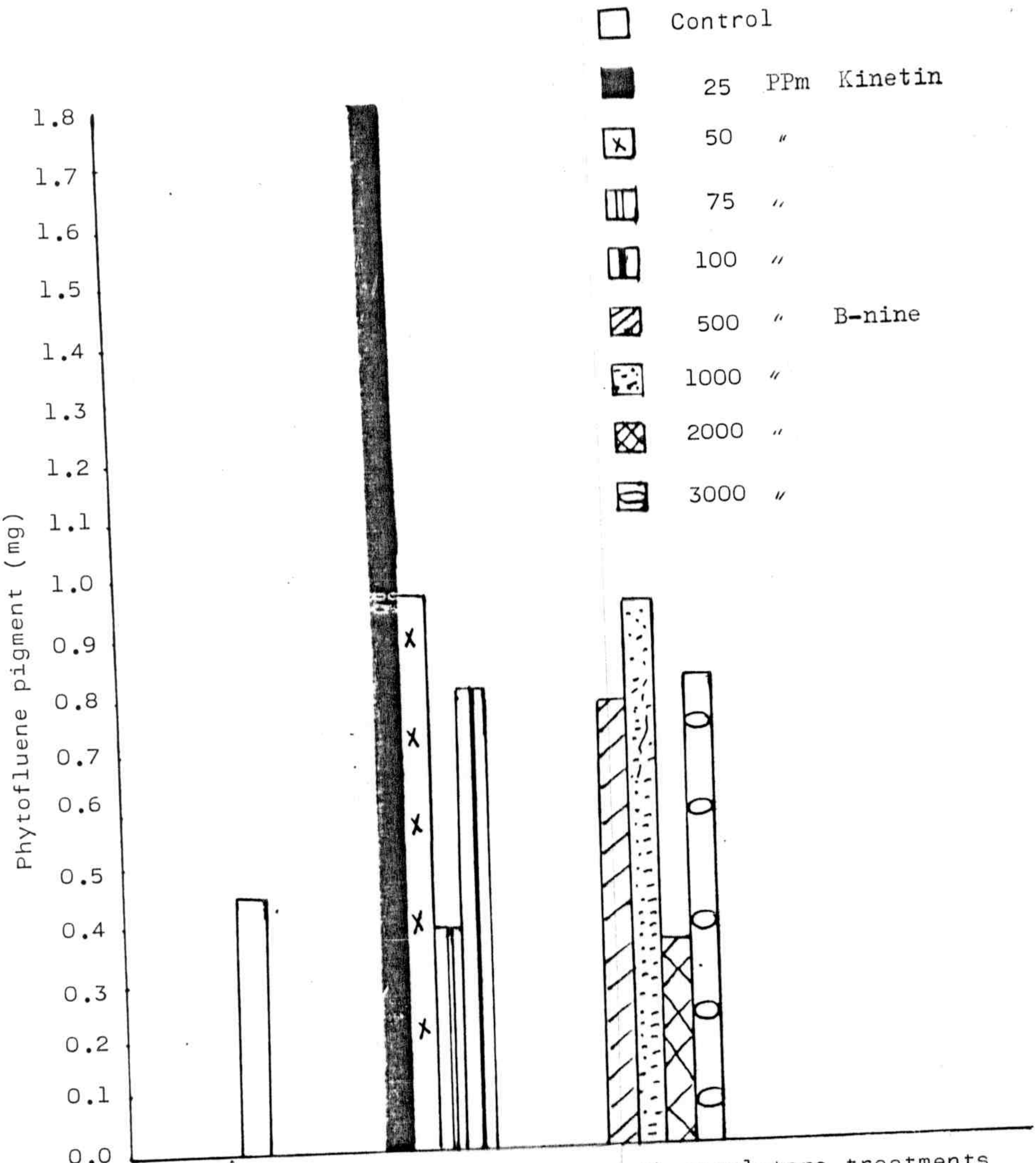


Fig. ( ): Effect of different growth regulators treatments on phytofluene pigment of *Tagetes patula* petals.

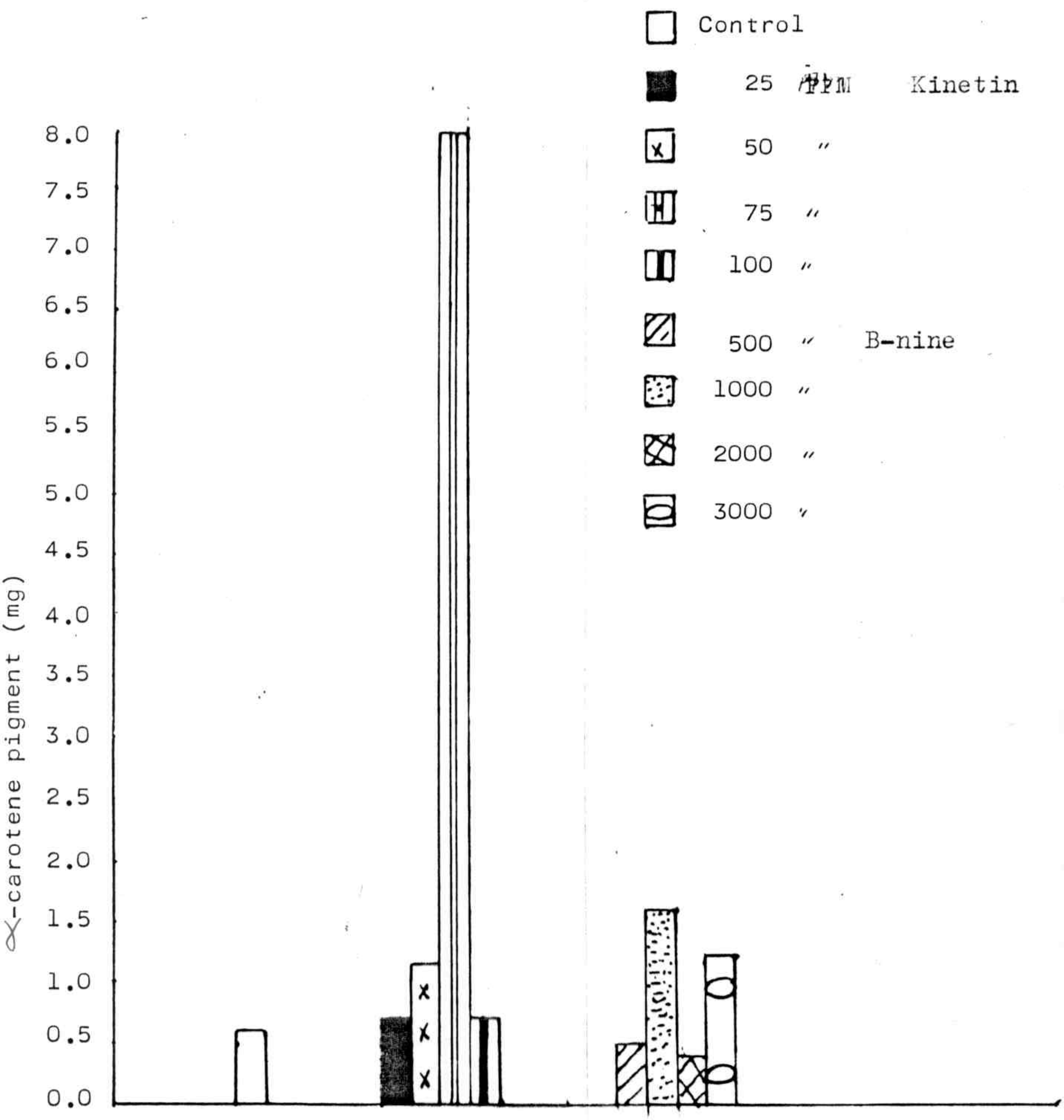


Fig. ( ): Effect of different growth regulators treatments on α-carotene pigment of *Tagetes patula* petals.

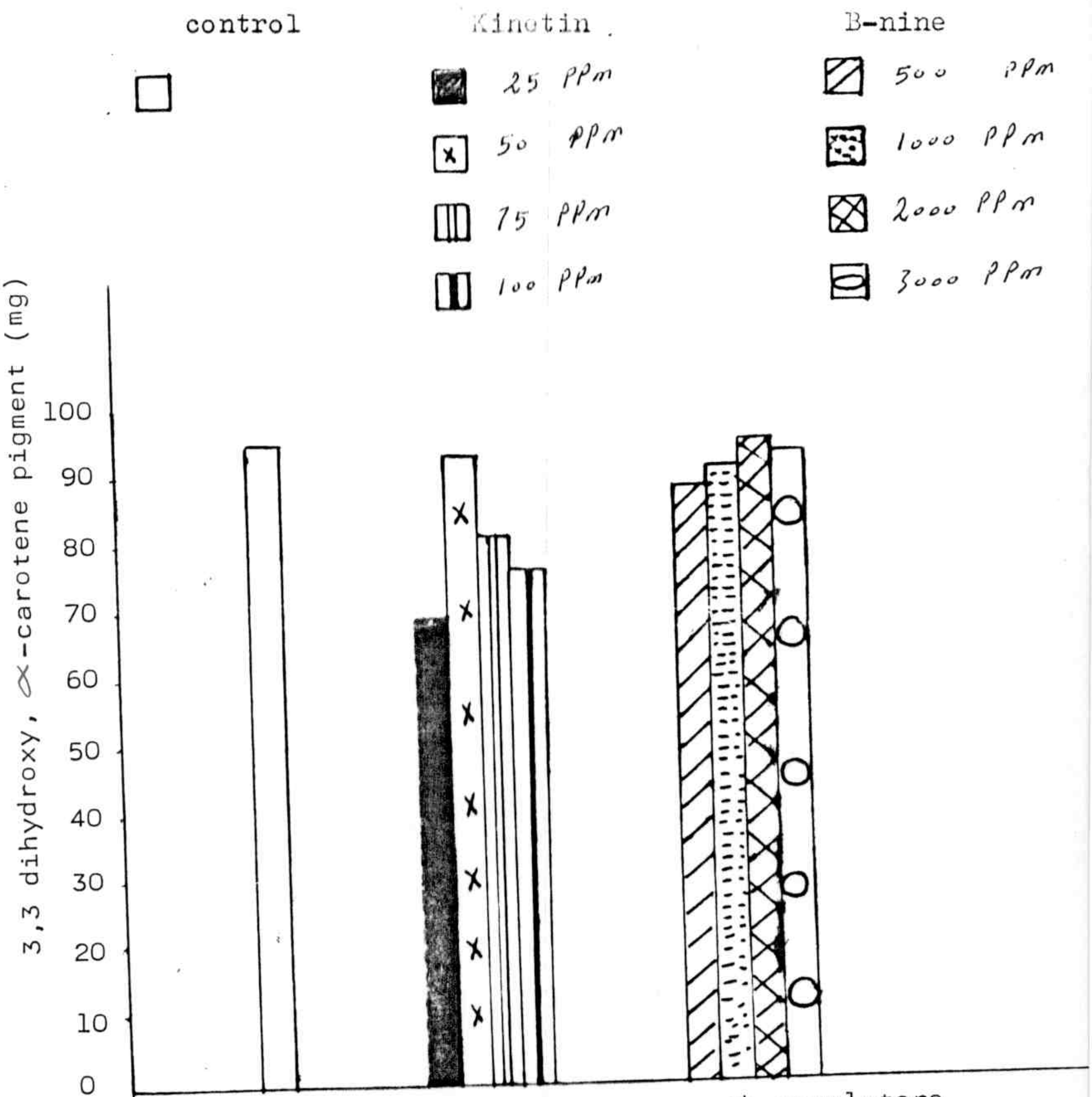


Fig. ( ): Effect of different growth regulators treatments on 3,3 dihydroxy∝-carotene pigment of *Tagetes patula* plants.

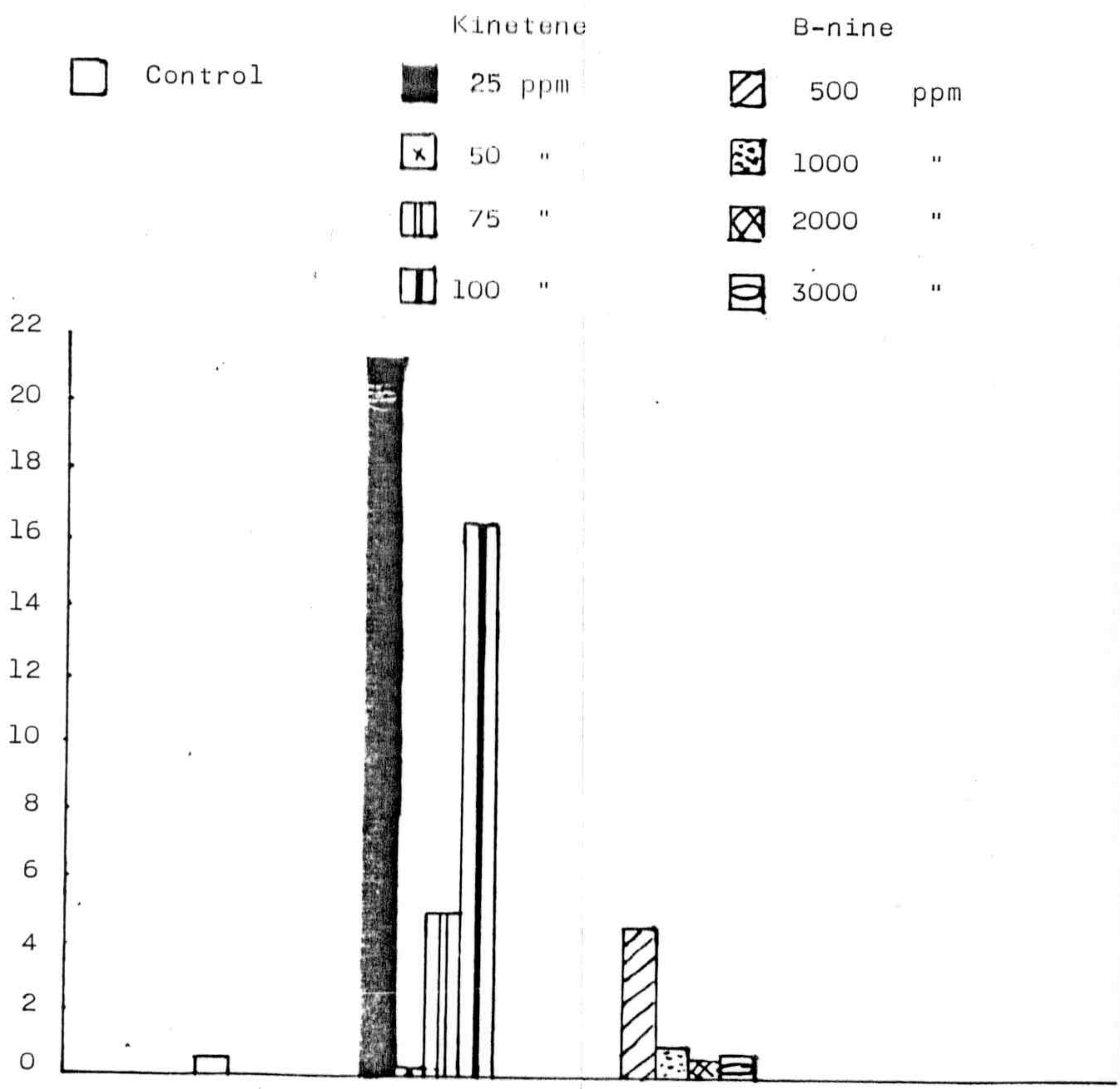
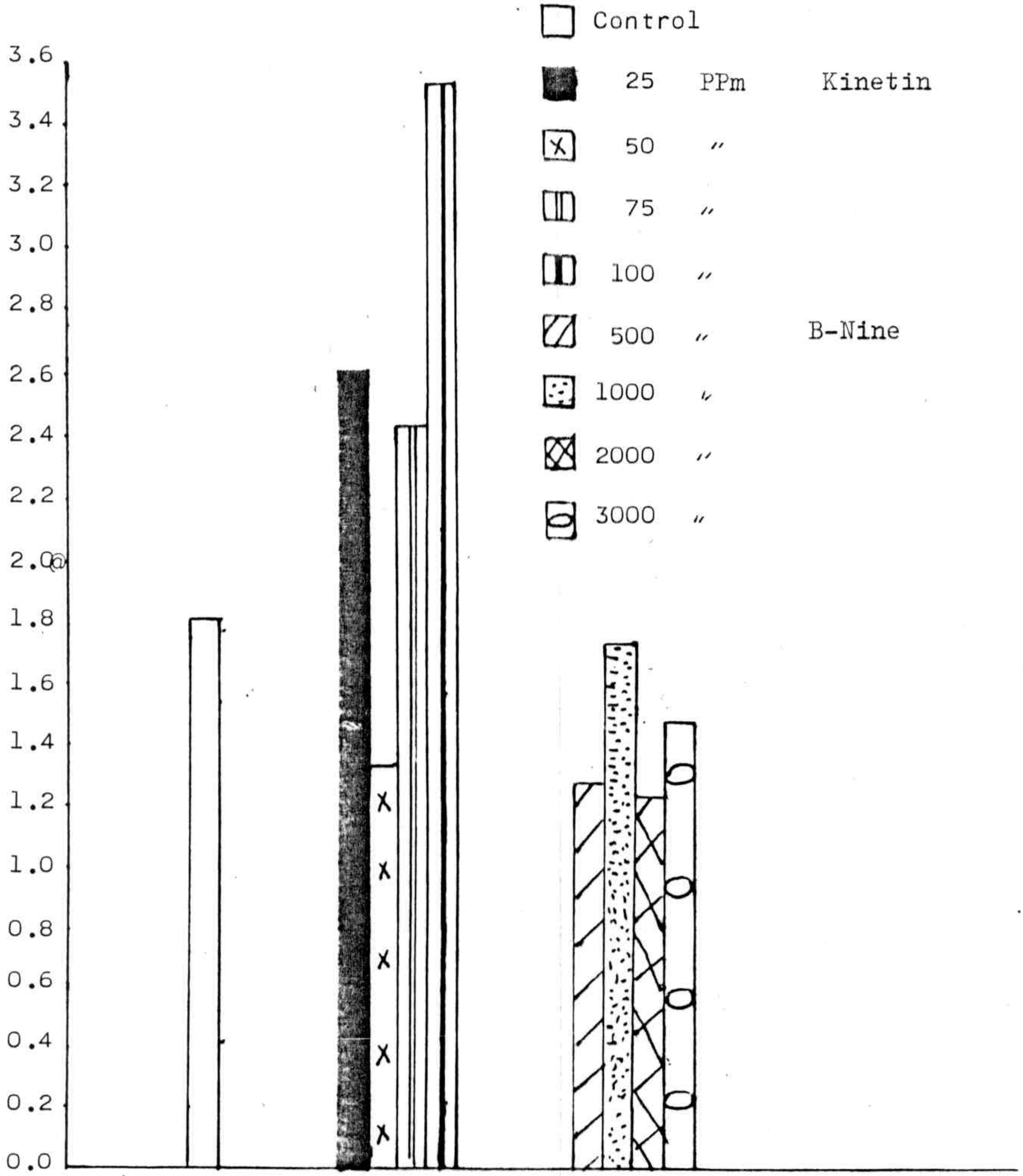


Fig. ( ): Effect of different growth regulators treatments on 3,3 aloxy (3,3 dihydroxy-B-carotene pigments of *Tagetes patula* plants.



<u>Fig. ( )</u>: Effect of different growth regulators treatments on B-carotene pigment of <u>Tagetes</u> <u>patula</u> plants.

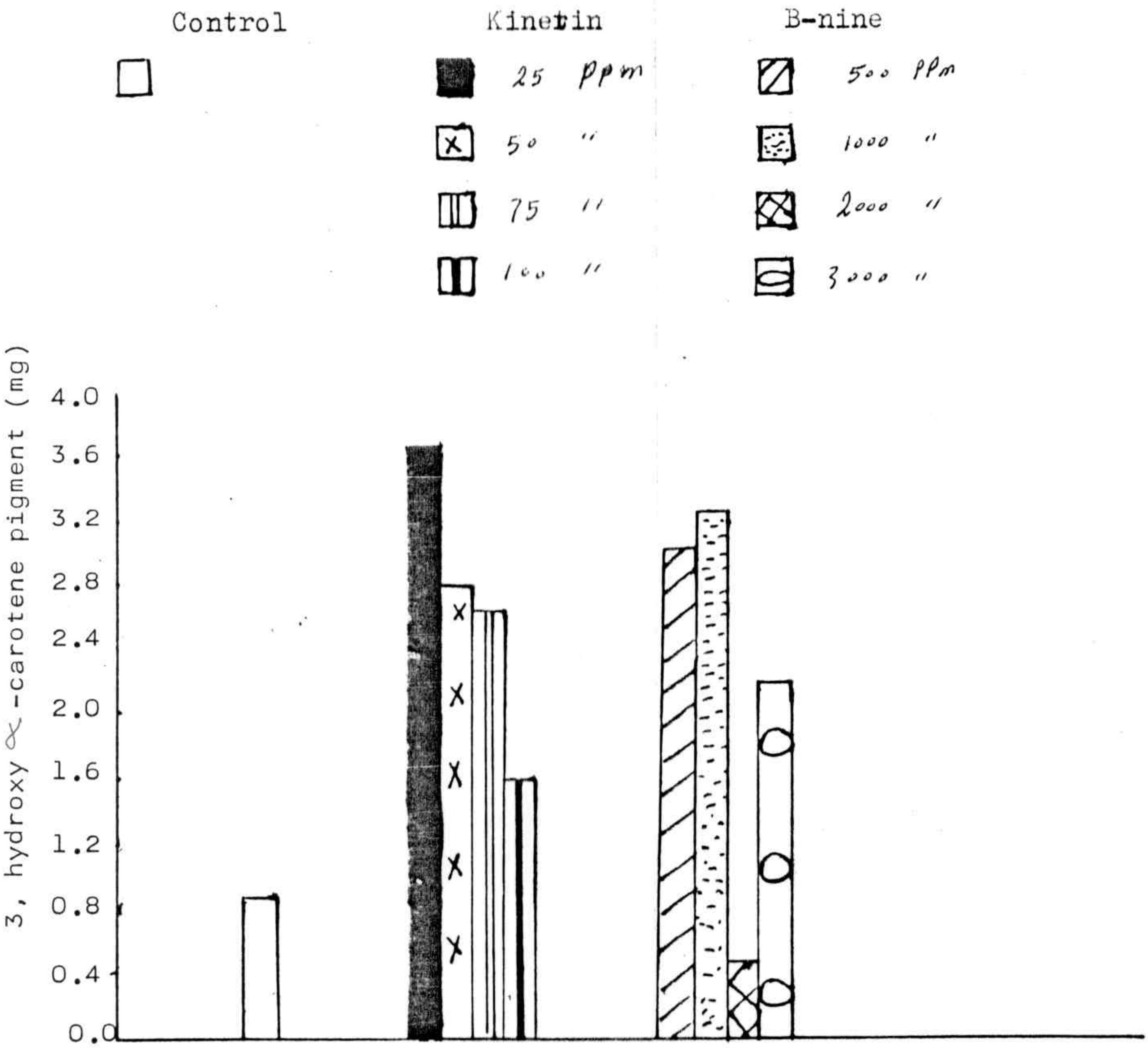


Fig. ( ): Effect of different growth regulators treatments on 3,hydroxy ∝-carotene pigment (mg) of *Tagetes patula* plants.

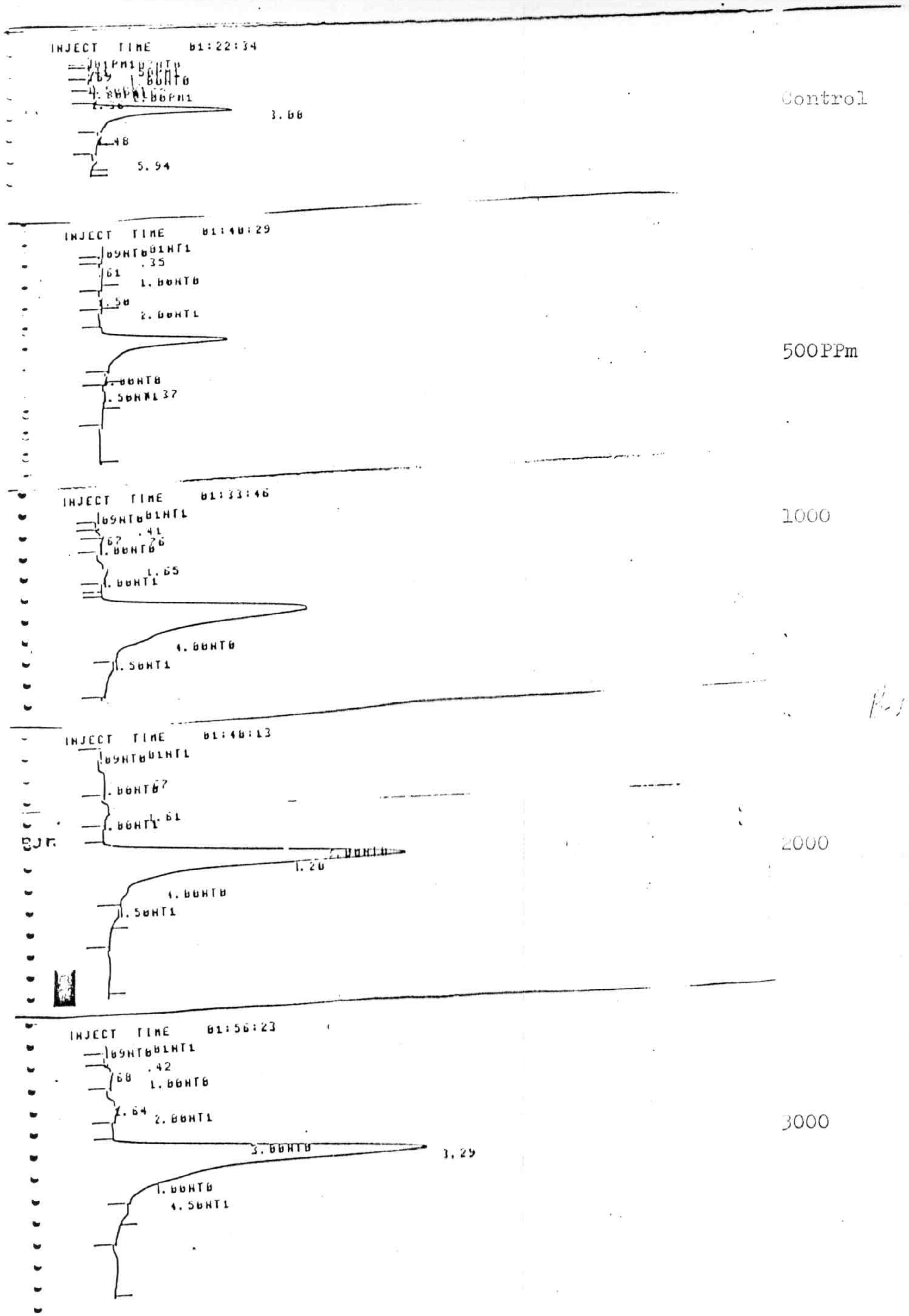


Fig. ( ): Effect of B-nine treatments on the pigment constituents of <u>Tageles patula</u> petals during 1985 season.

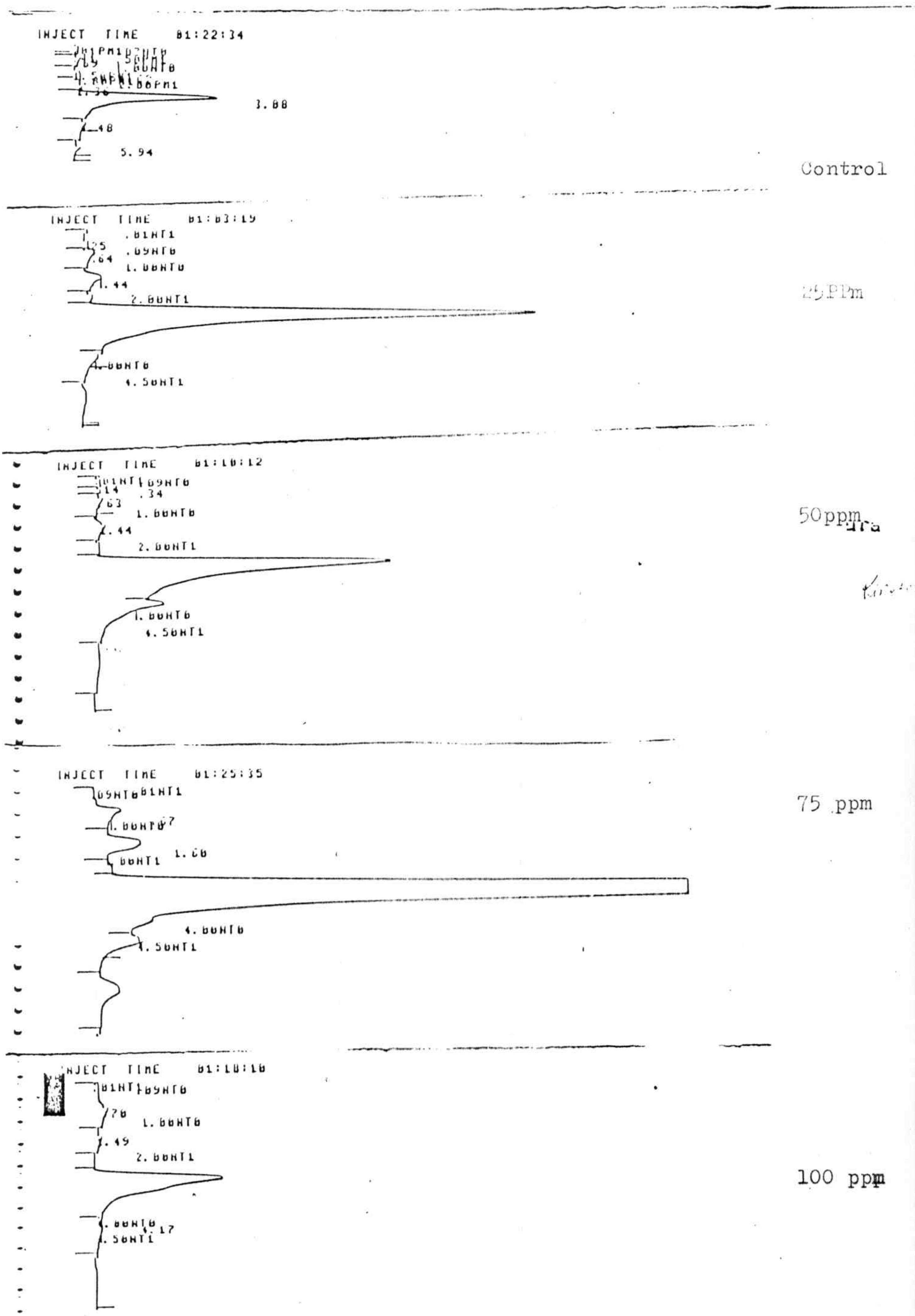


Fig. ( ): Effect of Kinetune treatments on the pigment constituents of _Tageles_

Table (5): Effect of Growth Regulators Treatments on the pigment constituents of *Tageles patula* petals During 1985 season.

Treatments	3,3-di-hydroxy-α-carotene	3-hydroxy-α-carotene	5,6-apoxy (33-dihydroxy-B-carotene	B-carotene	α-carotene	Phytofluene	Total
Control	95.261	0.878	0.636	1.823	0.635	0.450	99.683
Kinetin 25 ppm	69.615	3.752	21.446	2.630	0.671	1.835	99.949
Kinetin 50 ppm	93.280	2.810	0.254	1.348	1.169	0.977	99.838
Kinetin 75 ppm	81.482	2.653	4.942	2.452	8.080	0.390	99.999
Kinetin 100 ppm	76.073	1.646	16.632	3.574	0.714	0.812	99.451
B-nine 500 ppm	88.647	3.056	4.674	1.284	0.548	0.784	99.020
B-nine 1000 ppm	91.249	3.273	1.104	1.741	1.680	0.950	99.997
B-nine 2000 ppm	95.491	0.498	0.657	1.254	0.484	1.366	99.750
B-nine 3000 ppm	93.435	2.162	0.830	1.482	1.268	0.824	100.001

Table (6): Effect of Growth Regulator Treatments on the Percentage of Different carotenoides in *Tagetes patula* petals during 1985 season.

Treatments	3,3-di-hydroxy-α-carotene	3-hydroxy-α-carotene	5,6-apoxy (33-dihydro-xy-B-carotene	B-carotene	α- carotene	Phytofluene	Total
Control	3.715	0.034	0.025	0.071	0.025	0.018	3.888
Kinetin 25 ppm	2.715	0.146	0.836	0.103	0.026	0.072	3.898
Kinetin 50 ppm	3.638	0.110	0.010	0.053	0.046	0.038	3.895
Kinetin 75 ppm	3.178	0.103	0.193	0.096	0.315	0.015	3.900
Kinetin 100 ppm	2.967	0.064	0.649	0.139	0.028	0.032	3.879
B-nine 500 ppm	3.458	0.119	0.182	0.050	0.021	0.031	3.861
B-nine 1000 ppm	3.559	0.128	0.043	0.068	0.066	0.037	3.901
B-nine 2000 ppm	3.724	0.019	0.026	0.049	0.019	0.053	3.890
B-nine 3000 ppm	3.644	0.084	0.032	0.058	0.049	0.032	3.899

Table (7): Effect of Growth Regulator Treatments on the contents of Different carotenoides (gm) per individual plant of *Tagetes patula* during 1985

Treatments	3,3-di-hydroxy-α carotene	3-hydroxy-α-carotene	5,6-apoxy (33-dihydroxy -B-carotene	B-carotene	α-carotene	Phytofluene	Total
Control	1.312	0.012	0.009	0.025	0.009	0.006	1.373
Kinetin 25 ppm	1.040	0.056	0.320	0.039	0.010	0.028	1.493
Kinetin 50 ppm	1.463	0.044	0.004	0.021	0.019	0.015	1.566
Kinetin 75 ppm	1.238	0.040	0.075	0.037	0.123	0.006	1.519
Kinetin 100 ppm	1.107	0.024	0.242	0.052	0.010	0.012	1.447
B-nine 500 ppm	1.342	0.046	0.071	0.019	0.008	0.012	1.498
B-nine 1000 ppm	1.358	0.049	0.016	0.026	0.025	0.014	1.488
B-nine 2000 ppm	1.359	0.007	0.009	0.018	0.007	0.019	1.419
B-nine 300 ppm	1.280	0.029	0.011	0.020	0.017	0.011	1.368

used in this experiment (25 ppm). The increase percentages of the phytofluene as either percent or yield/ plant in comparison with the untreated plant were 300% and 366.7 % respectively .

Further concentrations of kinetin showed flexuosity in its potent on either the dehydration process of the parent compound or on the carotenoids bioprocession.
Raising the concentration of kinetin accelerated the formation of α-carotene apparantly. The values of that coloured carotenoid in the crude pigment, in plant petals and as yield per individual plant were 0.714, 0.028 gm and 0.10 due to 50 and 75 ppm treatments respectively . However , application of 100 ppm kinetin loiter the exertion of its function. obversely kinetin showed a fluctuated potency on the formation of B- carotene. The highest value of B- carotene percentage was realized through spraying the plants with 100 ppm kinetin. The plant production of B- carotene was restricted to the hormone concentration enhancing or deacelerating organogenesis.

The excretion of 3-hydroxy-α-carotene (α-cryptoxanthin) was opposite intergraded with the increment concentrations of kinetin. The increase in the values of α-cryptoxanthin due to application of only 25 ppm in comparison with the untreated plant was 329.41%. While further concentration of kinetin up 100 ppm resulted in an increase estimated 88.24% over the control plant. In mean time, further hydroxylation for α-carotene was diminished due to kinetin treatment, except

50 ppm kinetin treatment, which oblirerate the negative act of kinetin on the accumulation of lutein. Without a phraseological explanation, this can be presumably due to the function of kinetin on the rate of translation (tRNA) and the relative rates of hydroxylated carotenoids biosynthesis brought about by hormonal control. The maximum value for 5,6-epoxy (3,3-dihydroxy-B-carotene) (antheraxanthin) attained in plants treated with 25 ppm kinetin followed by 100 ppm kinetin. The increase percentages in comparison with the untreated plants were 3272 % and 2515% respectively for the concentration of antheraxanthin in crude pigment, and 3244 % and 2495 % respectively for its concentration in the plant petals. The yield of antheraxanthin per individual plant is reflected by the effect of kinetin on the yield of petals/ plant.

Elliott (1979) showed that BA increased betacyanin accumulation when applied after a 40° treatment of <u>Amaranthus tricolor</u> seedlings. Khan (1980) found that kinetin (1 mg/l) increased anthocyanin production in tomato seedlings.

B. Effect of B-nine:

1. On vegetative growth:

a. Plant height:

The data of plant height Table (1) show that the application of B-nine sprayings at different concentrations have no significant effects on plant height. Slight decrease in plant height could be noticed as a result of B-nine treatments in both seasons. The concentrations of 1000, 2000 and 3000 ppm B-nine resulted in the shortest plant in both seasons. But when the low concentration of 500 ppm was used in the second season slight increase in plant height could be obtained, since the mean height of plant with the low concentration was 48.0 cm compared with 46.3 cm for control plant and 43.7 cm for the plant treated with high concentration. Although these differences appear very small but we could not neglect it specially with dwarf plant like *Tagetes patula*. Besemer and Deiser (1969) on chrysanthemums showed that spraying B-nine reduced the total plant height by 10-20 cm. Bhattacharjee *et al*. (1976), noticed that plant height of dahlia was markedly suppressed by B-nine at the rate of 5000 ppm.

b. Number of main branches:

The number of branches per plant showed no significant differences owing to spraying plants with B-nine at different concentrations. But slight increases in these numbers could be noticed over control in both seasons with the concentrations of 1000, 2000 and 3000 ppm. Also slight decrease in the number of branches was noticed with using the low concentration of 500 ppm in second season as shown in Table (1). It could be noticed also that the low level of B-nine 500 ppm was in contrary to the high concentrations of 1000, 2000 and 3000 ppm in its effect on both plant height or number of branches per plant. El-Shamy (1982) on carnation mentioned that B-nine at all the rates (500, 1000 and 2000 ppm) significantly decreased the number of branches/plant.

c. Weight of stem:

The mean fresh and dry weights of stem seemed to increase with spraying plants with B-nine at different concentrations. The increases in the mean fresh and dry weights were significant with plants treated with 500, 1000 and 2000 ppm in both seasons. The increases in fresh weights with these treatments over control reached -0.23%, 19% and -0.15%, 5% for dry weights in the first season. While in the second season these increases were 35%, 24%, 18% and 28%, 23%, 18% for fresh and dry weights respectively.

It could be concluded that B-nine at low concentration is more effective in increasing vegetative growth of Tagetes. Crittendon (1967), treated poinsettia with B-nine and found that the leaves were significantly smaller and accumulated less dry weight. Also Sen and Sen (1970), revealed that B-nine retarded zinnia growth but increased that of sunflower.

2. Effect of B-nine on flowering:

a. Number of flowers per plant:

The mean number of flowers per plant increased as a result of spraying B-nine at different concentrations. Tagetes plants treated with B-nine at 1000 and 2000 ppm in the first season produced number of flowers increased significantly over control. While the plants sprayed with 3000 ppm showed no significant increase as shown in Table (2). With the second year experiment all B-nine treatments produced significantly higher number of flowers per plant over control though the lowest concentration was more effective in this concern. These data confirmed with those observed by Jana and Biswas (1979) on Folianthes tuberosa who mentioned that B-nine at 1000 ppm produced the maximum number of flowers/plant.

b. Weight of flowers per plant:

The mean weight of flowers per plant show nearly the same trend of results with mean number of flowers per plant. Since the plants treated with the low concentration of 1000 ppm B-nine produced the highest yield of flowers per plant followed by 2000 ppm and 3000 ppm sprayed plant in the first season. With second season the highest fresh weight of flowers per plant were obtained from plants treated with 500 and 1000 ppm followed by 2000 and 3000 ppm. The increases in fresh weights of flowers per plant of 1000 ppm treatment in first season and of 500 and 1000 ppm treatment in the second season were significant comparing with control plants. These results are in agreement with Agina (1980) on Tagetes erecta who mentioned that flower weight increased after treatment with B-nine. El-Shamy (1982) on carnation found that B-nine at the rate of 500 ppm significantly increased the average fresh weight of flowers.

c. Weight of petals per plant:

The mean yield of fresh and dry petals after separating sepals nearly cleared the same trend of results previously mentioned with the mean weight of flowers per plant Table (2). So the lowest concentrations of B-nine obtained the highest fresh and dry weights of petals/plant.The mean dry weight of petals per plant increased as the concentration of B-nine decreased. It must be expected that the data of fresh and dry weights of petal per plant to follow the same trend obtained with the mean fresh weight of flower per plant. Since it is the result of subtraction the sepals and the base of flower disk from the total weight of flowers for drying and pigment extraction.

3. Effect of B-nine on chemical composition:

a. Total carbohydrate percentage:

1.In leaves:

Allar (B-nine) seemed to affect carbohydrate percent in plant leaves especially with low concentration Table(3).Sprayin plants with 500 ppm B-nine increased total carbohydrate percent with about 30% over control plants, while the increase reached about 20% with 1000 ppm sprayed plants. But hight concentration of 2000 and 3000 ppm seemed to decrease carbohydrate percentages in plant leaves. Since 2000 ppm obtained equal value of total carbohydrate as control plants. With 3000 ppm sprayed plants have less value of carbohydrates under control. These values were 14.45, 13.48, 11.56 and 10.60 for 500, 1000, 2000 and 3000 ppm respectively compared to 11.56 for control plants.

These results indicate that B-nine at low concentration may have a promoting effects on plant growth and synthesis. Selim (1979) on Rosa and Salem (1984) on Chrysanthemum frutescens indicated that B-nine application increased sugars as well as the total carbohydrates in the leaves. While Almulla (1985) found that Alar sprays at most concentrations decreased the carbohydrate content in zinnia leaves. Also Almulla (1985) obtained an increase in total carbohydrate percent of Tagetes which reached 11.5% with Alar at 2000 ppm compared with 10.95% with control plant.

2. In stems:

Total carbohydrate percent of plant stem decreased with spraying plants with B-9 at different concentrations as shown in Table (3) except with the low level of 500 ppm which gave constant value as control plant. These results are agree with Abd-El-Aziz (1971) on Chrysanthemum hortorum who found that the low concentrations of B-nine (500, 1000 and 1500 ppm) increased the total carbohydrates in the stems and flowers of treated plants, however the high concentrations (2500, 5000 and 2500 ppm) decreased it. Almulla (1985) found that in Tagetes plants Alar sprayed increased total carbohydrate content in stems.

b. Minerals content:

1. In leaves:

No constant differences were observed concerning nitrogen percent of plant leaves as affected with B-nine treatments of different concentrations used. These results were in accordance with Almulla (1985), who recorded that Alar had no effect on nitrogen percent of Tagetes plant leaves. Al-Ani (1986), mentioned that B-nine had particular increasing effects on nitrogen percent of Iris tingitana leaves especially with high concentrations. Also Moshin and Smith (1972) on Chrysanthemum morifolium and Salem (1984), on Chrysanthemum frutescens concluded that B-nine increased nitrogen percent in plant leaves.

Concerning phosphorous percent in plant leaves data in Table (3) show that there were gradual increases in P % with increasing concentrations of B-nine from 1000 to 2000 or 3000 ppm, while the 500 ppm sprayed plants gave value of phosphorous percent equal with control plant. These data confirmed by the results of Moshin and Smith (1972), who reported that B-nine increased phosphorous percent of Chrysanthemum leaves. Al-Ani (1986), recorded also that B-nine affected phosphorous accumulation in Iris tingitana leaves.

Data in Table (3) indicate that potassium percent in plant leaves increased with all B-nine concentration used except the highest one of 3000 ppm which gave the same value as control plants, while the highest potassium percent in leaves resulted from the 1000 ppm treated plants. Abd-El-Aziz (1971) working on Chrysanthemum stated that B-nine had no constant effect on potassium percent of leaves.

2. In stems:

Concerning nitrogen, phosphorous and potassium percentages of plant stem data presented in Table (3) indicate that the same trend of results previously recorded on these percentages in plant leaves, could be noticed concerning plant stem. Many investigators prementioned accorde this trend in different plants.

It could be concluded that B-nine affected chemical composition of plant parts. It increased total carbohydrate, nitrogen, phosphorous and potassium percentages of both plant leaves or stems.

c. Oil percentage:

Tagetes patula plant gave a static neutral response for the different B-nine concerning the volatile oil percentage in plant flowers. Table (4)

The only remarkable effect resulted from 2000 ppm B-nine treatment. In mean time, calculation of the yield of the volatile oil per individual plant revealed that the growth substance B-nine had a stimulating effect, specially at concentration 2000 ppm. The increase percent in the oil production per plant due to treating the plant with 500, 1000, 2000 and 3000 ppm B-nine in comparison with untreated plants were 10.9, -4.6, 28.1 and 1.6% respectively.

Assemble the forementioned results it is possible to assent that the greatest effect on the yield of the volatile oil per plant resulted from 50 ppm kinetin, followed by 2000 ppm B-nine. Tentatively, the same data obtained by Agina (1980) observed that B-nine treatments statistically raised the percentage of concrete oil in marigold flower as compared with control. Migahid (1982) on Jasminum sambac found that the highest concrete percentage resulted from the treatment with 2000 ppm B-nine.

d. Pigment percentages:

It is obvious from the data in Tables (5,6,7) that the increment concentrations of B-nine up 2000 ppm accelerated the formation of phytofluene in plant petals. Further concentrations of B-nine up 3000 ppm diminished the phytofluene values in comparison with other concentrations, but still higher than that of the control treatment. The response of T. patula plant to different concentration of B-nine is oscillated concerning the formation of both α- and B-carotene: However the B-carotene concentration in the untreated plants surpassed its value in the plants sprayed with B-nine.

Treating the plants with 500 and 1000 ppm B-nine accelerated the formation of α-cryptoxanthin. The increase percents in comparison to the control treatment were 248 % and 272.8% respectively for the α-cryptoxanine percent in crude pigment and 250 % and 276.5% respectively for its concentration in plant petals.

Further concentration of B-nine obliterated the favourable response for the accumulation of the aforementioned substance. Application increment concentrations of B-nine resulted in an apparent enhancement for lutein biosynthesis in *Tagetes patula* petals. The maximum curve of luten was attained due to spraying the plants with 2000 ppm B-nine the increase percent in comparison with the untreated plants were 0.24% , 0.24% and 3.58 % for the lutein concentration in the crude pigment, plant petals and yield per individual plant respectively.

Tagetes patula plant gave a negative and fluctuated response for spraying with different concentrations of B-nine concerning the formation of dioxo-zeaxanthin (antheraxanthin). This can be attributed to the mechanism of the insertion of oxygen into xanthophylls which is a later step in the process. T mechanism involved a mixed function oxidase probably were controlled by the hormones.

The aforementioned results are in agreement and coincided with data obtained by Agafonov and Cubina (1981) on apple. They mentioned that chlormequat stimulated the accumulation of chlorophyll and carotenoids in the leaves. Gabr *et al.* (1984) on tomato reported that leaf chlorophyll and carotenoid contents were increased by cycocel and Alar.

3. Comparative Effects of the growth regulators on Tagetes plant:

1. On vegetative growth:

a. Plant height:

The data of plant height for both seasons indicate that all kinetin treatments increased plant height specially with moderate concentrations. But B-nine decreased plant height with moderate and high levels whereas it increased by the low level of 500 ppm. Since the mean height of plant reached 48.0 cms for the lowest level of B-nine and 52.0 cm for the highest level of kinetin respectively compared to 46.3 cm for control,

b. Number of main branches:

Kinetin treatments were noneffective on increasing branching of Tagetes plant in both seasons, while B-nine was clearly effective on increasing number of branches. The moderate and high rates of B-nine increased number of branches in both seasons, but the low level of 500 ppm decreased it in the second season.

c. Weight of stems:

The highest fresh or dry weight of plant stem was observed from plants treated with B-nine at 500 ppm (lowest level) followed by that treated with kinetin at 100 ppm (highest level). These weights were 409.0 and 78.8 gm for the fresh and dry weight of B-nine treatment and it was

385.7 and 76.40 gms for fresh and dry weights of kinetin treatment. The highest concentration of B-nine was less effective on increasing the weight of plant stem.

d. Weight of roots:

Data presented in Table shows that the fresh weight of root remarkably affected with both kinetin or B-nine treatments. Since there were noticable increases in the fresh weight of root over control plants with all rates of the two substances. Though the highest concentrations of Kinetin (100 ppm) and the lowest one of B-nine (500 ppm) were the most effective treatments in this concern in both seasons. The dry weight of roots confirmed the same trend of results observed with fresh weight.

2. On flowering:

a. Number of flowers:

Although both growth substances increased number of flowers/plant as shown in Table (2). It is clear that the moderate levels of kinetin (50 and 75 ppm) and the lowest level of B-nine (500 ppm) were the most effective treatments for increasing number of flowers/plant. The mean number of flowers/plant reached 501, 552 and 566 for the 50 and 75 ppm of kinetin and 500 ppm B-nine respectively compared with 382.33 for control plant in the second season of experiment. These results confirmed the trend of results pre-observed with vegetative growth.

b. Weight of flowers:

The highest yield of flowers per plant was produced by plants treated with kinetin at 50 ppm followed by treated with 1000 ppm B-nine in the first season while the second year when the added rates of both kinetin (75 ppm) and B-nine (500 ppm) were used, the later treatments became superior all other treatments of growth regulators in this respect as shown in table (2) since the yield of flowers/plant reached 734.33 for the lowest level of B-nine (500 ppm) compared to 553.00 and 702 for the highest levels of both B-nine (3000 ppm) or kinetin (100 ppm) and 513 for control plant. So the moderate levels of kinetin (50 and 75 ppm) and the lowest level of B-nine (500 and 1000 ppm) were nearly have the same effects on the flowering of Tagetes plant.

c. Weight of petals:

It is conceptable for the weight of petals/plant to follow and confirms the same trend obtained with the weight of flowers. So the highest fresh or dry weight of petals was obtained with kinetin at 50 ppm followed by kinetin 75 ppm and B-nine 500 ppm or 1000 ppm as shown in Table (2). The lowest concentrations of both kinetin and B-nine gave less increases concerning weight of petals over control plants.

3. On Chemical composition:

a. Total carbohydrate:

1. In leaves:

Total carbohydrate content in leaves increased only with the lowest level of B-nine (500 and 1000 ppm). On the other hand the high level of B-nine (2000 ppm) gave the same total carbohydrate percent as control, while the highest one of (3000 ppm) decreased it. It is clear from these results that the low levels of B-nine gave nearly the same effects as kinetin with Tagetes plant in most of characters under our study.

2. <u>In stems</u>:

No increases in total carbohydrate percent in plant stem were observed due to any of kinetin or B-nine treatments, but there were some decreases in this concern with kinetin at the rate of 50 and 100 ppm. All B-nine levels decreased total carbohydrate percentages in plant stems except with the lowest one of (500 ppm) which gave the same value as control plant.

b. <u>Minerals content</u>:

1. <u>In leaves</u>;

Mineral content of Tagetes leaves increased generally by all treatments of both substances except with the highest level of B-nine (3000 ppm) which decreased K% lower control plants. The most effective treatments in this concern were those of kinetin at 75 ppm followed by 500 ppm and B-nine at 2000 ppm, since they gave the highest percentages of N, P and K in Tagetes leaves. It is remarkable also that the highest concentrations of B-nine decreased both nitrogen and potassium than control, although gave the highest phosphorous percent in leaves over all other treatments of both kinetin and B-nine.

In stems:

Data presented in Table (3) indicate that kinetin and B-nine concentrations increased minerals content of Tagetes stems except with the low level of kinetin (25 ppm) which decreased nitrogen percent. It is remarkable that B-nine treatments were more effective on increasing mineral percentage in plant stems than kinetin. The highest percentages of nitrogen and phosphorous were obtained with plants treated with B-nine at 3000 ppm, while the highest potassium content of plant stem was attained with the 1000 ppm of B-nine.

c. Oil Percentages:

Assemble the forementioned results it is possible to assent that the greatest effect on the yield of the volatile oil per plant resulted from 50 ppm kinetin, followed by 2000 ppm B-nine. Tentatively, the same data obtained by Agina (1980) observed that B-nine treatments statistically raised the percentage of concrete oil in marigold flower as compared with control. Migahid (1982) on Jasminum sambac found that the highest concrete percentage resulted from the treatment with 2000 ppm B-nine.

In spite of the known role of kinetin as growth promator substances and B-nine as growth retardant one, but sometime they gave nearly same effects with some characters under our study. This was clear with many characters taken in concentration in this investigation especially when B-nine was used in the lowest concentration of 500 ppm. So B-nine seemed to increase chemical composition percentages in the retardant plant parts by increasing soluble contents as a result of lesser water.

EFFECT OF DIFFERENT FERTILIZATION TREATMENTS ON THE GROWTH, FLOWERING AND CHEMICAL COMPOSITION OF TAGETES PATULA PLANT:

1. Vegetative growth:

a. Plant height:

Data of plant height in Table (8) showed no clear differences in plant height with most of fertilization treatments except with medium and high level of nitrogen and all complete fertilizer levels. This trend of results was nearly constant in the two seasons of experimentation. These results were agree with those obtained by Kandeel (1982) on *Matricaria chamomilla*.

b. Number of main branches:

No significant differences in the number of branches were observed between fertilization treatments in both seasons as shown in Table (8). But there were slight increases in the number of branches with the height level of complete fertilization in both seasons of this work. Post (1940), stated that potassium promoted basal branching of sweet peas. Towari and Chhonkur (1967), on tomato observed that foliar application of urea caused the maximum increase in height and diameter of main shoot and induced maximum branching.

c. Weight of stems:

All fertilization treatments seemed to increase the fresh weight of Tagetes stems. The addition of nitrogen, phosphorous and potassium at different levels increased the

Table (8): Effect of the Different Fertilization Treatments on the vegetative Growth of <u>Tagetes patula</u> plants During 1984 and 1985 seasons.

Treatments	Height of plant in (cm)		No. of main branches / plant		Fresh weight of roots in (gm)		Dry weight of roots in (gm)		Fresh weight of stems in (gm)		Dry weight of stems in (gm)	
	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985
Control	39.30	50.70	4.33	5.00	9.63	9.32	2.98	2.71	252.67	296.67	45.83	53.00
$N_1P_0K_0$	40.70	49.00	4.33	5.33	9.74	12.26	3.50	2.92	291.00	328.67	57.19	59.64
$N_2P_0K_0$	41.70	49.70	5.00	5.33	9.66	18.14	3.13	4.79	326.67	415.00	64.91	72.51
$N_3P_0K_0$	41.00	49.00	4.00	6.00	10.93	10.81	3.51	3.91	302.67	366.00	60.24	63.48
$N_0P_1K_0$	40.30	43.30	5.33	4.67	11.36	9.71	3.32	4.13	294.00	336.00	59.54	61.06
$N_0P_2K_0$	39.70	49.30	5.33	5.33	9.88	15.65	3.05	3.67	400.67	401.00	77.10	80.17
$N_0P_3K_0$	40.30	47.00	5.00	5.00	14.01	13.26	3.89	4.21	311.00	317.33	53.64	55.84
$N_0P_0K_1$	38.30	48.30	5.00	5.33	12.52	14.43	3.54	4.03	273.00	354.67	51.65	58.40
$N_0P_0K_2$	39.00	48.70	4.67	5.33	12.60	13.64	3.63	3.72	337.67	416.33	67.89	68.05
$N_0P_0K_3$	39.70	46.70	4.33	4.67	12.33	15.12	3.59	3.72	325.00	346.00	61.21	67.55
$N_1P_1K_1$	40.70	47.00	4.00	5.67	8.51	14.02	2.93	3.45	350.00	344.00	69.64	69.28
$N_2P_2K_2$	41.30	48.30	4.67	5.00	12.16	13.69	3.87	5.08	414.33	427.00	76.57	84.83
$N_3P_3K_3$	41.30	49.00	5.67	6.33	11.32	13.19	3.39	3.08	342.67	368.67	65.03	69.37
L.S.D. 5%	3.31	5.83	1.87	1.37	3.46	4.22	0.92	1.27	44.39	76.10	7.50	6.10
1%	4.50	7.93	2.55	1.85	4.70	5.74	1.26	1.73	60.34	103.43	10.19	8.29

fresh weight of shoots especially with the medium level of each. The increase in stem weight over control reached 29.29, 58.57, 33.64% for the medium level of N, P and K respectively in the first season, while it reached 40.22%, 35.17%, 40.33% in the second season. Also the medium level of complete fertilization significantly increased the fresh weight of stem over control. The increases reached 63.98% and 43.93% in the first and second seasons respectively. Maheshwari et al. (1984) on Cymbopogon martinii mentioned that N application significantly increased grass dry weight and fresh weight yields over unfertilized control. The data of dry weights of stems Table (8) were confirmed with those of fresh weights since the medium levels of N, P or K and the medium level of complete fertilization obtained the most promising results in this respect. Many investigators studied the effect of different fertilization levels on the growth of plant organs and observed similar results such as Mohsen (1968). Gindich and Sheberstov (1971), Wahab and Hornok (1982), Bommegowda et al. (1983), and El-Hanafy (1985).

d. Weight of roots:

The weight of plant root affected greatly with nutrition treatments. The addition of N, P and K increased the fresh weight of roots in both seasons. The increase in the fresh weight of roots as a result of P or K addition was more than that with nitrogen or complete fertilization levels. The same trend of results was also found in the second season

Table (8). The dry weight of roots showed the same trend of results obtained with fresh weight. Abou-Leila (1978) found that the vegetative growth of Datura metel as the fresh and dry yields of the different organs increased by raising the fertilization levels of N.P.K.

2. Effect of different fertilization treatments on flowering:

a. Number of flower/plant:

The number of flowers per plant increased with fertilization treatments. The addition of N, P and K alone or accompanied with each other increased number of flower per plant in both seasons. The medium level of each fertilizers and the medium level of complete fertilization were the most effective treatments in increasing the number of flower These results were previously obtained with the vegetative growth measurements. This means that the strong vegetative growth produced more flowers as a result of good nutrition. El-Hanafy (1985) obtained the best plants and the greatest number of flowers of Dahlia when he used ammonium sulphate at 300 kg/fe and Ca superphosphate at level of 300 kg/fed. and K at level of 100 kg/fed.

b. Weight of flowers/plant:

The mean weight of flowers/plant increased with all fertilization treatments as shown in Table (9). The effect of different levels of N and P on increasing the yield of flowers/plant was not constant in both seasons of experiments. Since the medium level of nitrogen was superior the low or

Table (9): Effect of the Different Fertilization Treatments on the Flowering of *Tagetes patula* plants During 1984 and 1985 seasons.

Treatments	No. of flowers/plant		Weight of flowers/plant		Fresh weight of petals/Plant		Dry Weight of petals	
	1984	1985	1984	1985	1984	1985	1984	1985
Control	243.30	411.00	399.00	534.00	164.00	277.00	20.18	34.24
$N_1 P_0 K_0$	294.0	451.70	438.00	692.00	181.00	297.00	24.40	38.30
$N_2 P_0 K_0$	359.70	525.70	479.00	659.00	193.00	286.00	26.56	36.38
$N_3 P_0 K_0$	308.70	478.30	445.00	715.00	179.00	308.00	23.90	38.11
$N_0 P_1 K_0$	302.00	444.00	463.00	684.00	189.00	293.00	26.30	36.75
$N_0 P_2 K_0$	364.30	531.70	419.00	724.00	176.00	314.00	24.62	40.15
$N_0 P_3 K_0$	314.70	442.70	460.00	624.00	199.00	274.00	26.92	34.94
$N_0 P_0 K_1$	286.00	484.30	399.00	686.00	168.00	299.00	22.64	36.79
$N_0 P_0 K_2$	335.70	491.30	471.00	698.00	194.00	307.00	26.18	39.60
$N_0 P_0 K_3$	291.30	447.70	388.00	582.00	166.00	297.00	21.93	36.95
$N_1+P_1+K_1$	307.70	508.30	432.00	692.00	180.00	314.00	24.24	39.48
$N_2+P_2+K_2$	393.00	560.30	490.00	731.00	204.00	308.00	27.34	39.86
$N_3+P_3+K_3$	330.30	506.30	456.00	717.00	187.00	308.00	25.20	39.08
L.S.D. 5%	48.74	87.36	55.05	95.27	41.49	57.59	3.30	6.00
1%	66.24	118.75	74.82	129.50	56.39	78.26	4.49	8.15

high one in the first season while the high level of nitrogen was the most effective in the second season. Concerning with phosphorus the low level was superior in the first season while the medium level was most effective in the second season regarding the weight of flowers/plant. Either potassium additions or complete fertilization treatments confirmed previous results in this concern. Since the medium level of each was most effective in increasing the yield of flowers / Plant in both seasons of experiments. It could be noticed that these results are accordant to those obtained with vegetative growth. This means that the effect of fertilization on increasing the growth of vegetative parts reflect as an increase in the flower yield produced by the plant.

The effects of fertilization on the flowering of many similar plants had been recorded by many workers. Kroll (1962), Franz and Kirsch (1974), Agina (1975), El-Gamal *et al* (1983) and Maximoos (1985).

c. Weight of petals/plant:

The yield of fresh or dry petal per plant after removing sepals show no significant differences owing to the fertilization treatments. The trend of results in this concern confirmed greatly the trend of result concerning flower yield per plant. Since the weight of petals resulting by subtraction the weight of sepals and base of flower head from the total weight of flowers for pigment extraction.

It could be observed from the data of the two seasons presented in Table (9) that there were small increases in the fresh and dry weights of petals resulting with fertilization treatments. These increases were more clearer with the medium levels of N, P or K and complete fertilization levels Agina (1975) and Kandeel (1982) on Matricaria chamomilla showed that fertilization treatments with N, P, K or N + P + K increased fresh and dry weights of flower heads per plant compared with control.

3. Effect of different fertilization treatments on chemical composition:

a. Total carbohydrate:

1. In leaves:

Data in Table (10) cleared that nitrogen applications increased total carbohydrate percent in plant leaves. The moderate level of N gave the highest total carbohydrate over both low or high one. Also there were no differences could be observed in the total carbohydrate content of Tagetes leaves when nitrogen was added alone or in combination with phosphorous and potassium. So the same percentages of total carbohydrate were obtained with the different levels of nitrogen (N_1, N_2 and N_3) as those obtained with the complete fertilizers levels ($N_1 + P_1 + K_1$, $N_2 + P_2 + K_2$ and $N_3 + P_3 + K_3$) These percentages were 12.52%, 15.41% and 13.48% respectively while it was 9.63 with control plants.

These results indicate that nitrogen play an important role in plant nutrition and carbohydrate synthesis. Since it is the most effective element on plant growth and assimilation. The role of nitrogen in carbohydrate synthesis had been examined by many workers. Ismail (1977) on Ocimum reported that increasing nitrogen fertilization up to 90 kg/fed. with any of P levels 15 or 30 kgs/f. increased both reducing and non-reducing sugars. Abdel-Aziz (1978) on Majorana hortensis showed that N_2 and N_3 levels slightly increased the total carbohydrate percentage compared to N_1 or N_0 treatments.

Phosphorous also seemed to affect carbohydrate percent in Tagetes plant leaves as shown in table (10) Phosphorous additions increased total carbohydrate percentage over control plants except with the medium level. The lowest level of phosphorous produced the highest percent of total carbohydrate in plant leaves.

It could be seen that plant response to low level of phosphorous fertilization so there is no need to applied high levels of phosphorous. Kandeel (1982) on Matricaria chamomilla mentioned that the addition of phosphorous with constant level of nitrogen and potassium caused an increase in carbohydrate content of the vegetative parts of the plant.

Potassium take the same trend of phosphorous since the lowest level gave the highest carbohydrate percent in leaves followed by the medium levels. There was no difference between the highest level and control plant in this respect. These results showed that potassium in soil was sufficient for plant growth and assimilation of nutrient substances, and such increase of potassium application might reflect antigonised effect on the absorption of other elements. Hassanain (1985) on <u>Pelargonium graveolens</u> stated that K_2O at the rate of 4.0 gm/plant increased total carbohydrate contents in the leaves in the second cut, however, raising the rate to 8.0 gm/plant increased total carbohydrate content in the two cuts.

Data presented in Table (10) show that different levels of complete fertilizer (N, P, K) affected greatly total carbohydrate content in leaves of Tagetes plant. The trend of results indicate that all levels of fertilization increased markedly carbohydrate content of leaves over control. The moderate level of fertilization resulted in the highest carbohydrate content, thus the increase in this treatment reached more than 50% over control plants while the increases were about 30% and 25% with the high and low level of fertilization respectively. These results were in accordance with Essa (1984), on rose who recorded that carbohydrate content in leaves was affected by fertilization treatments. He mentioned that the carbohydrate percent in leaves increased to 21.66% with NPK fertilization while it was 13.33 with control plants. Since the role of complete fertilization could be resulted in best growth and more accumulation of carbohydrate substances.

b. In plant stem:

The moderate level of nitrogen was the only affective treatment that increased carbohydrate content of plant stems. No differences were observed with both low or high levels of nitrogen in this concern although superior control plants.

The same trend of results was pre-observed with carbohydrate content of plant leaves. So the moderate level of nitrogen is sufficient for good assimilation of carbohydrate in plant parts. Kandeel (1982), on Matricaria chamomilla indicate that total carbohydrate increased with increasing nitrogen level.

Total carbohydrate percentage of stems increased gradually with increasing phosphorous level while the lowest level of phosphorous reduced carbohydrate percent under control. This result was in the contrary with the effect of low level of P on carbohydrate content of leaves since carbohydrate percent in leaves was most affected by the lowest level of phosphorous. Kandeel (1982) revealed that the addition of phosphorous with constant level of nitrogen and potassium caused an increase in the carbohydrate content of the vegetative parts of the plant.

Potassium application affected clearly the carbohydrate content of stems especially with low and high levels. No considerable differences could be observed between the moderate level and control plant in this concern.

It could be noticed from the results of total carbohydrate percentages in both leaves or stems that low level of K was sufficient for good carbohydrate accumulation in Tagetes plant parts. These results agree with Kandeel (1982) who observed that there was a slight increase in total carbohydrate of the vegetative parts of chamomile plant by potassium addition.

Generally the content of total carbohydrate in plant stems was almost more than those of leaves in all cases as shown in Table (10). Complete fertilizers levels of (N+P+K) affected clearly the total carbohydrates content in stems of Tagetes plants,so the highest the fertilizer level the highest the carbohydrate percentage of stems. These percentages were 14.45%, 16.37% and 17.34% for low, medium and high levels respectively compared to 13.45% for control plant. The same trend of result was Pre- observed with leaf content of carbohydrate reflicting good assimilation of plants when taken sufficient amount of nutrition. These results were in agreement with Shams El-Din (1976) who stated that total carbohydrates % increased in leaves and stems of the fertilized plants. The increases were promoted with the medium fertilization level of chrysanthemum. Also Abou-El-Ghait (1980) on *Lilium longiflorum* found that the high level of nutrition increased the total carbohydrates and the soluble sugars especially in the flower stalk and bulbs.

B. Minerals Percentages In Plant Parts:

a. In leaves:

Nitrogen fertilization increased nitrogen percent in plant leaves especially with the moderate level. While phosphorous and potassium percentages were decreased by nitrogen addition except with the low level of nitrogen which increased the phosphorous percent in leaves. Ibrahim (1960) on sweet peas, found that nitrogen content in flowers, leaves or stems expressed as, actual amounts was increased due to nitrogen application, but he added that there was no significant effect among the three levels of nitrogen applied (250, 500 and 1000 mg/pot) on the N content. Hargital and Vass (1976), reported that rising N rates increased soluble N content of stem parts and leaves of chrysanthemum and tomatoes.

All phosphorous treatments increased phosphorous percentages of plant leaves especially with low level, Nitrogen also increased by the addition of moderate level of phosphorous while K percent decreased in plant leaves with all phosphorous additions. Kandeel (1982) on chamomile mentioned that phosphorous applications with constant level of nitrogen and potassium increased the phosphorous and nitrogen percent of the vegetative parts of plant. EL- Deeb (1982) on Atropa pelladonna mentioned that plants received different phosphorous levels gave an increase in the nitrogen and phosphorous accumulations in different plant tissues.

Data presented in Table (10) concern with minerals content indicate that application of potassium at different rates decreased K percent in Tagetes leaves at all rates of additions, whereas it increased nitrogen percent of the same organ. Phosphorous percent increased also by the addition of potassium at low and moderate levels. These results were in accordance with El-Ghitany and Khattab (1969) who found that the addition of K alone or with P or N or together led to an increase in the percentage of nitrogen and phosphorous in carnation leaves. Hassanain (1985) showed that potassium fertilization had no constant effect on mineral content in leaves or stems of geranium plants.

The percentages of nitrogen and phosphorous in plant leaves increased with the addition of complete fertilization increasing the fertilization rate increased nitrogen percent in plant leaves, while phosphorous percent did not affect with these increases. Potassium showed the response to the application of different rates of complete fertilizers.

These results cleared that plant synthesis encouraged by the addition of nitrogen and phosphorous fertilizers, Accordingly potassium in soil is sufficient for plant growth and there is no need for adding it. These results was in accordance with Shams El-Din (1976) on chrysanthemum who showed that the percentage of N, P and K in the leaves and stems generally increased as the level of fertilization increased. El-Labban (1969) concluded that in datura plants, the percentage of nitrogen in different plant parts increased with increasing the levels of added nitrogen in the presence of low level of phosphorous and potassium. Kandeel (1982) with chamomile showed that the mean percentage of nitrogen phosphorous and potassium were increased with increasing the level of complete fertilizer.

b. In stems:

It is clear from the data presented in Table (١٥) that the low level of nitrogen fertilization is more effective in increasing nitrogen, phosphorous and potassium content in plant stems over either control or other levels of fertilization. Also low and high level of nitrogen increased stem content of nitrogen, phosphorous and potassium. Similar results were observed on different plants by Ibrahim (1960), Hargital and Vass (1976) and Attoa (1981).

Phosphorous fertilization increased nitrogen percent in plant stems only when it used at moderate level (P_2), while both low and high **levels** of P decreased nitrogen Percent in plant stems. Phosphorous content in plant stem also increased with the phosphorous applications especially with low level. Also potassium content of stems increased by phosphorous additions, but there were no differences in potassium percentages of plant stems when P was added at low or high level. El Deeb (1982) on Atropa belladonna plants mentioned that plants received different phosphorous levels gave an increase in the nitrogen and phosphorous accumulations in different plant tissues. Also Attoa (1981) recorded that any addition of either phosphorous or potassium or both together increased nitrogen percent in sweet peas stems.

The addition of potassium fertilization at low or high level decreased nitrogen percentages in plant stem under control as shown in Table (10). While nitrogen content increased with the application of moderate level of potassium. All levels of potassium fertilization increased phosphorous percent in plant stem. But the low level was the most effective in this concern. While potassium percent in stems increased with all potassium levels used, so highest level of potassium obtained highest percent of potassium in plant stem. Kandeel (1982) with chamomil mentioned that increasing potassium level resulted in an increase in potassium and nitrogen percentages in plant stems.

The addition of complete fertilizer seemed to increase stem content of nitrogen when it was added with moderate or high level. While phosphorous and potassium content of stems increased with all levels of complete fertilizer. The highest percent of phosphorous in plant stems was obtained with the lowest level of complete fertilizer. On other side potassium content of stems reached its maximum with the addition of highest rate of complete fertilizer, so it could be concluded that the addition of complete fertilization increased element contents of plant parts. Many investigators improved that importance of complete fertilization and its role in mineral accumulation in plant parts, Agina (1975), Kandeel (1982) and Attoa (1981).

It could be concluded from the previous data that nitrogen fertilization plays an important role in the accumulation of N, P and K content in plant parts leaves or stems than any other element. As also mentioned with total carbohydrate content that nitrogen was the most effective element for increasing carbohydrate content in plant parts leaves or stems. But comparing the data with that when it accompanied with phosphorous and potassium in a complete fertilizer.

It is clear that nutrient elements became more effective when added together than when added alone. So the accumulation of N, P and K or carbohydrates in plant parts increased as the rate of complete fertilization increased.

c. Oil percent:

Results in Table (11) indicate that the increase in the oil content due to treatment receiving 15.5 gm N_2/m^2 over the untreated plants was 31.16 %

In mean time the maximum oil yield per individual plant or per feddan attained as a result of feeding the plants with 15.5 gm N_2/m^2 followed by 23.3 gm N_2/m^2 and 7.8 gm N_1/m^2. The additional values for the oil production/plant over that obtained from untreated plant are 25.5 %, 46.8% and 31.9% respectively.

The same above mentioned trend for the oil percentage against increment amounts of phosphorous fertilization was observed. It is intelligible that the volatile oil yield per plant is conventional with the act of different doses of P_2O_5 on the dry matter production.

There is no precession concerning the oil percentage due to application of lower doses of potassium.

Highest level of potassium up 18.0 gm K_2O/m^2 resulted in an increase amounted 44.6 % in comparison with the control. The production of the volatile oil is restricted with the effect of potassium on both oil percentage and yield of dry matter per plant.

It is worthy to mention that the plant gave highest oil percentage when fertilized with a mixture of the essential

Table (11): Effect of Different Fertilization Treatments on accumulation in Tagetes flowers During 1985 season.

Treatments	Oil percentage	Oil yield/ plant in gms	Oil yield/fed. in Kgs.
Control	0.138	0.047	2.256
$N_1P_0K_0$	0.155	0.059	2.851
$N_2P_0K_0$	0.181	0.066	3.168
$N_3P_0K_0$	0.162	0.062	2.976
$N_0P_1K_0$	0.159	0.059	2.832
$N_0P_2K_0$	0.156	0.063	3.024
$N_0P_3K_0$	0.157	0.055	2.640
$N_0P_0K_1$	0.163	0.060	2.880
$N_0P_0K_2$	0.155	0.061	2.928
$N_0P_0K_3$	0.185	0.068	3.264
$N_1 + P_1 + K_1$	0.183	0.072	3.467
$N_2 + P_2 + K_2$	0.209	0.083	3.984
$N_3 + P_3 + K_3$	0.213	0.083	3.984

elements in amounts 23.3 gm N_2, 17.4 gm P_2O_5 and 18.0 gm K_2O per m^2.

The increase percentage attained due that standard treatment in comparison with unfertilized plants is 76.5 % for the oil percentage. However, the maximum oil yield/plant was attained due to $N_2P_2K_2$ treatment. Increasing the amounts of different fertilizers ($N_3P_3K_3$) gave no further increase in the oil production per plant. The forementioned results are in agreement and coincided with data obtained by Razinskaite (1966) who found that fertilization with ammonium nitrate increased the accumulation of essential oil in caraway seeds. Abou-El-Fadl (1969) stated that the application of 300 kg/fed. of ammonium sulphate increased significantly the volatile oil content in Fennel seed.

Ivanova and Gogija (1965) on geranium reported that phosphorous fertilizer increased oil accumulation in the leaves. El-Sayed (1973) on geranium reported that raising phosphorous level in fertilizers increased the oil yield.

Kalinkevic (1950) found that reducing the concentration of potassium increased the essential oil percentage in the leaves of camphor basil plants. El-Gengaihi (1964) reported that potassium increased the oil percentage of Egyptian geranium.

Beraia and Shpakova (1975) obtained that the greatest herbage and essential oil yield in geranium when plants received nitrogen, Phosphorous and potassium as 2:2:1 compared with the basic rate of 0.2 g of each element per kilograme soil.

Ghosh and Chatterjee (1976) found that the best results of growth and essential oil content of Mentha piperita and M. spicata were obtained by addition of nitrogen, phosphorous and potassium fertilizers.

d. Pigment percentages:

The nutrient economy of plants is a system of biotic, and physiochemical to which different plants react in different ways. Autotrophic plants needs certain elements in relatively large amounts, involved in several metabolic processes. viz chlorophyl synthesis is inhibited and anthocyanin synthesis is increased due to potassium deficiency. Macro nutritive elements and biosynthesis of the carotenoids as well as lower terpenes relationship has been not studied much more extensively. Unfortunately the picture rather feeble than being more clear as the concerned. Data are still lacking and are greatly confused by many conflicting reports.

The crude pigment of T. patula petals had been separated by HPLC. Six carotenoids were found and havebeen identified as 3,3-dihydroxy-α-carotene as a main constituent followed by 3-hydroxy-α-carotene, 5,6-apoxy (3,3-dihydroxy-B-carotene, B-carotene, α-carotene and phytofluene. From the results obtained by the preceeding experiment it seems that the plants showed a positive response to the addition of successive amounts of nitrogen up to N_2 level. Concerning the biosynthesis of the parent substance phytofluene which occurs as a result of fluene dehydration. The increase in phytofluene percentage in plant petals reached to 140 % and 170 % than that of the untreated plant due to N_1 and N_2 levels respectively Table (13) Thereafter this reaction seemed that reached its saturation level.

So increasing nitrogen fertilizer supply decreased the phytofluene percentage. This may be attributed to the dilution factor c.f. the dry weight data in Table (8).

Data tabulated in Table (14) concerning the phytofluene content per individual plant coincides the forementioned results as well as reflect the effect of nitrogen fertilizer supply on the production of petals/plant. α and -B-carotenes percentage in plant petals exhibited fluctuated data and irregular variation. While the petals of plants received 7.8 g N/m^2 had the highest percentage of α-carotene followed by plant supplied with 23.3 g N_3/m^2. The addition of 15.5 g N_2/m^2 sharply decreased the percentage of α-carotene to the point lower than the value of this compound in untreated plants. Meanwhile, the nitrogen fertilization did not evoked the excretion of B-carotene and gave negative values

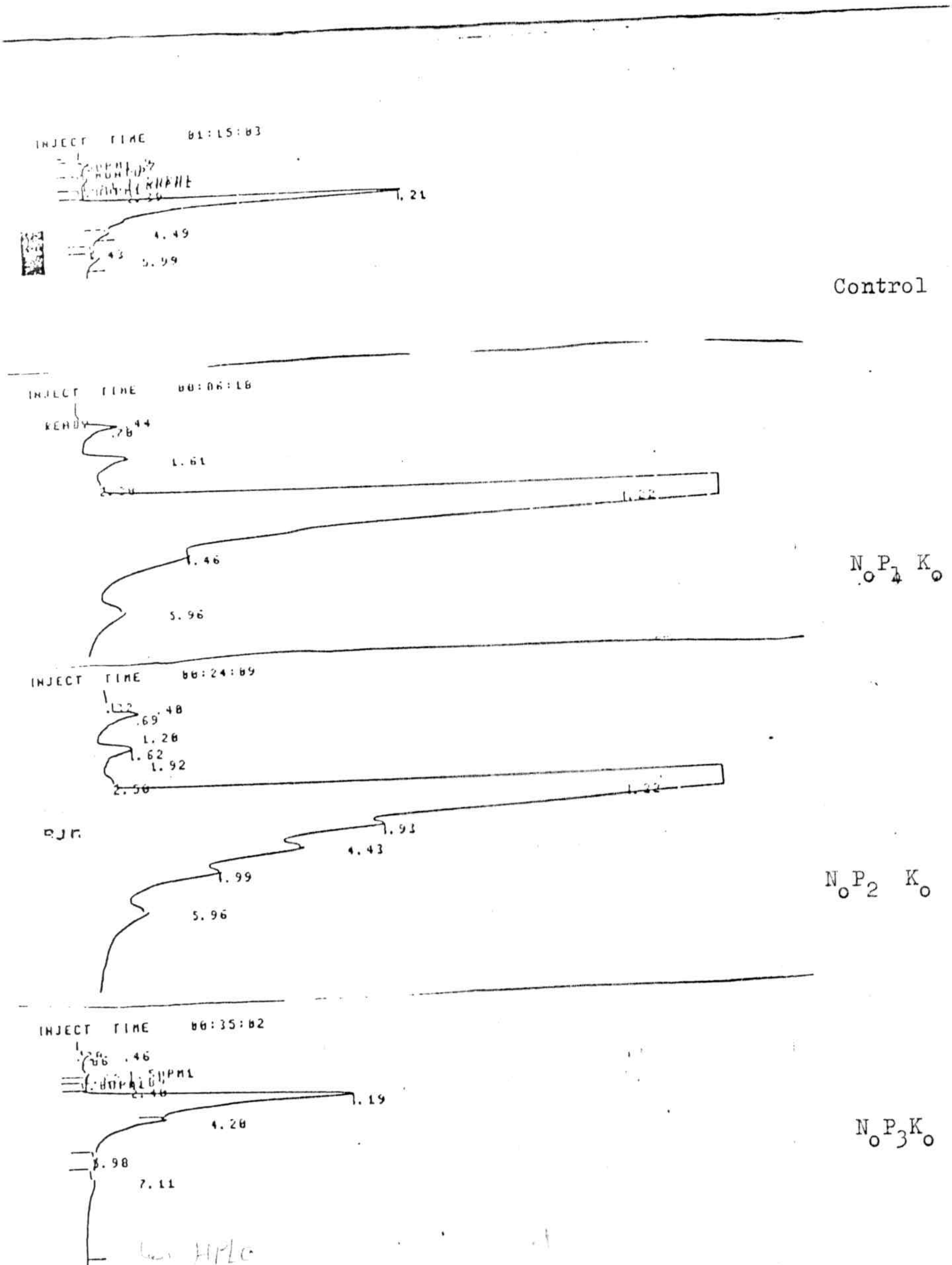


Fig. ( ): Effect of phosphorus treatments on the pigment constituents of *Tagetes patula* petals during 1985 season.

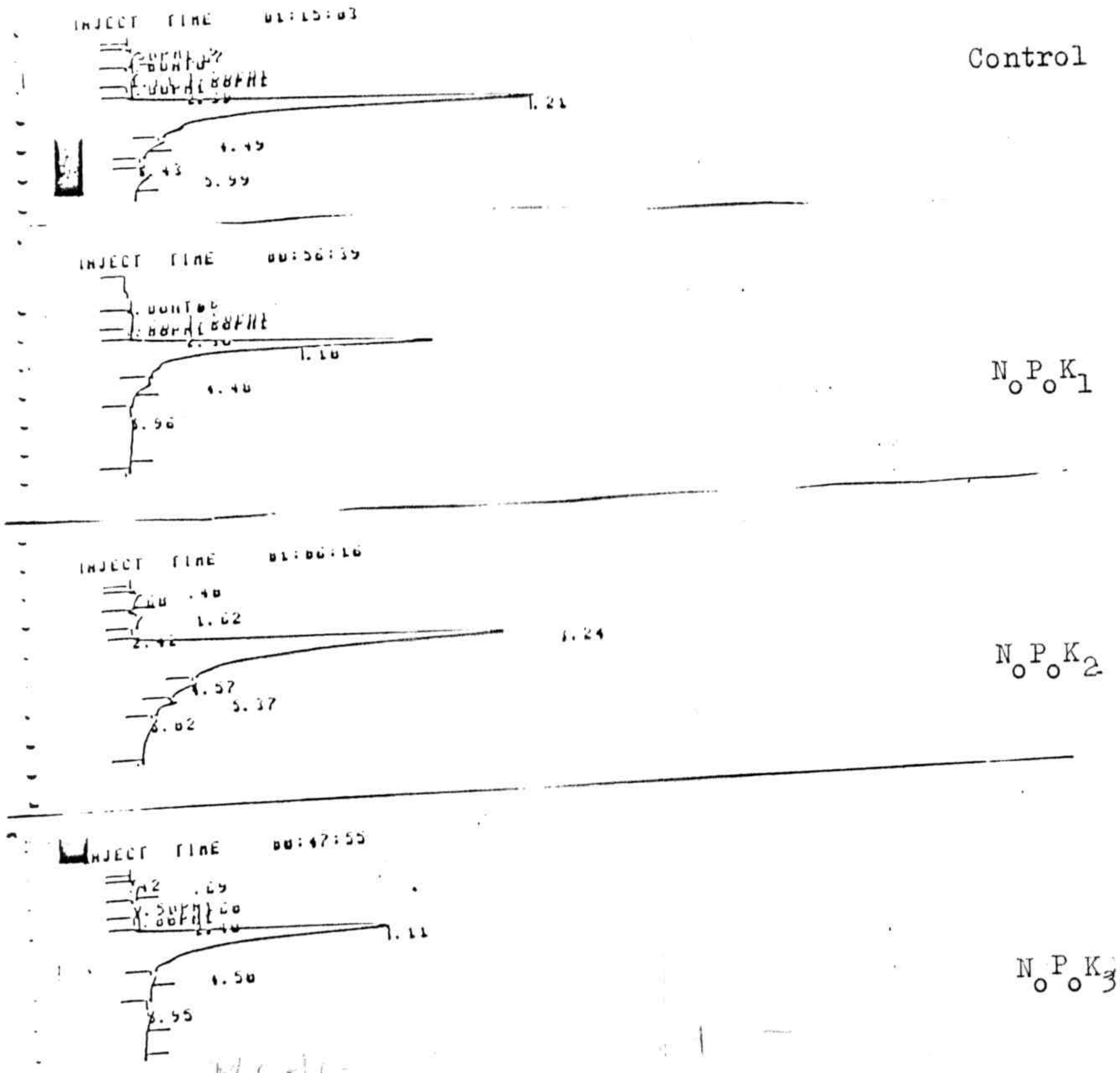


Fig. ( ): Effect of potassium treatments on the pigment constituents of *Tagetes patula* petals during 1985 season.

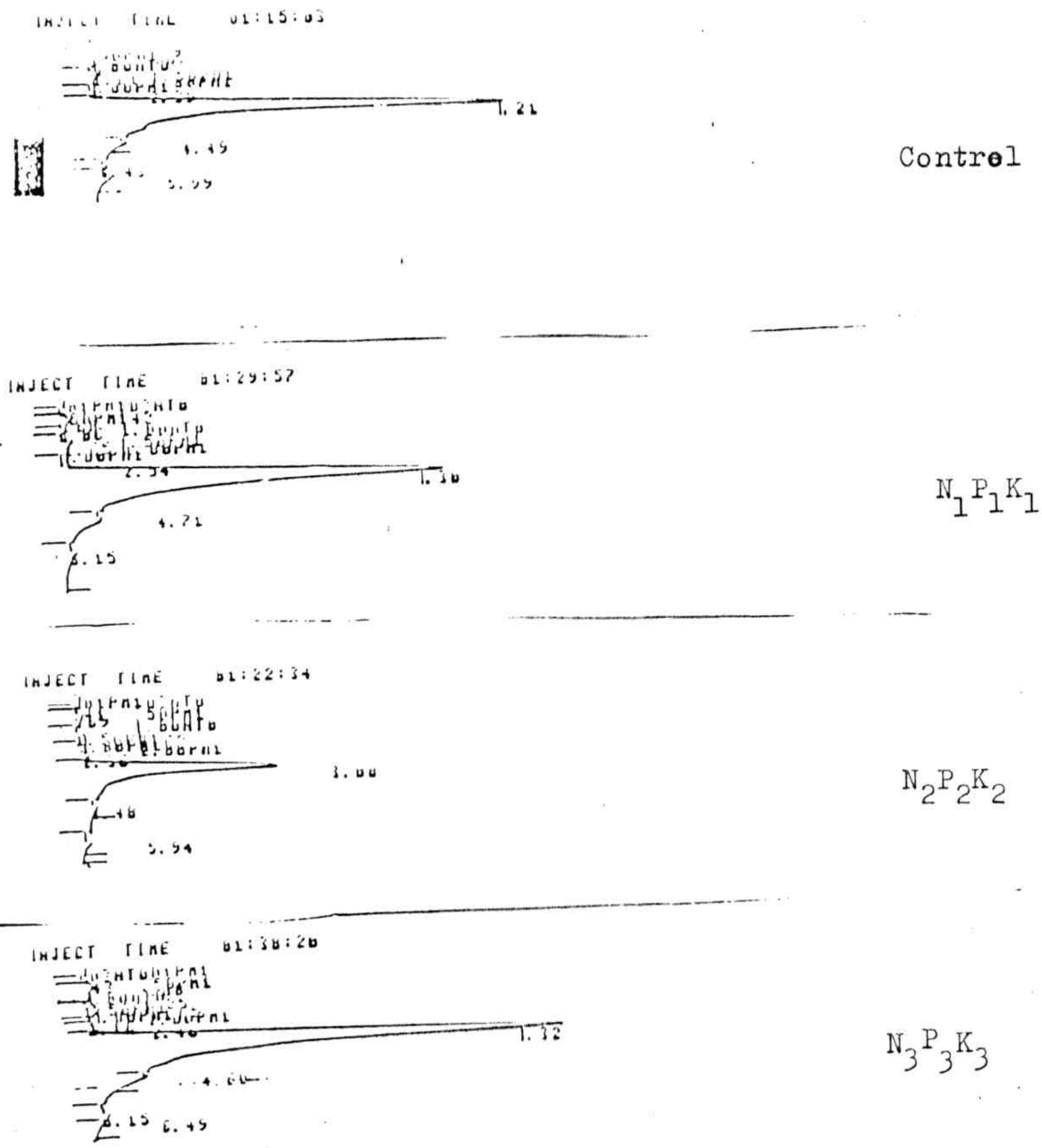
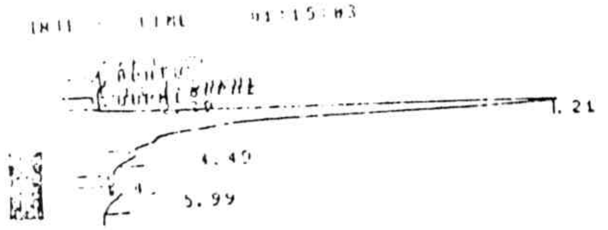
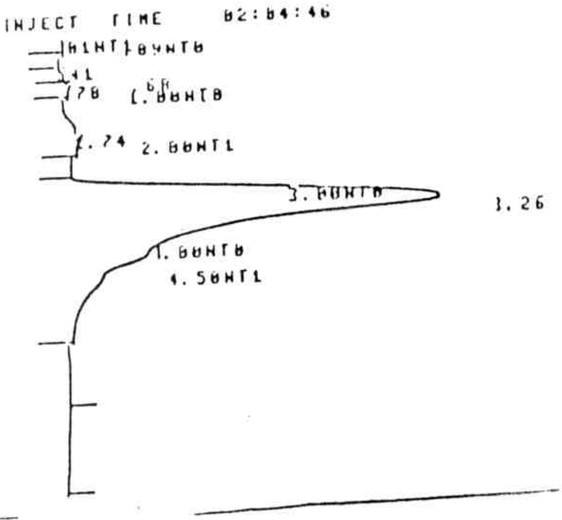


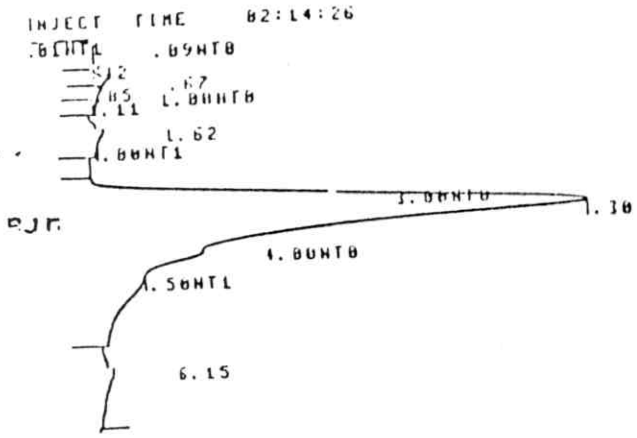
Fig. ( ): Effect of complete fertilizer levels on the pigment constituents of *Tagetes patula* petals during 1985 season.



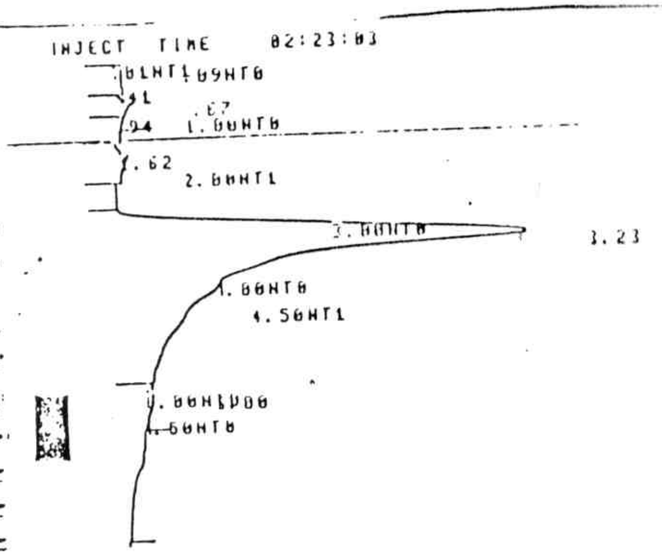
Control



$N_1P_oK_o$



$N_2P_oK_o$



$N_3\ P_o\ K_o$

Fig. (( ): Effect of nitrogen treatments on the pigmenr constituents of ... petals during 1985 season.

Table (12): Effect of Different Fertilization Treatments on The pigment Constituents of *Tagetes patula* petals During 1985 season.

Treatments	3,3,di-hydroxy-γ carotene	3-hydroxy--carotene	5,6-apoxy (33-di-hydroxy-B-carotene	B-carotene	γ-carotene	Phytofluene	Total
Control	76.080	1.045	11.294	4.784	0.601	0.523	94.327
N_1 P_0 K_0	93.398	2.334	0.591	1.446	0.930	1.237	99.936
N_2 P_0 K_0	93.103	3.913	0.505	0.251	0.311	1.381	99.964
N_3 P_0 K_0	95.720	0.886	0.406	1.418	0.773	0.262	99.465
N_0 P_1 K_0	97.657	0.667	Traces	0.370	0.705	0.246	99.645
N_0 P_2 K_0	85.946	1.977	6.679	3.522	0.977	0.828	99.929
N_0 P_3 K_0	79.643	1.148	13.760	3.567	0.952	0.634	99.704
N_0 P_0 K_1	95.569	1.061	0.348	1.542	0.732	0.704	99.956
N_0 P_0 K_2	93.542	1.304	1.639	1.696	1.059	0.760	100.000
N_0 P_0 K_3	67.458	1.282	19.989	9.793	0.756	0.676	99.954
$N_1+P_1+K_1$	85.039	1.179	9.382	2.842	0.853	0.481	99.776
$N_2+P_2+K_2$	95.261	0.878	0.636	1.823	0.635	0.450	99.683
$N_3+P_3+K_3$	93.675	1.545	0.838	0.921	0.885	1.108	98.972

Table (13): Effect of the Fertilization Treatments on The percentage of Different Carotenoides in <u>Tagetes patula</u> petals During 1985 season.

Treatments	3,3,dihydroxy γ carotene	3-hydroxy-α-carotene	5,6-apoxy (33-dihydroxy -B-carotene	B-carotene	α-carotene	Phytofluene	Total
Control	2.970	0.041	0.440	0.186	0.023	0.020	3.680
$N_1 P_0 K_0$	3.640	0.091	0.023	0.057	0.036	0.048	3.895
$N_2 P_0 K_0$	3.630	0.150	0.020	0.029	0.012	0.054	3.875
$N_3 P_0 K_0$	3.730	0.035	0.016	0.055	0.030	0.010	3.860
$N_0 P_1 K_0$	3.810	0.026	Trace	0.014	0.014	0.027	3.850
$N_0 P_2 K_0$	3.350	0.077	0.260	0.137	0.038	0.032	3.894
$N_0 P_3 K_0$	3.106	0.045	0.537	0.139	0.037	0.025	3.889
$N_0 P_0 K_1$	3.730	0.041	0.014	0.060	0.028	0.027	3.900
$N_0 P_0 K_2$	3.650	0.051	0.064	0.066	0.040	0.030	3.901
$N_0 P_0 K_3$	2.630	0.050	0.780	0.382	0.030	0.027	3.899
$N_1+P_1+K_1$	3.320	0.460	0.366	0.111	0.033	0.019	4.309
$N_2+P_2+K_2$	3.720	0.034	0.025	0.071	0.025	0.018	3.893
$N_3+P_3+K_3$	3.650	0.060	0.033	0.036	0.035	0.043	3.857

Table (14): Effect of the Fertilization Treatments on The Contents of Different Carotenoids (g) per individual plant of Tagetes patula During 1985

Treatments	3,3-dihydro-α xy α carotene	3-hydrox- α-carotene	5,6-apoxy (33-dihydroxy) -B-carotene	B-carotene	α-carotene	Phytofluene	Total
Control	1.017	0.014	0.151	0.064	0.008	0.007	1.261
N_1 P_0 K_0	1.394	0.035	0.009	0.022	0.014	0.018	1.492
N_2 P_0 K_0	1.321	0.055	0.007	0.011	0.004	0.020	1.418
N_3 P_0 K_0	1.422	0.013	0.006	0.021	0.011	0.004	1.477
N_0 P_1 K_0	1.400	0.010	Trace	0.005	0.005	0.010	1.430
N_0 P_2 K_0	1.345	0.031	0.104	0.055	0.015	0.013	1.563
N_0 P_3 K_0	1.085	0.016	0.188	0.049	0.013	0.009	1.360
N_0 P_0 K_1	1.477	0.016	0.005	0.024	0.010	0.010	1.542
N_0 P_0 K_2	1.349	0.019	0.024	0.024	0.015	0.011	1.442
N_0 P_0 K_3	0.968	0.018	0.288	0.141	0.011	0.010	1.436
$N_1+P_1+K_1$	1.323	0.018	0.146	0.044	0.013	0.008	1.552
$N_2+P_2+K_2$	1.469	0.013	0.010	0.028	0.010	0.007	1.537
$N_3+P_3+K_3$	1.426	0.023	0.013	0.014	0.014	0.017	1.507

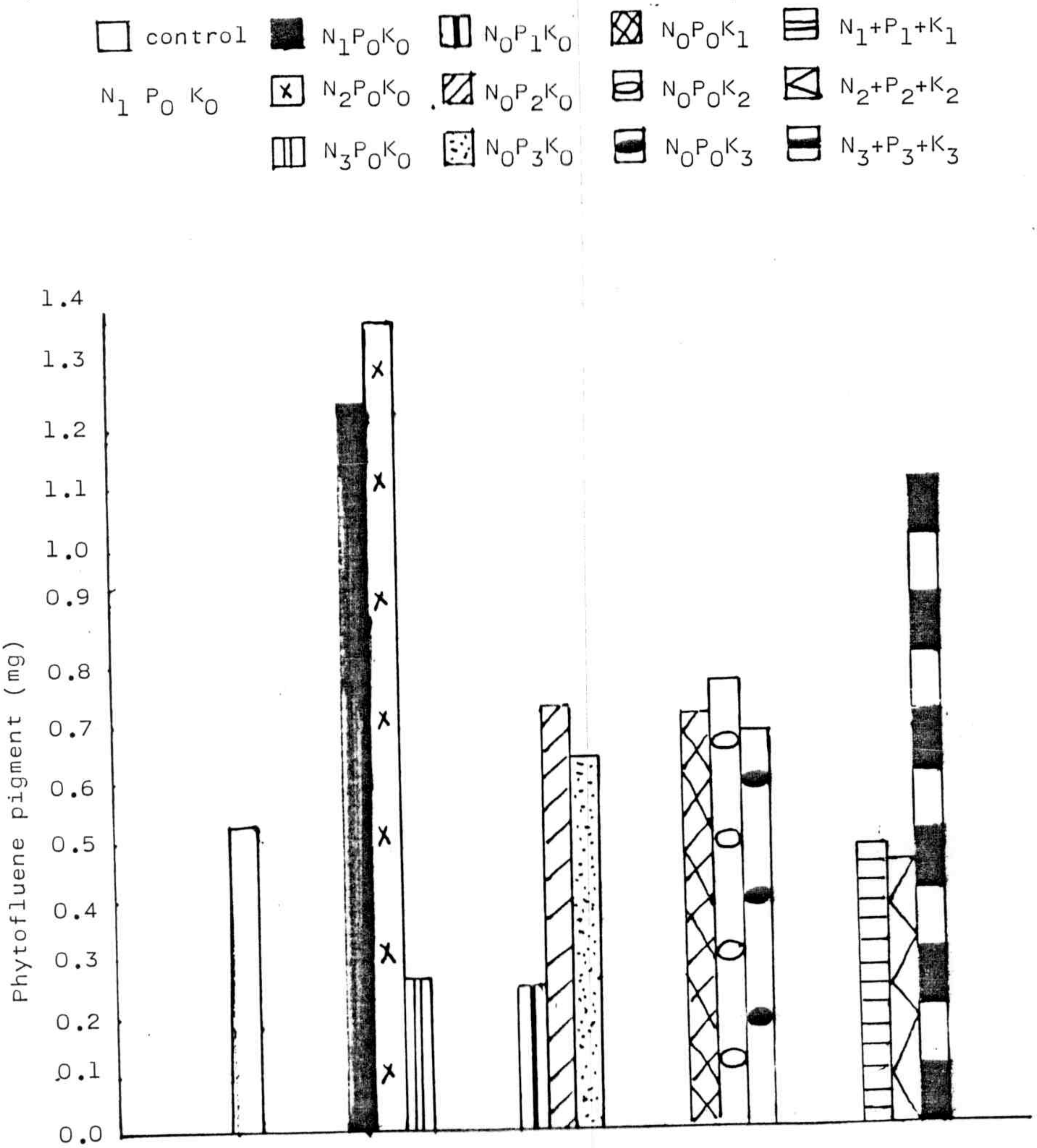


Fig. ( ): Effect of different fertilizer treatments on phytofluene pigment of Tagetes potula petals.

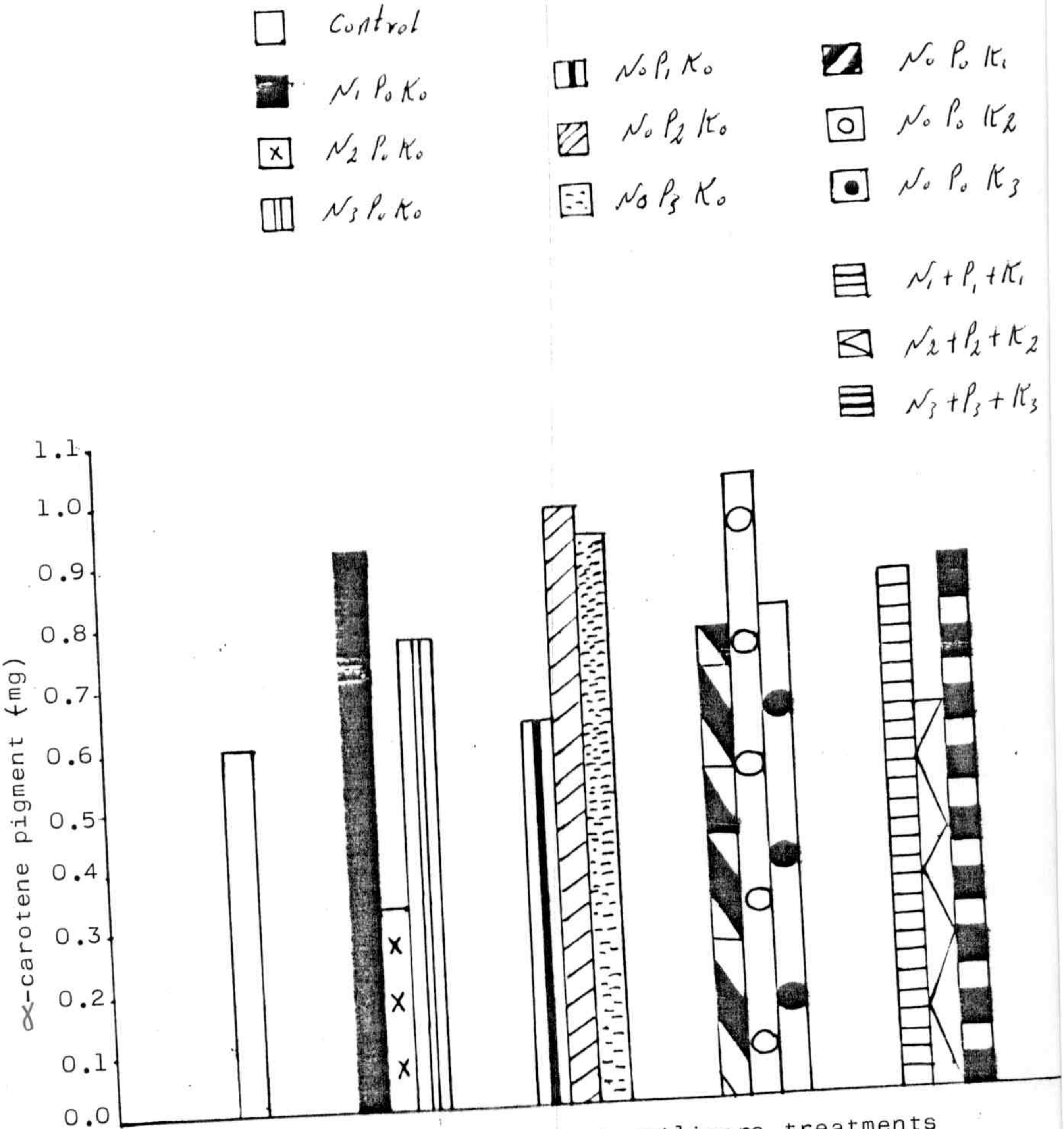


Fig. ( ): Effect of different fertilizers treatments on α-carotene pigment of *Tagetes patula* petals.

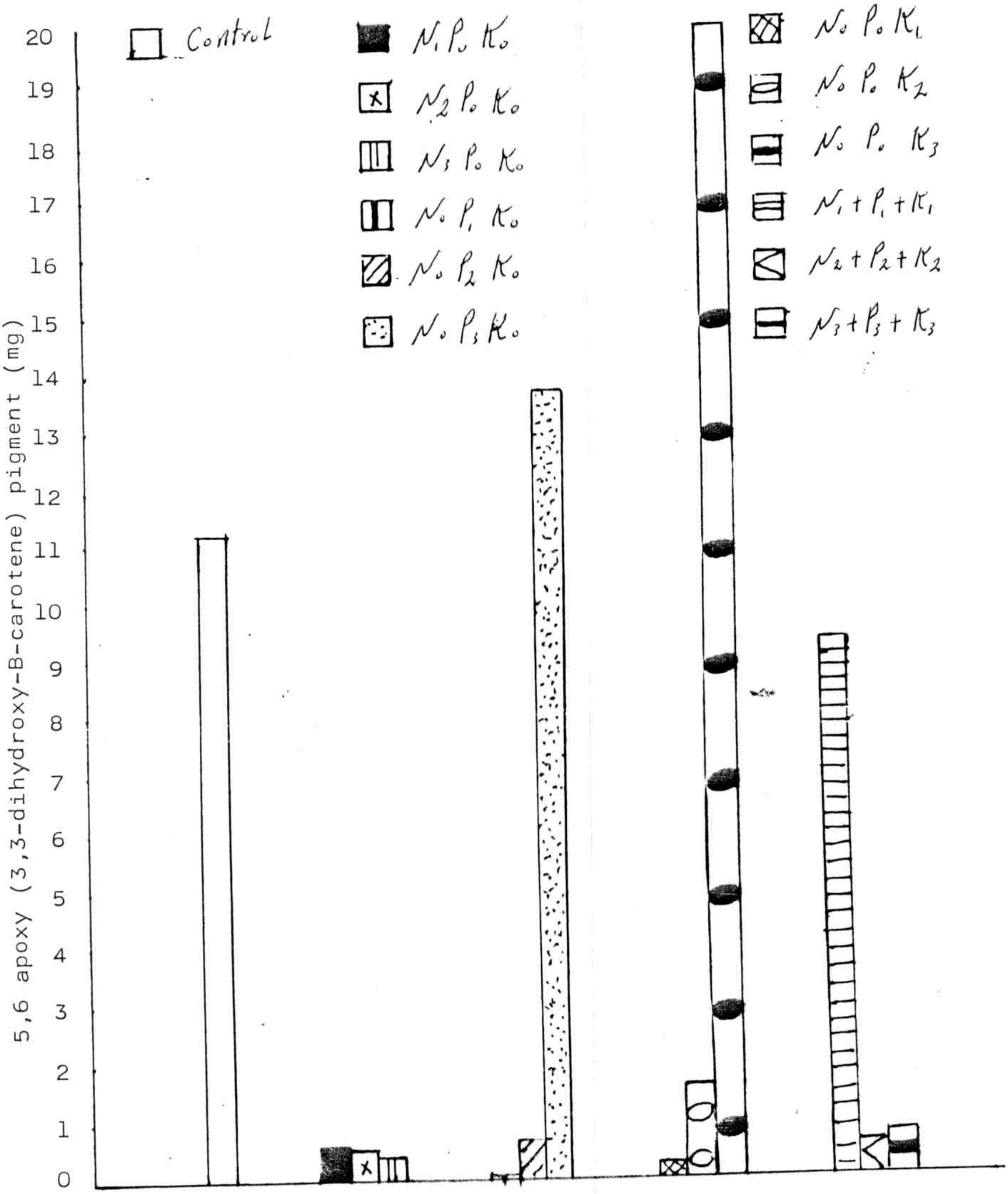


Fig. ( ): Effect of different fertilizer treatments on 5,6 apoxy (3,3 dihydroxy B-carotene of *Tagetes patula* petals.

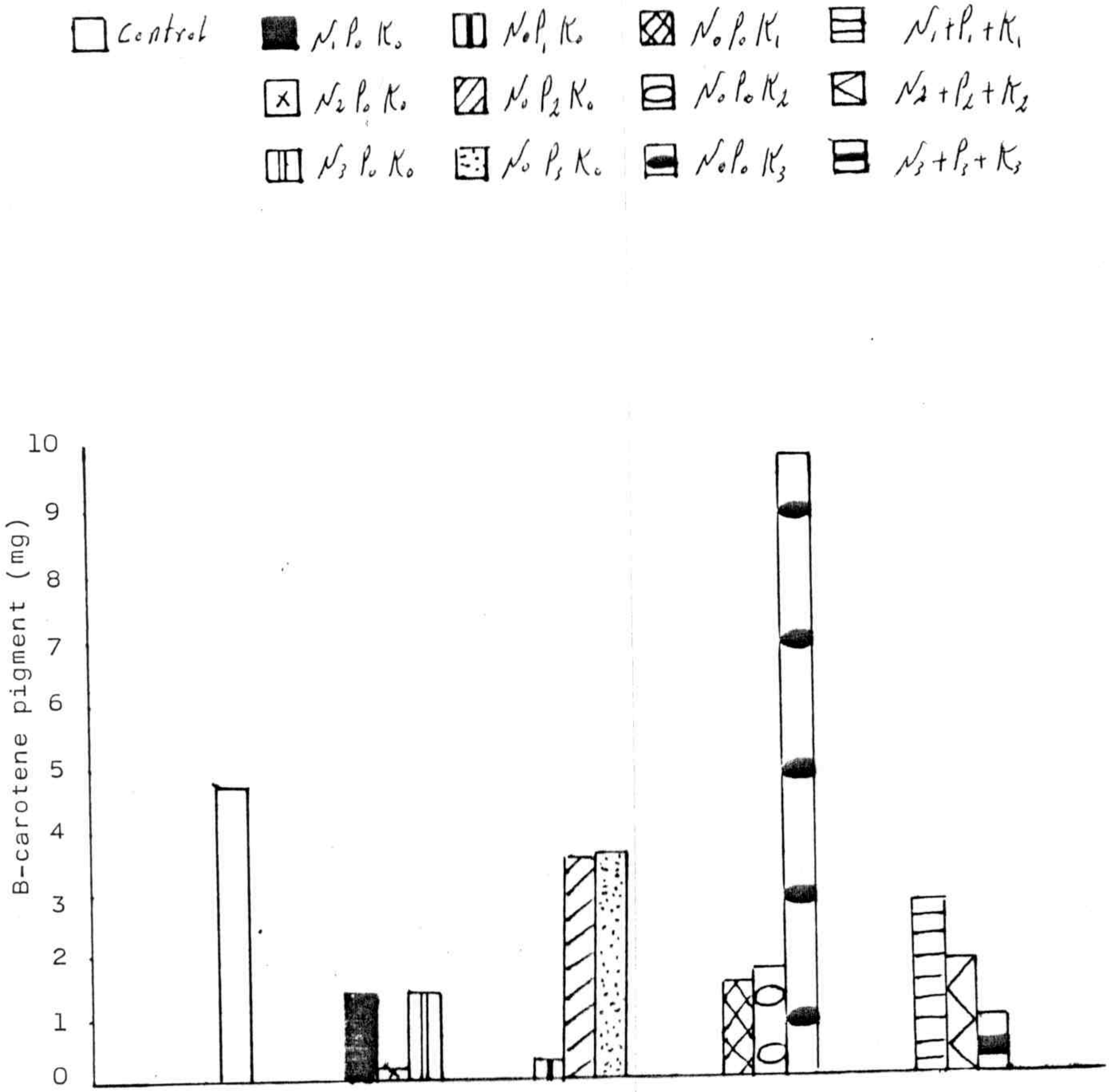


Fig. ( ): Effect of different fertilizer treatments on B-carotene pigment of *Tagetes patula* petals.

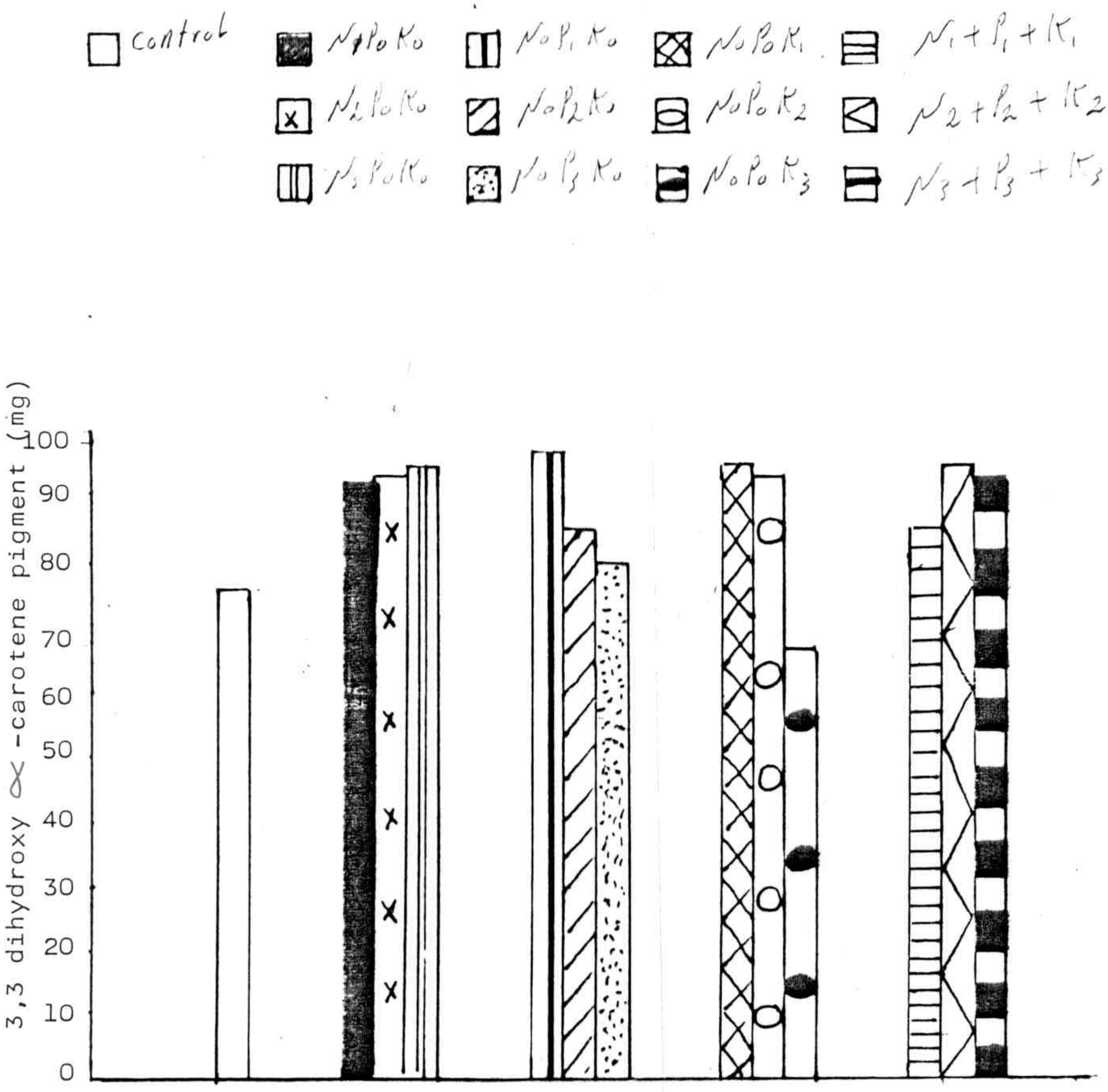


Fig. ( ): Effect of different fertilization treatments on 3,3 dihydroxy α -carotene pigment of *Tagetes patula* petals.

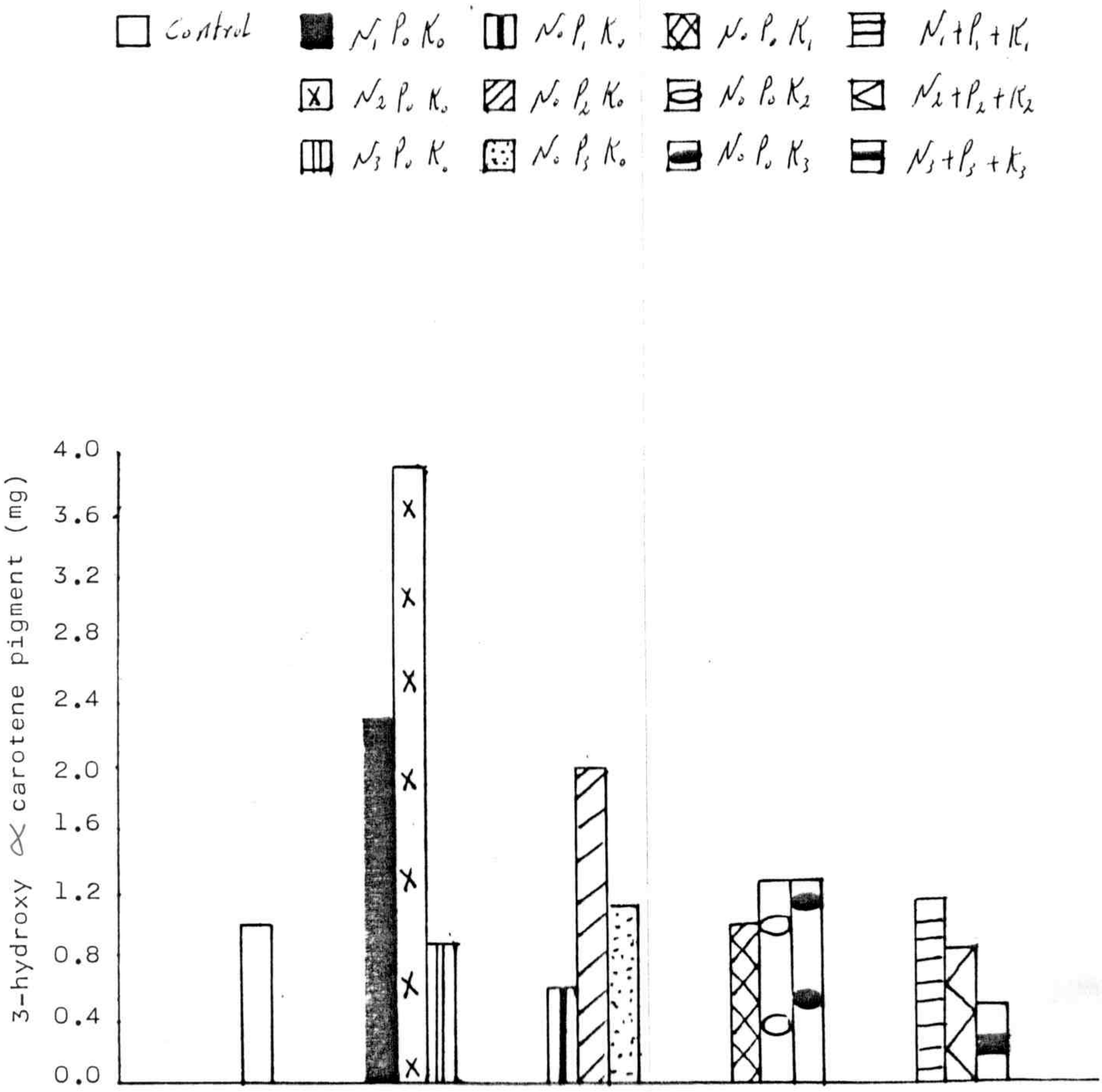


Fig. (   ): Effect of different fertilizer treatments on 3-hydroxy ∝-carotene pigment of *Tagetes patula* petals.

in comparison to the control plant. In mean time, also the lowest value of B-carotene obtained against the 15.5 N_2/m^2 treatment. The absolute amounts of α- and B-carotenes per individual plant parallel with their concentrations (percentages) in T. patula, Table (14). It is evident that the formation of α-cryptoxanthin through hydroxylation process of α-carotene was influenced by fertilization the plant with successive portions of nitrogen up to 15.5 g/m^2 The percentages of 3-hydroxy-α-carotene in petals of plants received 7.8 g and 15.5 g N_2/m^2 were more than double and triple its value in untreated plant-petals. It is clear that T. plants supplied with high nitrogen fertilizer levels possessed a large size and grew faster. For this prementioned character, the B-carotene production less surplus to be pronounced to capital, hence the rate of hydroxylation was not enough to meet or to parallel the petals growth in weight due to high nitrogen fertilization levels.. Plants can be devided into three very general groups according to the types of carotenoids which produce as their major flower pigments, it seems the T. patula synthesis mainly highly oxo-xanthophylls in particular 3,3-dihydroxy-α-carotene (lutein). Feeding the plants with nitrogen accelerated the accumulation of lutein. The increase in lutein percentage due to consecutive alloments of nitrogen in comparison with the untreated plants was 22.53 %, 22.22% and 25.54 % respectively. On the whole, it seems that the influence of nitrogen fertilization on the yield of lutein as a main constituent was homeostasis The insertion of oxygen into xanthophylls is formed with the concomitant disappearance of carotenes. It seems that nitrogen fertilization is not favourable in a certain way for the mechanism involves synthesize highly oxidized xanthophylls which incorporated with a mixed function oxidase. The aforementioned data coincide with the results mentioned by Manitasevic and Horgas (1975) that high nitrogen rate reduced the amount of coloured carotenes especially B-carotene and increased that of their colourless precursor phytofluence in carrots.

The difference in dyes fractions percentages and content in relation to phosphorous fertilization is brought in table (12). Phosphorous plays a part in prosthetic groups of some enzymes, the change from adenosine diphosphate to adenosine triphosphate and the reverse is an esse ntial for energy transfere for carotenoids biosynthesis which are synthysised from the universal isoprenoid precuror, iso-pentenyl pyrophosphate IPP isomerize to dimethyallyl--phosphate (DMAPP), condense with TPP to form geranylgeranyl pyrophosphate, which condenses to form the first C-40 product the colourless polyene phytoene and on dehydration the phyto-fluene is formed.

Due to addition of low dose of phosphorous to T. plant, the concentration of phytofluene logged behind. This may be attributed to the phenomena that at the lowest phosphorus supply,.it seemed that such supply was not far beyond the compensation point at which other metabolic processes are conducted out first consuming the available phosphorous in plant cells. Higher phosphorous dose up 11.6 gm P_2O_5/m^2 stimulated further metabolic processes to induce high concentration of phytofluene (32 mg/100 gm) followed by 5.8 gm P_2O_5/m^2 treatment (27 mg/100 gm), The content of phytofluene per individual plant was restricted with its concentration and the yield of petals per individual plant.

In general the concentration values of α-carotene in T. patula petals surpassed that of the control plant due to supplying the plants with phosphorous fertilizer. The percentage of α-carotene and its content attained its maximum point in plants grown in soil fertilized with a dose of 11.6 gm phosphorous/m^2 followed by 17.4 gm P_2O_5/m^2 treatment. The increase percentage due to the two forementioned treatment in comparison with the untreated plant were 62.5% and 58.4 % respectively for α-carotene concentration 87.5 % and 62.5 % respectively for its content/plant.

The addition of different levels of phosphorous to T. plant gave lower values in general concerning the concentration and the absolute amount of B-carotene in T. petals in comparison with the control plants. However, increasing the phosphorus doses provoked gradually the accumulation of B-carotene in petals tissues.

Hydroxylation path in direction to form 3-hydroxy-α-carotene seemed to be tied with the route of α-carotene excretion. The highest concentration of α-cryptoxanthin in

T. petals was attained its maximum point due to feeding the plant with 11.6 gm phosphorous/m^2 followed by 17.4 gm phosphorous/m^2. The increase percentage in the α-crypt oxanthin content per individual plant due to the forementioned treatment in comparison with the paupered plants were 121.4% and 14.29% respectively.

Addition the lowest phosphorous fertilizer portion applied in the current expriment resulted in the highest concentration of 3,3-dihydroxy-α-carotene (lutein) in plant petals, which recorded 3.81%. Further addition of phosphorous diminished the lutein excretion in petals tissues.

In mean time phosphorous gave a negative act on the oxidation of zeaxanthine the precursor of 5,6-epoxy (3,3-dihydroxy-B-carotene) (antheraxanthine). However, increasing the amounts of phosphorous fertilizer added to the plants obviously provoked and raised gradually the formatio n of the antheraxanthine in plant petals.

The plant grown in a habitate fertilized with potassium is slightly preponderant in comparison with untreated plants concerning its capacity to excrete both phytofluene and α-carotene. However, potassium can be considered as a poignant element but labile. The highest values of phytofluene and α-carotene were realized due to treating the plant with 12 gm K_2O/m^2 followed by 6.0 gm K_2O/m^2 treatment.

B-carotene production in *T. patula* petals is distinctly affected with raising doses of potassium fertilizer. The increase percentage B-carotene in plant petals grown in 6.0, 12.0 and 18.0 gm K_2O/m^2 treatments were -67.74, -64.52 % and 105.4% respectively in comparison with control plants. Also, the production of the individual plant from B-carotene increased due to the aforementioned treatments and amounted 0.024%, 0.024% and 0.141% respectively as compared to the untreated plant.

The percentages of α-cryptoxanthin in petals as a function of potassium fertilization are presented in Table (12). It is conceivable that in general the percentage of the hydroxy derivative of α-carotene is parallel to the concentration of the parent-α-carotene estimated in explants collected from plants grown in different levels of potassium. The yield of α-cryptoxanthin is restricted with the plant production of petals c.f. Table (9) and the percentage of that substance in petals in different potassium treatments.

The T. patula plant showed a negative trend concerning the production of lutein against the raising levels of potassium fertilization. The addition of 6.0 gm and 12.0 gm K_2O/m^2 resulted in obvious increase in the lutein concentration estimated 25.62% and 22.92 % respectively in comparison with the control treatment. Further addition of potassium diminished the lutein formation to the lowest point and the decrease percentage was 11.33 % as compared with the untreated plant. Presumably the obtained data is explicable on the base of the lower value of the carbohydrate percent in <u>T. patula</u> leaves which seems attributed to less efficient photosynthesis which might be necessary for stimulating O_2 production as the oxygen of the hydroxyl function in lutein arises from O_2 and not H_2O. The mechanism probably involves a mixed function oxidase. This beside presumably that the fact the plants grown at higher potassium level. Its production of lutein converted partially but rapidly to the dioxo-carotenoid substance. The highest value of 5,6-epoxy (3,3-dihydroxy-B-carotene) attained due to fertile the plant with the highest dose of potassium fertilizer (18.0 g K_2O/m^2). The increase percentages in the concentration and yield of antheraxanthin in Tagetes petals received 18.0 g K_2O/m^2 were 77.27 % , 90.7 % respectively .

The addition of a mixture of N, P and K containing the highest portion of each element keeping the ratio of 2:3:1 resulted in the highest values of both colourless and coloured carotenoids except B-carotene and its dioxo-dihydroxyl derivative. The increase percentages afforded by plants received 23.3 N , 17.4 g P_2O_5 and 18.0 g K_2O/m^2 in comparison with the untreated ones were 115 %, 52.17 %

46.34 and 22.9 % respectively for phytofluene, α-carotene, α-cryptoxanthine and lutein respectively.

To ligate the function of the forementioned macro-nutritive elements in formation of T. patula dyes, it seems obviously that fertilization the plant with low rate of complete fertilizer gave best values for total dyes determined as Percentage and yield per individual plant.