4. RESULT AND DISCUSSION

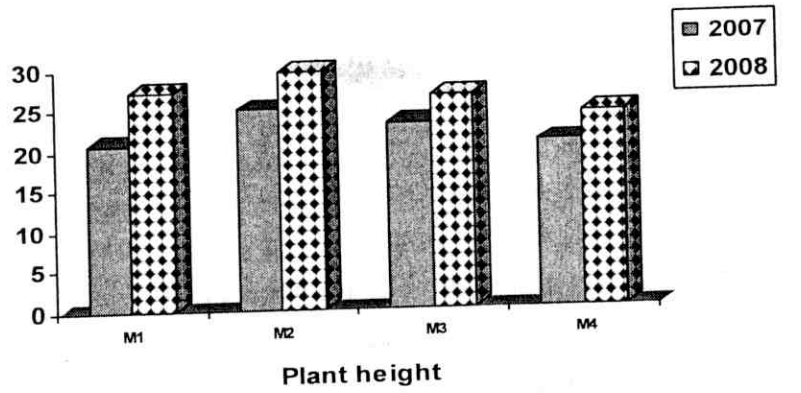
Part (1):Effect of some planting media on *Adiantum cuneatum* plants.

a- On vegetative growth:

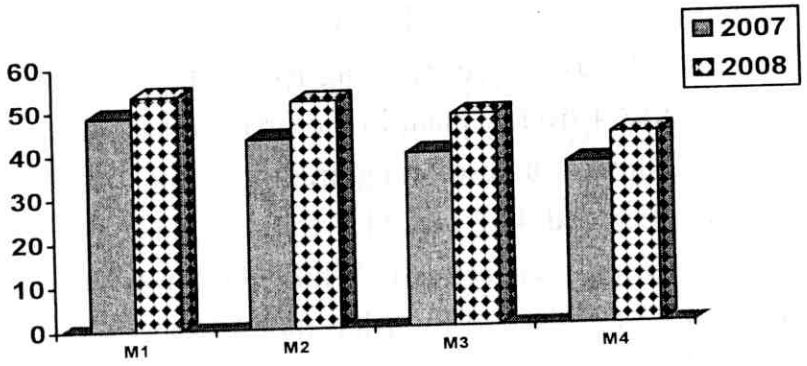
1- Mean plant height (CM).

According to data presented in Table (1) on mean plant height as affected by M1= clay: leaf dust: sand (1:1:1 by volume), M_2= clay: peat moss: sand (1:1:1), M_3= clay: vermiculite: sand (1:1:1) and M_4= clay: sand (1:1), it could be concluded that all used planting media showed different effects on plant height of Adiantum plants. However, the highest mean values of plant height were obtained by using the treatment of M1 followed in descending order by M_2 as they gave 25.7 and 24.9 cm, respectively, whereas the lowest values of plant height were obtained by using the treatments of M_4 and M_3 as they gave 23.0 and 21.6 cm, respectively. This trend was true only in the first season, while in the second one, the picture was completely changed where M_2 showed its superiority in this respect followed by the treatment of M_1 as they gave 29.4 and 27.1 cm, respectively. These results are in agreement with those attained by **Zencrinkran and Menguc (1994)** on *Adiantum capillus* veneris L- they studied the effect of different media and obtained the best media for growth was on peat moss., **Chmiel and Stasiak, (1997)** on *Adiantum raddianum* cv.fragrans, *Ptereris cretica* cv.wimsetti and *Nephrolepis crodifolia*. Proved that a 1:1:1 mixture on peat, sand and keramzit medium gave the best

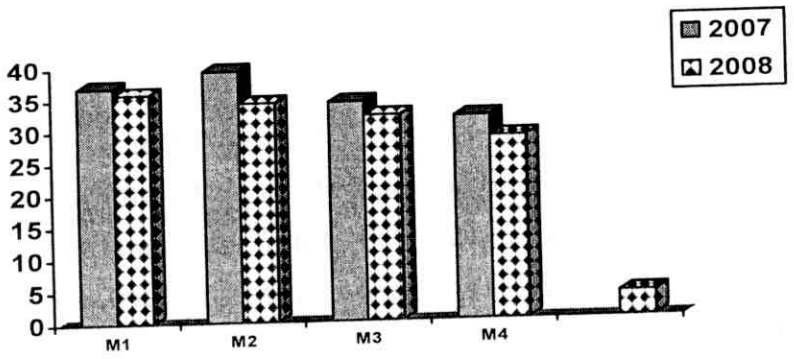
Figure (1): Effect of some plant media on vegetative growth of *Adiantum cuneatum*, L plants during 2007 and 2008.



Plant height



No. of fronds/plant



No. of leaves/frond

(1997), on *Adiantum raddianum* cv. Fragrans, peteris cretica cv. Wimsetti and Nephrolepis cordifolia. Proved that 1:1:1 mixture

growth, **Chmiel and Stasiak (1997)** on *Nephrolepis exaltata* cv. Bost on marathon and *A hispidulum* gave good plant growth on AQuA TERRA- RP, AQuA TERRA-2orAQuA TERR3., **Saher (2000),** on yucca and **Nowak and Strojny (2003)** on Gerbera plant. They found that the tallest plant was recorded by using the media of coco-plant.

2- Number of fronds/ plant:

The data obtained on the number of fronds / plant as affected by some planting media are presented in Table (1). The results reveal that alt tested planting media statistically increased the number of fronds/ plant. However, the greatest number of fronds per plant was gained by using the treatment of M_1 as it gave 48.6 and 53.4 fronds/ plant in the first and second seasons, respectively followed in descending order by using the treatment of M_2 which recorded 43.2 and 51.8 fronds / plant in the first and second seasons, respectively. While, the lowest number of fronds/ plant was registered by using the treatment of M_4 as it gave 36.7 and 43.3 fronds / plant in the first and second season, respectively.

These results are agreement with those obtained by **M_c Connell (1988)** on *Ficus benjamina*. He found that plant growth rate was greater in commercial medium in peat,vermiculite, sand barkash and Pin bark, it was 95% for *F. benjamina*, **Korkar (1996),** on *Coadiaeum variegatum*, recommended using M_3 (1sand:1clay:1sawdust) which considered unexpensive and available media for growing plants., **Chmiel and Stasiak,**

4- Fresh weight of fronds/ plant (g):

(1997), on *Adiantum raddianum* cv. Fragrans, peteris cretica cv. Wimsetti and Nephrolepis cordifolia. Proved that 1:1:1 mixture of peat, sand and keramzite medium gave the best growth.

3- Number of leaves/ frond:

Data in Table (1) indicate that the highest number of leaves / frond was recorded by using the treatment of M_2 in the first season and M_1 in the second season as they gave 39.4 and 35.8 leaves/ frond, respectively, followed descending by using the treatments of M_1 in the first seasons and M_2 in the second one as they recorded 36.9 and 34.2 leaves/ frond respectively. The differences among M_1 and M_2 in the first season were significant, where in the second one the differences between M_1 and M_2 were non- significant, as the plants under such treatments had nearly close values. These results are agreement with those obtained by **Ali (1991)**, on *Chlorophytum comosum*, showed that growing media had a highly significant effect on number of leaves was on a mixture from potting+ perlit+evermiculite (1:1:1)., **Mc Connel and Shiralipour (1991)** on *Dracaena fragrans*, reported that the highest number of leaves / plant occurred in mixtures with 300(commercial mixture)., **El- Sayed (1994),** on *Brassaia actinphylla*, reported that growing media containing peat moss+ sponge (2:1) gave the highest number of leaves/plant., **Chmiel and Stasiak, (1997)** on *Adiantum raddianum* cv. Fragrans, *Peteris cretica* cv. Wimsetti and *Nephrolepis cordfolia*, proved that a 1:1:1 mixture of peat, sand and keramzite medium gave the best growth.

4- Fresh weight of fronds/ plant (g):

The data obtained on fresh weight of fronds per plant (g) as affected by some planting media are shown in Table (2). These results may be discussed as follows:

All used planting media affected the fresh weight of fronds/ plant in both seasons of this study. However, the heaviest fresh weight of fronds/ plant was recorded by using the treatments of M_1 followed descendingly by using the treatment of M_2 as they registered 24.7 and 21.9 (g), respectively. This trend was true only in the first seasons while in the second one the picture was completely reversed where M_2 showed its superiority in this concern. Meanwhile, the differences between M_1 and M_2 in the first season were significant, whereas the differences between M_1 and M_2 in the second season did not reach to the level of significance as the plants under such treatment had nearly close values. On contrary, the lowest values of fresh weight were recorded by using the treatment of M_4 as it registered 18.2 and 23.6 (g) in the first and second seasons, respectively. These results are agreement with those obtained by, **Ali (1991),** on *Chlorphytum comosum*, showed that a mixture potting soil+ perlite+ vermiculite (1:1:1) produced the heaviest fresh weight of leaves., **El-Sayed (1994),** on *Brassica actinophylla*, reported that a mixture from peat moss+ sponge (2:1) or peat moss +foam (2:1) gave the heaviest fresh weight of foliage., **Nowak and Strojny (2003),** on Gerbera, recommended that the higher fresh weight was in coco- peat, white peat, fine+ perlite and coarse fraction.

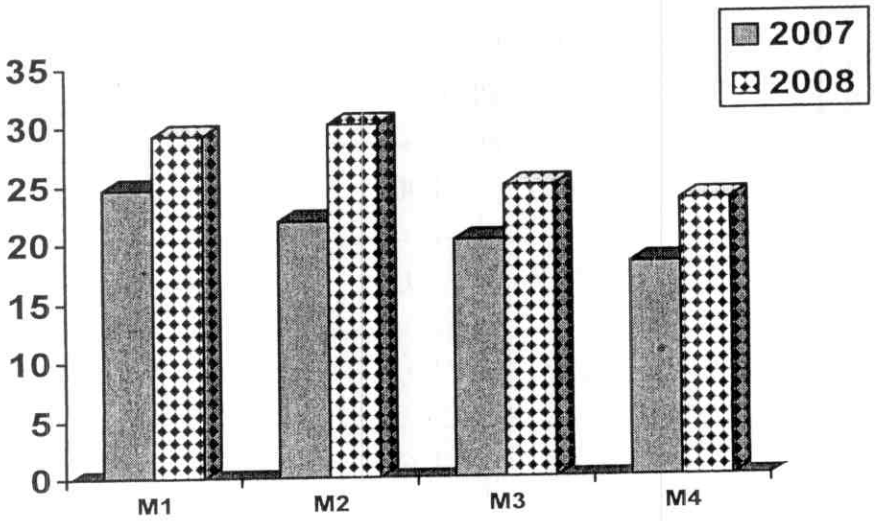
Table (2): Effect of some planting media on fresh and dry weight of fronds of *Adiantum cuneatum*, L plants during 2007 and 2008.

Parameters	Fresh weight of fronds		Dry weight of fronds	
Season	2007	2008	2007	2008
M_1	24.7	29.2	3.34	3.88
M_2	21.9	30.1	2.62	3.84
M_3	20.2	24.9	2.47	3.18
M_4	18.2	23.6	2.16	2.99
LSD at 5%	1.83	1.24	0.32	0.36

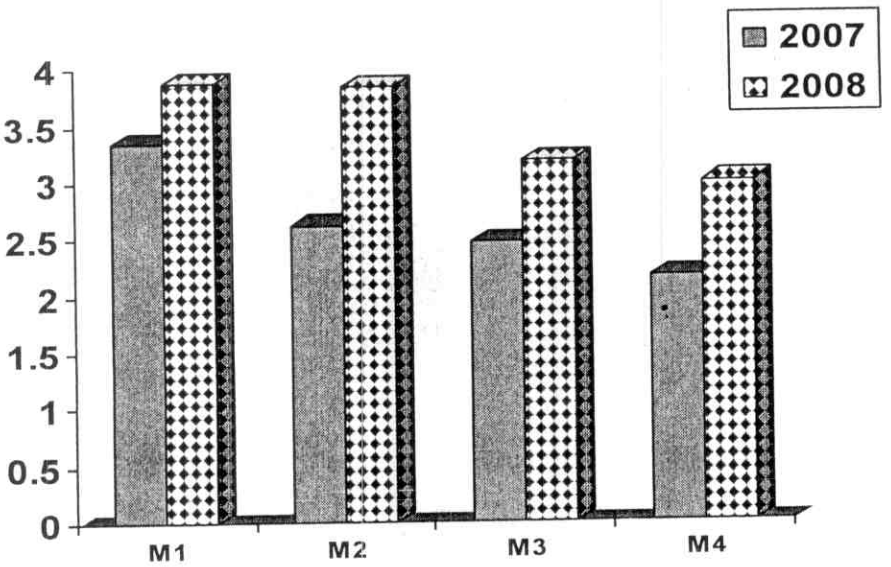
M_1= 1 clay: 1 sawdust: 1 sand M_2= 1 clay: 1 peat moss: 1 sand

M_3= 1 clay: 1vermiculite: 1 sand M_4= 1 clay: 1 sand

Figure (2): Effect of some planting media on fresh and dry weight of fronds of *Adiantum cuneatum*, L plants during 2007 and 2008



Fresh weight of fronds



Dry weight of fronds

5- Dry weight of fronds/ plant (9).

The date obtained on dry weight of fronds/ plant (g) as affected by some planting media are presented in Table (2). The results of the dry weight of fronds / plant attained a parallel trend with the fresh weight results, with little difference. In general, the heaviest dry weight of fronds/ plant was gained by using the treatment of M_1 as it gave 3. 34 and 3.88(gm) followed in descending order by the treatment of M_2 which gave 2.62 and 3.84 (gm) in the first and second season, respectively. The differences between the aforementioned results were non significant as the plants under such treatments (M_1 and M_2) had nearly close values in both seasons. On the other hand, the lowest values of dry weight were recorded by using the treatments of M_4 and M_3 in both seasons of this study, These results are agreement with those obtained by, **Hammad (1994),** on *Cupressus sempervirens*, found that medium containing sand: clay: foam (3:1:1) was the best., **Zencrinkran and Menguc, (1994)** on *Adiantum capillus*.venerisL-they showed that peat moss was the best media for growth., **Chmiel and Stsiak (1997),** on *Adiantum raddianum* cv. Fragrance, *Peteris cretica* cv. Wimsetti and *Nephrolepis cordifolia*, proved that a 1:1:1 mixture of peat, sand and keramzite medium gave the highest dry weight.

B- Root growth measurements:

According to data presented in Table (3) it could be concluded that using M_1 as a planting media showed to be the most effective one for producing the heaviest fresh and dry

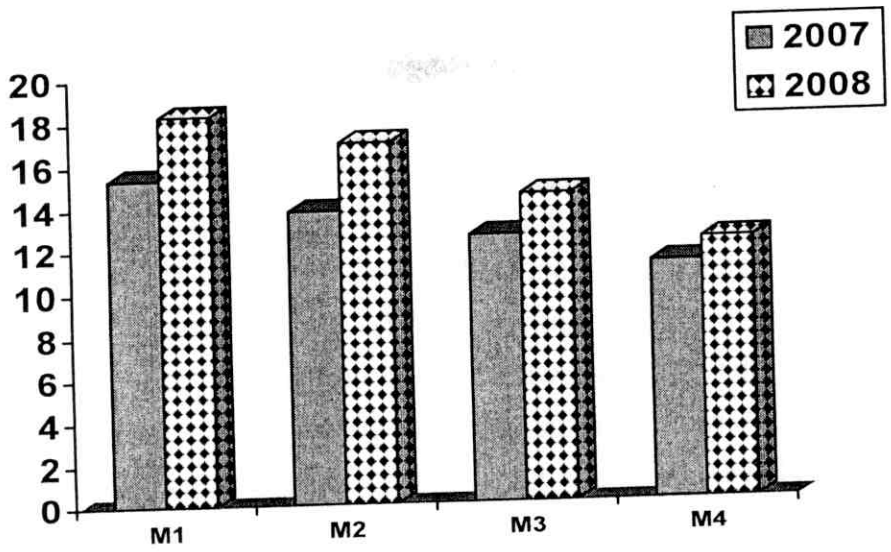
Table (3): Effect of some planting media on fresh and dry eight of root /plant of *Adiantum cuneatum*, L plants during 2007 and 2008

Parameters	Fresh weight of root/plant		Dry weight of root/plant	
Season	2007	2008	2007	2008
M_1	15.63	18.27	1.36	1.73
M_2	13.79	16.92	1.10	1.42
M_3	12.52	14.40	0.98	1.19
M_4	11.10	12.17	0.83	0.96
LSD at 5%	1.03	1.14	0.12	0.15

M_1= 1 clay: 1 sawdust: 1 sand M_2= 1 clay: 1 peat moss: 1 sand

M_3= 1 clay: 1vermiculite: 1 sand M_4= 1 clay: 1 sand

Figure (3): Effect of some planting media on fresh and dry eight of root /plant of *Adiantum cuneatum*, L plants during 2007 and 2008



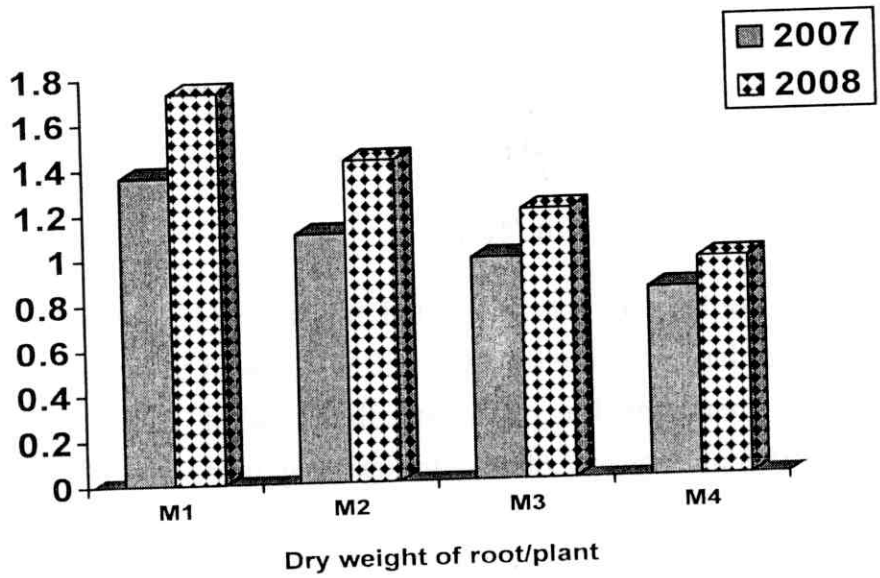
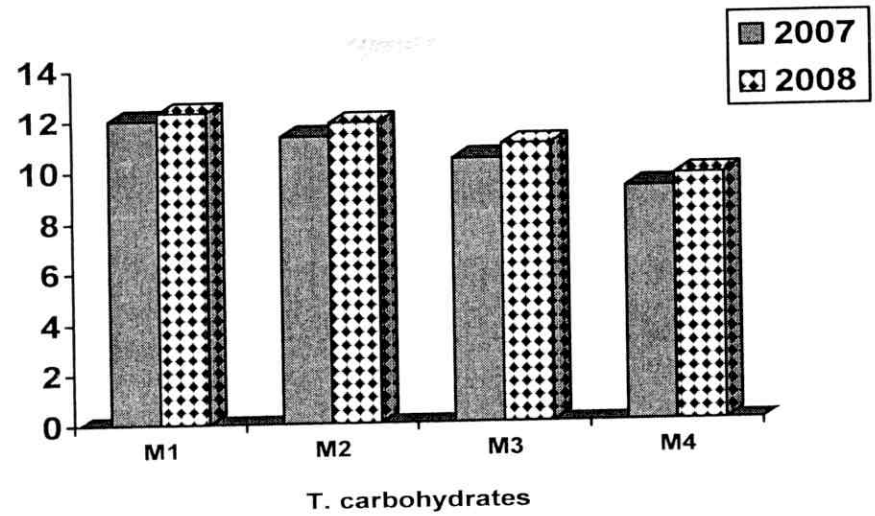
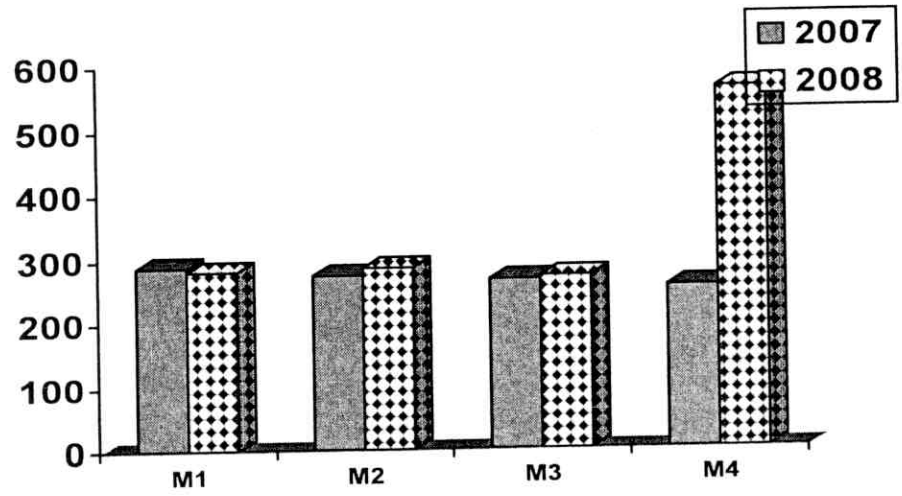


Figure (5): Effect of some planting media on total carbohydrates and chlorophylls of leaves of total carbohydrates and chlorophylls during 2007 and 2008



T. carbohydrates



T. chlorophylls

using the treatment of M_1 which recorded 287 and 282(mg/100F.W). The differences between the above mentioned two treatments were not significant in both season, as the plants such treatment had nearly close values. On other side, the lowest values of leaf chlorophylls content were recorded by using the treatment of M_4 in both seasons.

6-Leaf total indoles content:

The data obtained on the leaf total indoles content in fresh samples of Adiantum leaves as affected by some planting media are presented in Table (6). The results reveal that all tested planting media statistically increased the leaves total indols content in both seasons. However the best result was gained by using the treatment of M_2 as it gave 239 and 243 (mg/100g.F.W) in both seasons, respectively followed in descending order by using the treatment of M_1 which recorded 237 and 238 (mg/100g F.W) in both seasons, respectively. While the lowest valueswas registered by using the treatment of M_4 as it gave 208 and 206(mg/100gF.W) in the first and second seasons, respectively.

7- Leaf total phenols content:

Data in Table (6) indicate that the highest total phenol quantity was recorded by using the treatment of M_4 in the first and second seasons as it gave 193 and 197 (mg/100gF.W), respectively followed descendingly by using the treatment of M_3 in the first and second seasons as the recorded 184 and 180(mg/100gF.W), respectively. The differences among M_4 and

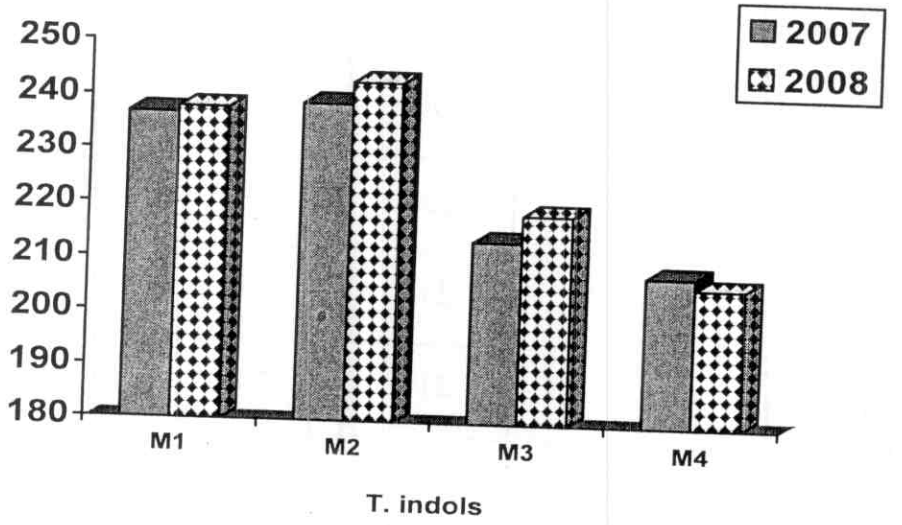
Table (6): Effect of some planting media on total content of indols and phenols of *Adiantum cuneatum*, L plants during 2007 and 2008

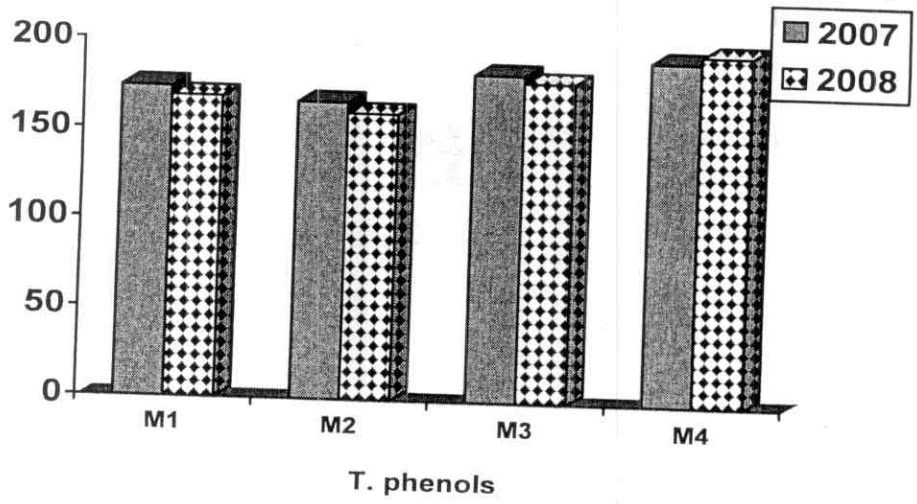
Parameters	T. indols		T. phenols	
Season	2007	2008	2007	2008
M_1	237	238	174	169
M_2	239	243	167	161
M_3	214	219	184	180
M_4	208	206	193	197
LSD at 5%	6.56	7.19	6.11	5.92

M_1= 1 clay: 1 sawdust: 1 sand M_2= 1 clay: 1 peat moss: 1 sand

M_3= 1 clay: 1vermiculite: 1 sand M_4= 1 clay: 1 sand

Figure (6): Effect of some planting media on total content of indols and phenols of *Adiantum cuneatum*, L plants during 2007 and 2008





M_3 in both seasons, were significant. Whereas the lowest leaves total phenols content was gained by using the treatment of M_2 as it gave 167 and 161(mg/100gF.W) in both seasons.

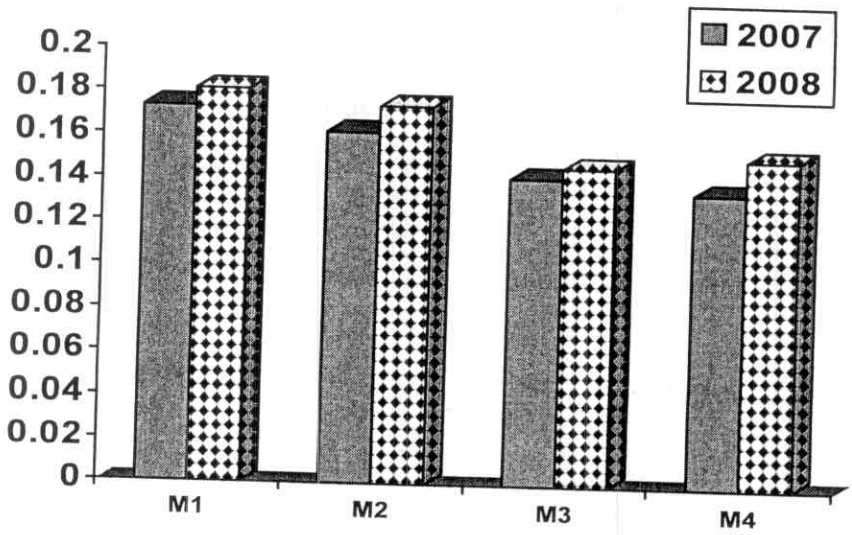
D-Leaves oil percentage

Data presented in Table (7) show that the highest leaves oil percentage of Adiantum plant was induced by using M_1 followed in descending order by using M_2 as they recorded 0.173 and 0.162, respectively . On contrary the lowest values of leaves oil percentage were recorded by using M_4 and M_3 as they registered 0.136 and 0.142%, respectively. This trend was true only in the first seasons, while in the second one the situation is completely changed, where M_1 showed its superiority in this concern, followed by using M_2 as they gave 0.181 and 0.174%, respectively on the reverse, the lowest leaves oil percentage of Adiantum plants was obtained by using M_3 and M_4 as they recorded 0.147 and 0.152, respective.

Table (7): Effect of some plant media on oil percentage of *Adiantum cuneatum*, L plants during 2007 and 2008.

Parameters	Seasons	
	2007	2008
M_1	0.173	0.181
M_2	0.162	0.174
M_3	0.142	0.147
M_4	0.136	0.152
L.S.D at 5%	0.014	0.017

Figure (7): Effect of some plant media on oil percentage of *Adiantum cuneatum*, L plants during 2007 and 2008.



Part II: Effect of bio and chemical fertilizer on growth and chemical composition of *Adiantum cuneatum* plants

A: Effect on vegetative growth parameters:

1- Plant height (cm):

According to data presented in Table (8) on plant height of *Adiantum cuneatum* plant as affected by some fertilizer treatments i.e., f_1= control, F_2=100 chemical fertilizer dose, F_3=75% chemical fertilizer dose, F_4= 75% chemical fertilizer dose + 25% bio – fertilizer dose, F_5= 50% chemical fertilizer dose + 50% bio- fertilizer dose, F_6= 75% bio –fertilizer dose25%+ chemical fertilizer dose and F_7= 100% bio- fertilizer dose, it could be concluded that all tested fertilizer treatments succeeded in increasing the plant high of Adiantum plants as compared with control in both seasons. However, the tallest plants of Adiantum plants was recorded by using F_2 as it gave 32.1 and 34.0 cm in the first and second seasons, respectively. Also, the treatments of F_3 and F_4 caused highly significant increment in this parameter when compared with control in both seasons. The differences between the abovementioned two treatments (F_3 and F_4) were non significant in both seasons of this study. Irrespective control the lowest mean values of plant height was gained by using the treatments of F_7 and F_6 in both seasons. The differences between the aforementioned two treatments (F_6 and F_7) and control were significant in both seasons. The remained treatment (F_5) occupied an intermediate

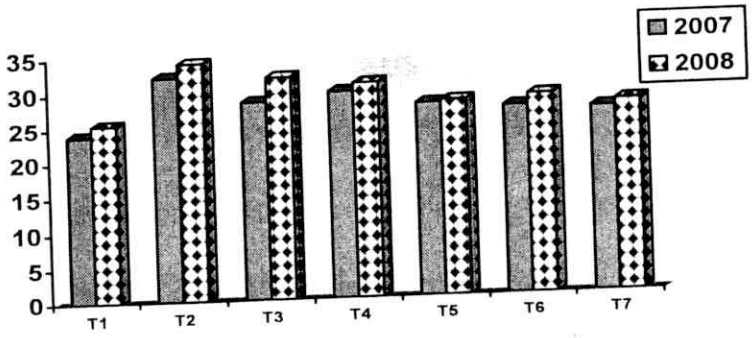
Table (8): Effect of some treatments of bio and chemical fertilizer on vegetative growth of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons.

Parameters	Plant height		No. of fronds		No. of leaves	
Season	2007	2008	2007	2008	2007	2008
T_1	23.9	25.4	52.4	49.3	38.4	41.2
T_2	32.1	34.0	81.9	81.8	57.3	62.1
T_3	28.4	31.8	74.2	78.6	52.2	56.8
T_4	29.6	30.7	84.7	82.4	56.9	63.2
T_5	27.6	27.9	73.7	78.1	53.8	54.3
T_6	26.9	28.4	71.8	75.0	51.7	52.0
T_7	26.4	27.3	72.3	69.2	48.2	49.7
LSD At 5%	2.45	2.14	11.19	13.20	8.73	7.07

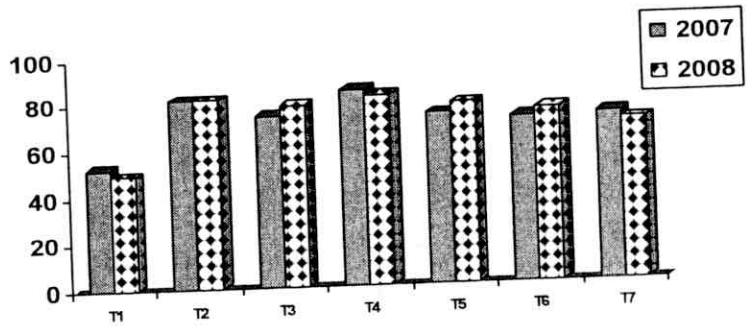
T= control T_2= 100% chemical T_3= 75% chemical T_4 = 75% chemical+ 25% bio

T_5 = 50% chemical + 50% bio T_6 = 75% bio + 25% chemical T_7 = 100% bio

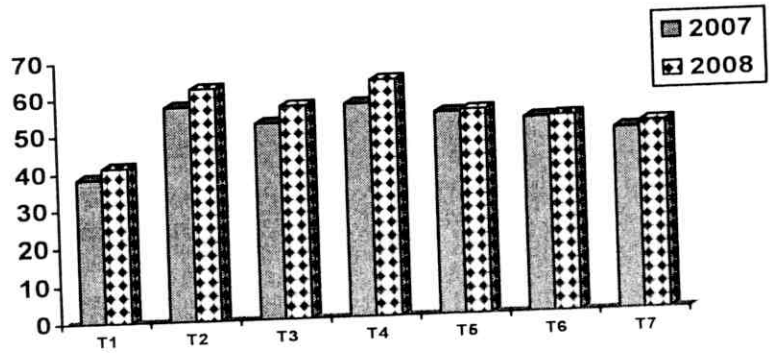
Figure (8): Effect of some treatments of bio and chemical fertilizer on vegetative growth of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons.



plant height



No. of fronds



No. of leaves

position between the aforementioned treatments. These results are in agreement with those attained by **Hanger and Brown, (1985),** on *Adiantum raddianum*, showed that the best plant growth and quality in plants were fertilized weekly for 22 weeks with 0.5,2.5 time the recommended liquid fertilizer rate., **Ibrahim (2000),** on *Foeniculum vulgar*, found that plant height were increased by using NPK at the rates of (150: 225: 75kg) ., **Attia and Soad (2001)** on *Catharanthus roseus* plants obtained that nitrobein at 250kg/fed.gave the tallest plants., **Dessouky (2002),** recommended that nitrobein at 5kg/fed. Gave the most effective one on plant height.

2- Number of fronds / plant.

The data obtained on the number of fronds / plant as affected by some fertilizer treatments are shown in Table (8). These results may be discussed as follows: All tested fertilizer treatments statistically increased the number of fronds per plants when compared with control in both seasons, however using the treatment of F_4 showed to be the most effective treatment for inducing the greatest number of fronds per plant as it registered 84.7 and 82.4 fronds / plant as compared with control and the rest treatments in the first and second seasons. Additionally, using the treatments of F_2 and F_3 resulted in highly increments in this parameter as compared with control. Irrespective control, the lowest number of fronds / plant was gained by using the treatments of F_6 and F_7 in both seasons. These results are in agreement with those attained by, **Ahmed (2001)** on *Calendula officinallis*, **El- Kashlan (2001)** on roselle, detected that seed

with each of Biogene, Nitrobein and phosphorine at 400g/fed. at sowing obtained the best number of leaves. that nitrobein at 5kg/fed. Gave the most effective one on number of branches.

3- Number of leaves / frond:

Data presented in Table (8) show that all studied fertilizer treatments succeeded in increasing the number of leaves/ frond as compared with control in both seasons of this study. However, the highest number of leaves/ frond was obtained by using the treatment of F_2 which gave 57.3 leaves/ frond, followed by using the treatments of F_4 as it gave 56.9 leaves/ frond. The differences between the above mention two treatments were non- significant. This trend was true only in the first season , whereas in the second one the picture was completely changed, whore F_4 showed its superiority in this concern, followed by F_2 as they recorded 63.2 and 62.1 leaves / frond, respectively. Irrespective control, the lowest number of leaves / frond was gained by using the treatments of F_7 and F_6 in both seasons of this study. These results are in agreement with those noticed by, **Abd El-Latif (2002)** on *Carium carvi*, noticed that nitrobein at the rate of one kg/fed. Increased the number of branches.

4- Fresh weight of fronds / plant "g":

Data in Table (9) reveal that all studied fertilizer treatments statistically succeeded in increasing the fresh weight of fronds/ plant in both seasons of this study as compared with control. However, using the treatment of F_4 showed to be the

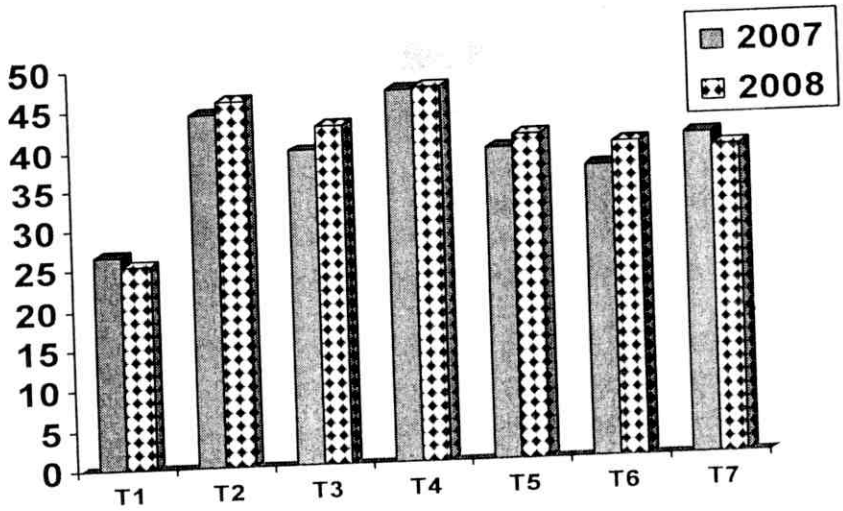
Table (9): Effect of some treatments of bio and chemical fertilizer on fresh and dry weight of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons.

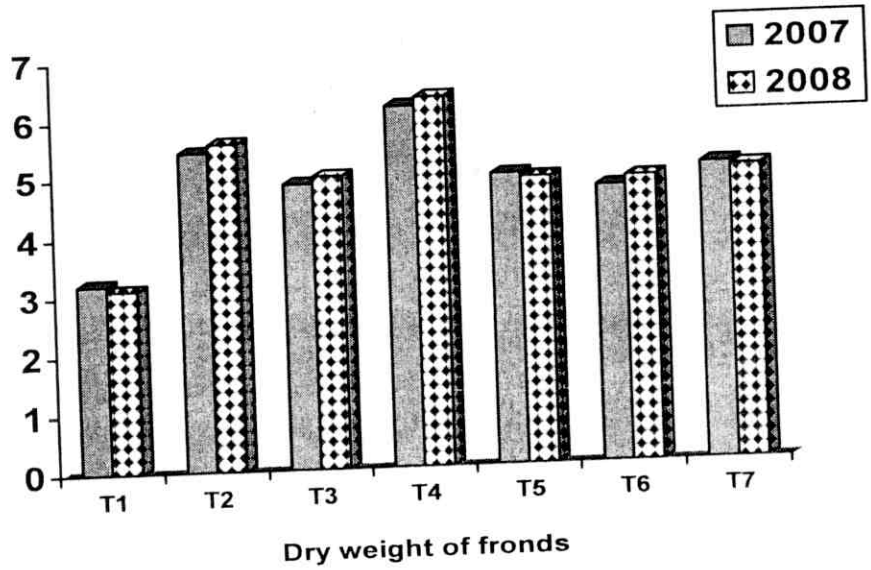
Parameters	Fresh weight of fronds		Dry weight of fronds	
Season	2007	2008	2007	2008
T_1	26.7	25.3	3.21	3.11
T_2	44.3	45.9	5.44	5.58
T_3	39.5	42.4	4.85	4.97
T_4	46.6	46.9	6.15	6.29
T_5	39.2	40.6	4.93	4.86
T_6	36.6	39.4	4.68	4.83
T_7	40.1	38.7	5.03	4.97
LSD At 5%	8.74	9.80	0.93	0.81

T= control T_2= 100% chemical T_3= 75% chemical T_4 = 75% chemical+ 25% bio

T_5 = 50% chemical + 50% bio T_6 = 75% bio + 25% chemical T_7 = 100% bio

Figure (9): Effect of some treatments of bio and chemical fertilizer on fresh and dry weight of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons





most effective treatment for producing the heaviest fresh weight of fronds /plant as it gave 46.6 and 46.9 "g" in the first and second seasons, respectively. In addition the treatment of F_2 gave highly significant increments in these parameters when compared with control in both seasons. The differences between the aforesaid two treatments were non- significant in both seasons. Irrespective control, the lowest values of this parameter were recorded by using the treatment of F_6 in the first season, and F_7 in the second one. The remained treatments occupied an intermediate position between the abovementioned treatments in both seasons of this study. These results are in agreement with those obtained by **Ahmed (2001)** on *Calendula officinalis* plants, showed that the plants treated with 4.5 gm yeast /L gave significantly increase in fresh weight, **Abd El- Latif (2002)** on *Carium carvi* noticed that nitrobein at the rate of one kg/fed. increased the fresh weight.

5- Dry weight of fronds / plant "g":

According to data presented in Table (9) it is clear that the results of the dry weight of fronds / plant attained a parallel trend with the fresh weight results, with little differences in the level of significance. In general, the heaviest dry weight of fronds / plant was registered by using the treatment of F_4 followed in descending order by using the treatment of F_2 in both seasons. In contrary, the lowest dry weight of fronds / plant was attained by using untreated plant "control" followed as decendingly by using the treatment of F_6 in both seasons. These results are in agreement with those obtained by, **Ibrahim (2000),** on

Foeniculum vulgar, found that the use of NPK at the rate of (150: 225: 75kg/fed).increased the dry weight, **Attia and Soad (2001)** on *Catharanthus roseus* plants, found that nitrobein at 250g/fed. gave the best result of dry weight., **Hafez (2003)** on borage, stated that nitrobein at 600gm/kg seeds greatly enhanced the dry weight.

B-Root growth measurements:

Data in Table (10) show that all tested fertilizer applications succeeded in increasing the fresh and dry weights of roots/plant as compared with control in both seasons. However, F_4 –fertilized plants showed to be the most effective treatment for producing the heaviest fresh and dry weights of roots/plant as it gave 27.93 and 28.98 (g) for fresh weight, 2.56 and 2.76 (g) for dry weight in the first and second seasons, respectively. Also, using the treatment of F_2 resulted in highly significant increasing in this parameters as it gave 26.84 and 28.35 (g) for fresh weights 2.47 and 2.66 (g) for fresh weight in the first and second seasons, respectively. Irrespective control, the lowest values of these parameters were gained by using the treatments of F_6 and F_7 in both seasons. The remained treatments occupied an intermediate position between the above-mentioned treatments in both seasons of this work.

Fresh results are agreement with observed by, **Mohamed (1992),** on *Livistonia chinensis*, found that spraying with feelifertil at 0.6% beside using medium contained 1clay:1sand = peat moss gave the heaviest fresh and dry weight of roots/ plant.,

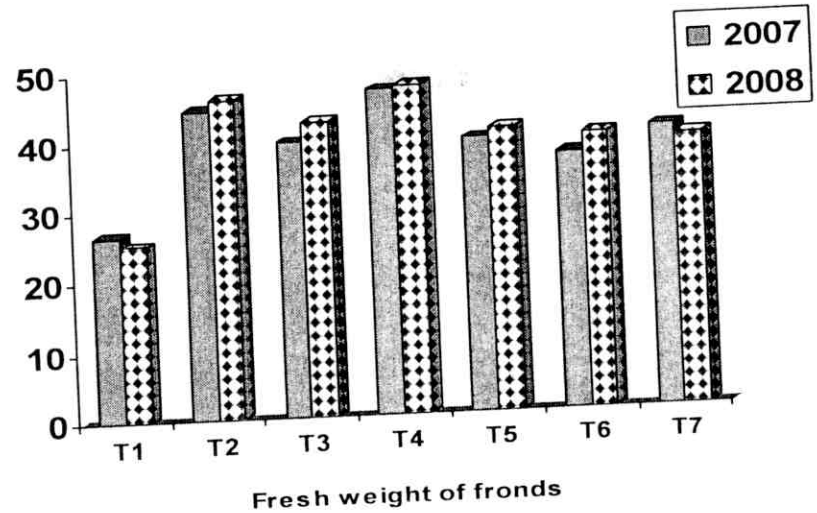
Table (10): Effect of some treatments of bio and chemical fertilizer on fresh and dry weight of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons.

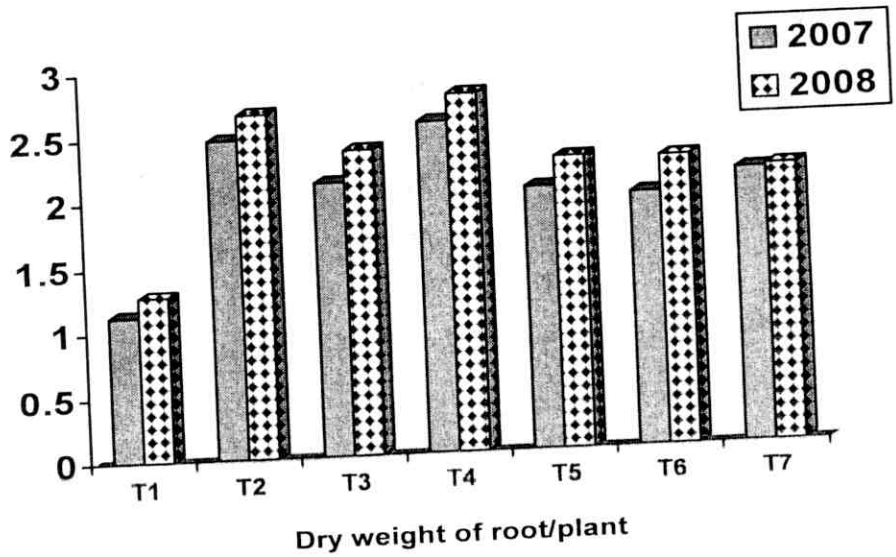
parameters	Fresh weight of root/plant		Dry weight of root/plant	
Season	2007	2008	2007	2008
T_1	14.21	15.25	1.12	1.27
T_2	26.84	28.35	2.47	2.66
T_3	23.40	26.01	2.11	2.36
T_4	27.93	28.98	2.56	2.76
T_5	23.79	24.80	2.02	2.25
T_6	22.11	24.18	1.95	2.23
T_7	24.21	23.56	2.11	2.13
LSD At 5%	3.49	4.29	0.14	0.12

T= control T_2= 100% chemical T_3= 75% chemical T_4 = 75% chemical+ 25% bio

T_5 = 50% chemical + 50% bio T_6 = 75% bio + 25% chemical T_7 = 100% bio

Figure (10): Effect of some treatments of bio and chemical fertilizer on fresh and dry weight of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons.





El- Shayeb (2009) on *Oenethera biennis*, recorded that the combination between bio fertilizers at 50g/ plot with garlic extract at 75% significantly increased in fresh and dry weight of roots.

C- On chemical composition measurements:

1- Leaf nitrogen content (%):

According to data presented in Table (11), it could be concluded that all tested treatments showed high effects upon the leaf nitrogen content (%) with significant differences when compared with control in both seasons. In general, the richest leaf nitrogen content was obtained by using the treatment of F_2 as it recorded 3.46 and 3.37 (%) in the first and second seasons, respectively followed in descending order by using the treatment of F_4 and F_3 in both seasons of this study. In the reverse, the lowest leaf nitrogen content (%) was registered by using control treatment, followed ascendingly by using the treatments of F_7 and F_6 in both seasons of this study. These results are agreement with those attained by, **Badawi (2000),** on *Hibiscus sabdariffa*, stated that the highest increase of N in the leave was by using N 300 kg+ P200+K100kg/fed+biofertilizer., **Nofal *et al.*, (2001)** on *Ammi visnaga*, obtained that higher percentage of N in the leaves by adding mixture of Azotobacter + Azospirillum+ full doses of mineral NPK., **Kenawy** (2005) on *Hibiscus sabdariffa*, proved that all N. fixing bacteria treatments significantly improved N% in the herb., **Shah (2007)** on black cumin, proved that 352 mg N/pot significantly increased N accumulation., **Hemdan (2008)**

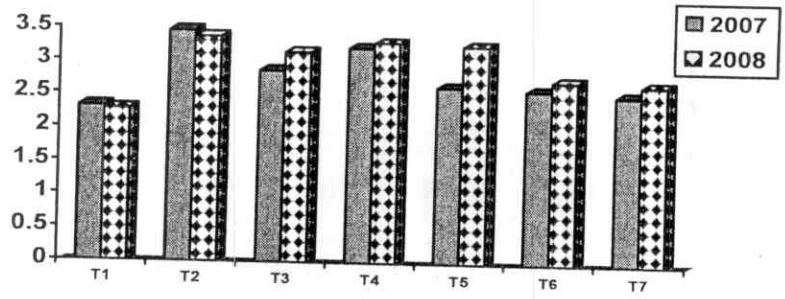
Table (11): Effect of some treatments of bio and chemical fertilizer on N, P, K and total carbohydrates (%) of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons.

Parameters	N%		P%		K%	
Season	2007	2008	2007	2008	2007	2008
T_1	2.31	2.27	0.129	0.121	1.13	1.17
T_2	3.46	3.37	0.167	0.183	1.86	1.83
T_3	2.86	3.14	0.153	0.160	1.69	1.72
T_4	3.21	3.29	0.151	0.184	1.84	1.81
T_5	2.63	3.25	0.149	0.157	1.72	1.75
T_6	2.59	2.73	0.132	0.153	1.68	1.73
T_7	2.52	2.68	0.134	0.160	1.54	1.62
LSD At 5%	0.123	0.156	0.012	0.022	0.112	0.231

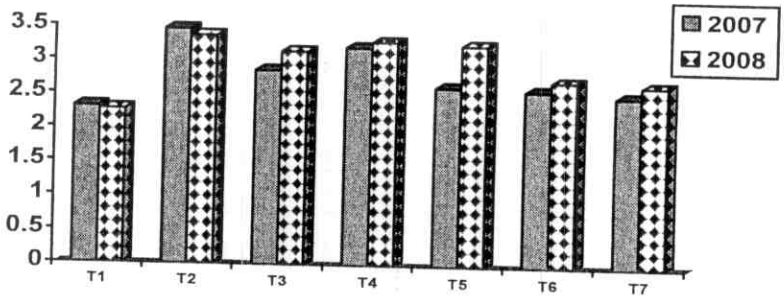
T= control T_2= 100% chemical T_3= 75% chemical T_4 = 75% chemical+ 25% bio

T_5 = 50% chemical + 50% bio T_6 = 75% bio + 25% chemical T_7 = 100% bio

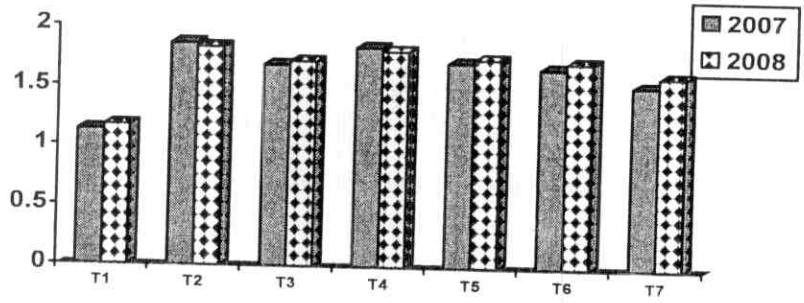
Figure (11): Effect of some treatments of bio and chemical fertilizer on N, P, K and total carbohydrates (%) of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons.



N%



N%



K%

on anise plants fertilization with rate (200: 300: 100, NPK) kg/fed resulted the highest percentage of nitrogen.

2- Leaf phosphorus content (%):

It is obvious from data presented in Table (11) that leaf phosphorus content (%) was greatly increased by using all studied treatments in both seasons when compared with control. However, F_2 -treated plants showed to be the most effective treatment for inducing the greatest leaf phosphorus content, followed by using the treatments of F_3 and F_4. This trend was true only in the first seasons, while in the second one the picture was completely reversed where F_4 showed to be the most effective treatment for inducing the highest value of this parameter followed descendingly by using F_2. The lowest mean values of this parameter were gained by using control treatment in both seasons of this study. These results are in agreement with those obtained by, **Hassan (1996)** on *Aspidistra elatior* detected that leaves P content increased as a result of using NPK at 3:1:2., **El-Deeb (1999)** on *Philodendron oxycardium*, found that NPK (19-6-20or 11.3:8.5:7.5) and at 1:2:1 increased the content of P., **Gad (2001)** on *Foeniculum vulgar* and *Anethum graveolens*, reported that the different commercial biofertilizer increased P in the leaves.

3- Leaf potassium content (%):

According to data in Table (11), it was clear that all tested fertilizer treatments succeeded in increasing leaf potassium

content (%) when compared with control in both seasons of this study. However, the richest leaf potassium content was recorded by using the treatment of F_2 followed descendingly by using the treatments of F_4 and F_5 of both seasons. Regardless control, the lowest values of leaf potassium content was obtained by using the treatment of F_7 in both seasons of this study. These results are in agreement with those obtained by, **Gomaa and Abou Ali** (2001) on *Pimpinella anisum*, showed that the use of chroococcum and Azospirillum brasilense + biogas manure or organic nitrogen fertilizer , increased the content of potassium.

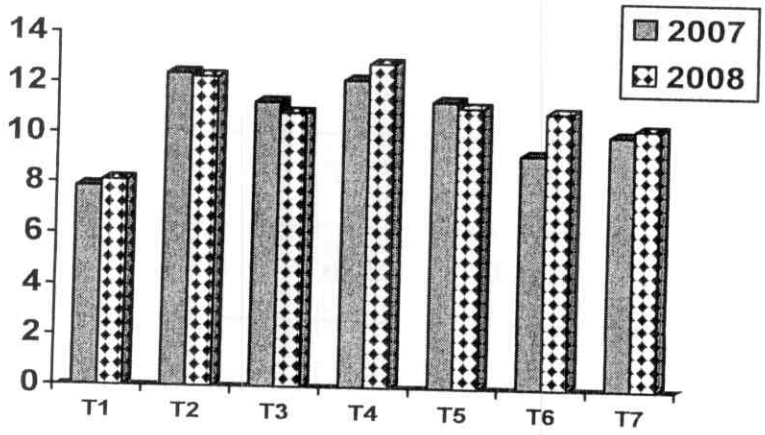
4- Total carbohydrates content (%):

Data of total carbohydrates content (%) in dried leaves of *Adiantum cuneatum* plants at the end of this experiment are presented in Table (12). It was obvious that all studied treatments statistically succeeded in increasing leaf total carbohydrates content (%) when compared with control in both seasons of this work. However, the greatest leaf total carbohydrates content (%) was recorded by using the treatment of F_2 as it gave 12.39 and 12.26 (%) followed by the treatment of F_4 which gave 12.18 and 12.84 (%), in the first and second seasons, respectively. The differences between the two above-mentioned treatments were non- significant in both seasons. Additionally, the treatments of F_5 andF_3 resulted in highly significant in this parameter. These results are agreement with those obtained by **Attia and Soad (2001)** on *Catharanthus roseus* plants, found that 250g/fed of nitrobein gave the highest percentage of total carbohydrates, and **Abdou and El-sayed**

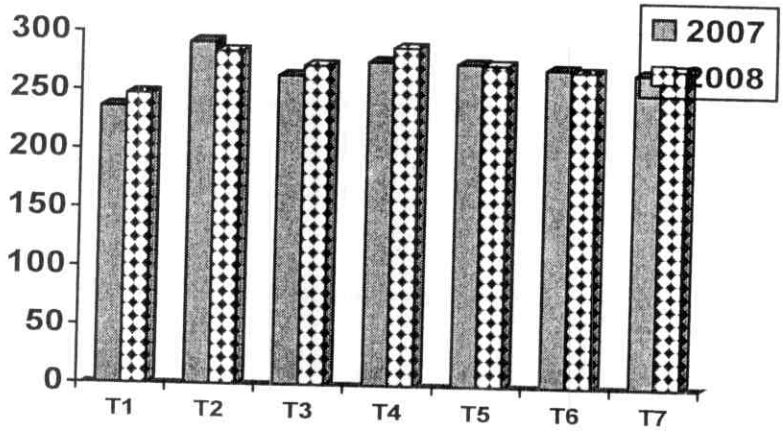
Table (12): Effect of some treatments of bio and chemical fertilizer on total carbohydrates and chlorophylls of leaves of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons

Parameters	T. carbohydrates		T. chlorophylls	
Seasons	2007	2008	2007	2008
F_1	7.84	8.09	236	247
F_2	12.39	12.26	292	284
F_3	11.28	10.86	264	273
F_4	12.18	12.84	277	289
F_5	11.38	11.14	276	275
F_6	9.26	10.98	272	270
F_7	10.07	10.34	269	273
L.S.D at 5%	2.14	2.07	21.36	18.19

Figure (12): Effect of some treatments of bio and chemical fertilizer on total carbohydrates and chlorophylls of leaves of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons



T. carbohydrates



T. chrlorophylls

(2002) on *Carium carvi*, L plants found that nitrogen and total carbohydrates increased by treating with Azotobacter chroococcum and Azospirillum lipoferum at 600kg/fed .

5- Leaf total chlorophylls content (mg/100gF.W):

Data of total chlorophylls content (mg/100gF.W) in fresh leaf samples after one month from the last treatment of the experiment are presented in Table (12) it was clear that all tested fertilizer treatments resulted in highly significant increments in this parameter in both seasons of this study. However, F_2 treated plants exhibited to be the most pronouncing one for inducing the greatest leaf total chlorophylls content followed by using the treatments of F_4 and F_5 as they gave 292,277 and 276 (mg/100 g F.W) respectively. The differences between the three abovementioned treatments did not reach to the level of significance. This trend was true only in the first seasons, while in the second one the picture was changed, where F_4 -treated plants showed its superiority in this concern, followed by using the treatments of $F_2$and F_5, as they recorded 289,284and 275 respectively. Irrespective control, the lowest leaf total chlorophylls content (mg/100gF.W) was gained by using the treatments of F_7 and F_6 in both seasons of this study. These results are in agreement with attained by, **Pool and Conover (1978),** on *Adiantum raddianum*, proved that weekly applications of NPK fertilizer, produced good growth of maiden hair fern., **El-Deeb (1999)** on *Asplenium nidus* and *philodendron erubescens*, that kristallon at 2.4 and 6g/Pot/month and NPK at 1:1:1, 2:1:1, 1:1:2, 3:1:1, 3:1:2, respectively increased

chlorophylls contents, and **Gomaa and Abou Aly (2001)** on *Pimpinella anisum*, found that the use of chroococcum + Azospirillum brasilense+ biogase manure or organic nitrogen fertilizer, increased the chlorophylls content.

6- Leaf total indols content "mg/100gF.W):

Data obtained on total indols content in fresh samples of Adiantum leaves an leaves as affected by some fertilizer treatments are presented in Table (13). It was observed that all studied fertilizer treatments succeeded in increasing leaf total indols content as compared with control in both seasons. However, the highest values of leaf total indols content was recorded by using the treatment of F_2 as its gave 267 and 273, followed in descending order by using the treatment of F_4 which gave 259 and 271 "mg/100g.F.W)" in the first and second seasons, respectively. On contrary, the lowest values of leaf total indols content was gained by using control plants followed ascendingly by using the treatments of F_7 and F_6 in both seasons of this study. The remained treatments occupied an intermediate position between the aforesaid treatments in both seasons. These results go on line with that obtained by **Youssef (2004)** who mentioned that treated *Strelitzia regeinan* plants with stimufol fertilizer at 4 or 6g/l increased leaf total indols content .

7-Leaf total phenols content (mg/100g.F.W).

Data in Table (13) indicate that all tested fertilizer treatments caused an decrease in leaf when compared with control in both seasons. Generally, the highest values of leaf total

Table (13): Effect of some treatments of bio and chemical fertilizer on total chlorophyll and total indols and total phenols (mg/ 100g F.W) of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons.

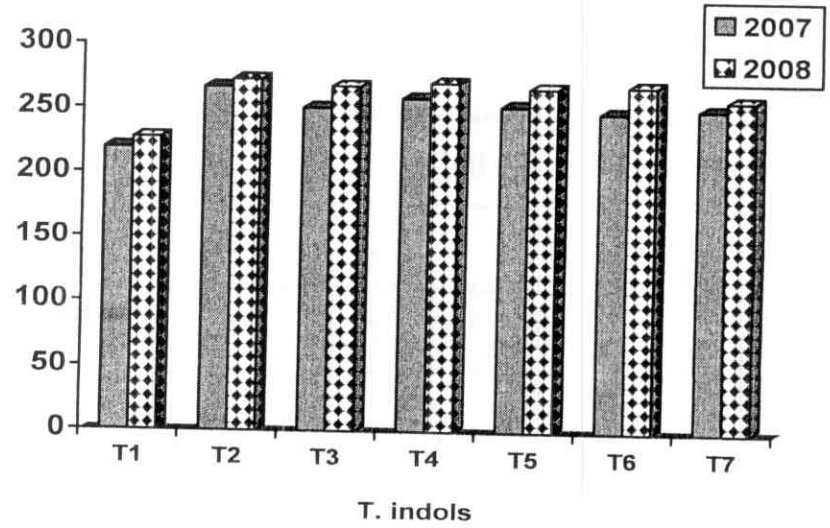
Parameters	T. indols		T. phenols	
Season	2007	2008	2007	2008
T_1	219	227	183	178
T_2	267	273	143	154
T_3	251	268	149	163
T_4	259	271	148	152
T_5	253	267	153	167
T_6	248	269	162	165
T_7	251	258	163	168
LSD At 5%	17.29	19.25	12.13	14.70

T= control T_2= 100% chemical T_3= 75% chemical T_4 = 75% chemical+ 25% bio

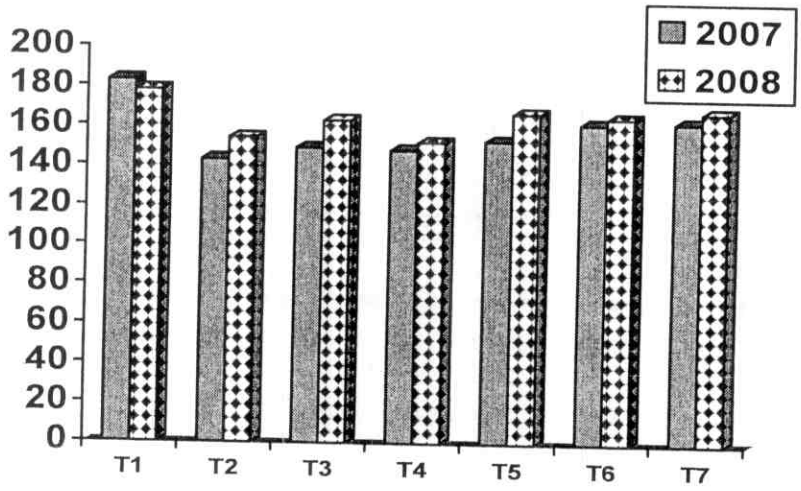
T_5 = 50% chemical + 50% bio T_6 = 75% bio + 25% chemical T_7 = 100% bio

phenols content was recorded in untreated plants "control" in

Figure (13): Effect of some treatments of bio and chemical fertilizer on total chlorophyll and total indols and total phenols (mg/ 100g F.W) of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons.



T. indols



T. phenols

plants. Therefore, such addition of well balanced NPK fertilization quantities insured production of high fruit and oil

carbohydrates and related glycolysis, amino acid metabolism, fat metabolism and biological oxidation. Lack of phosphorus, therefore hampers metabolic processes, such as the conversion of sugars into starch and cellulose **(Devlin, 1972).**

Potassium is important for growth and elongation probably due to its function as an osmoticum and may react synergistically with IAA. Moreover, it promotes CO_2 assimilation and translocation of carbohydrates from the leaves to storage tissues **(Mengel and Kirkby, 1987).**

The role of NPK fertilization on promoting vegetative growth characters, enhancing yield component parameters and increasing fruit yield and oil yield production as well as stimulating the photosynthetic pigments and nitrogen, phosphorus and potassium content of lovage plants could be explained by recognizing their fundamental involvement in the very large number of enzymatic reaction that depend on NPK fertilization. NPK reflected directly on increasing the content of chlorophyll a, b and carotenoids as well as NPK % and content in the leaves were indirectly the cause for enhancing the augmenting of all other vegetative growth traits, yield components and finally fruit as well as oil yield production of lovage plants.

2-Effect of bio-fertilization

A- N-fixing bacteria:

The use of N-fixing bacteria (netrobein) as a bio-fertilizer product containing nitrogen fixing bacteria, e.g. Azotobacter and Azospirillum was found to have not only the ability to fix nitrogen but also to release certain phytohormones of gibberellins and indolic nature which could enhance plant growth absorption of nutrients and so on photosynthesis process **(Hegde *et al.*, 1999)** Microorganisms used as bio-fertilizers may affect their host plant by one mechanism or more such as nitrogen fixation production of growth promoting substances or organic acids, enhancing nutrients uptake or protection against plant pathogens **(Hawaka, 2000)**. Also, N-fixers synthesize stimulatory compounds such as, gibberellins, cytokinins and IAA. They act as growth regulators, which increased the surface area per unit of root length and were responsible for root hair branching with an eventual increase in the uptake of nutrients from the soil **(Sperenat, 1990 and Dadarwal *et al.*, 1997).**

B- Phosphate dissolving bacteria

The use of Phosphate dissolving bacteria (phosophorein) as a bio-fertilizer product containing very active phoshphate dissolving bactcria has proved is efficiency in enhancing different aspects of plant growth and development of many plant species including medicinal and aromatic plants. Establishment of astrong root system is related to the level of available

phosphate in the soil **(Abou El-Hassan *et al.*, 1993).** phosphate dissolvers or vesicular arbuscular mycorrhizae and silica bacteria are capable of converting tricalcium phosphate to monocalcium phosphate ready for plant nutrition **(El-Gibaly *et al.*, 1997; Ali *et al.*, 1987; Abd-Alla 1998 and Hawaka, 2000).** Phosphate also increased mineral uptake and water use efficiency **(El-Awag *et al.*, 1993).**Under the Egyptian soil conditions, **Abo El-Nour *et al.*, (1996)** and **El-Sheekh, (1997)** mentioned that using phosphorein with or instead of mineral – P apparently increased the available P- concentration in the soil and plants.

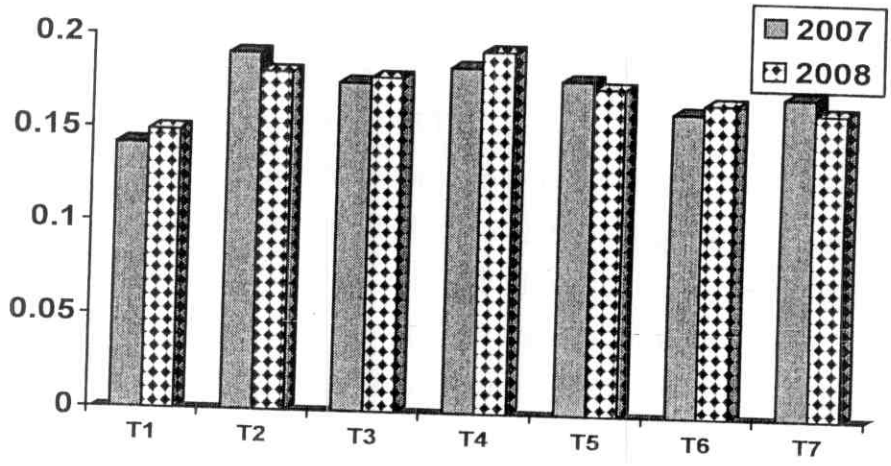
D-Leaves oil percentage:

Data in Table (14) reveal that all tested fertilizer treatments succeeded in increasing leaves oil percentage of Adiantum plants as compared with control in both seasons. However, F_2- treated plants showed to be the most effective treatment for inducing the highest value of leaves oil percentage as it gave 0.191% followed by using the treatment of F_4 which gave 0.185%. Also, using the treatments of F_5 and F_3 caused high significant increasments in this parameter when compared with control as they gave 0.179 and 176%, respectively. Irrespective control, the lowest values of this parameter were recorded by using the treatments of F_6 and F_7 as they recorded 0.163 and 0.172%, respectively. This trend was true only in the first season, while in the second one the picture was completely changed, where F_4- fertilizes red plants was found to be the most effective treatment for producing the highest leaves oil percentage as it gave 0.194%, followed, by using the treatment

Table (14): Effect of some treatments of bio and chemical fertilizer on oil percentage of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons

Parameters	Seasons	
	2007	2008
F_1	0.142	0.149
F_2	0.191	0.181
F_3	0.176	0.179
F_4	0.185	0.194
F_5	0.179	0.175
F_6	0.163	0.168
F_7	0.172	0.164
L.S.D at 5%	0.019	0.017

Figure (14): Effect of some treatments of bio and chemical fertilizer on oil percentage of *Adiantum cuneatum*, L plants during 2007 and 2008 seasons.



of F_2 which gave 0.181%. Additionally, using the treatments of F_3 and F_5 resulted in high increases of this parameter as they recorded 0.179 and 0.175%, respectively. Irrespective control, the lowest values of this parameter were gained by using the treatments of F_7 and F_6 as the registered 0.164 and 0.168, respectively. These results are agreement with attaind by **Abd El-Naeem (2008),** on caraway plants proved that NPK (200+300+200Kg/fed.) led to significant increase in essential oil and oil yield /plant per feddan., **Tanious (2008),** on caraway plants pointed to that the highest volatile oil %and oil yield /plant and per fed. by using (200+300+100Kg/fed.) and with nitrobein treatments.