RESULTS AND DISCUSSION

The results obtained from this investigation in the two growing seasons 1994/1995 and 1995/1996 are discussed here under four main headings.

I. Effect of Varieties.
II. Effect of Nitrogen Fertilizer.
III. Effect of Phosphorus Fertilizer.
IV. Effect of the Interactiion.

I. Effect of Varieties :

a. Growth characters and petal yield :

Mean values of some growth characters, i.e. stem length, stem diameter, number of leaves and leaf area/plant, leaf area index, specific leaf weight/plant, no. of leaves for head production, fresh and dry weight of leaves and stem and branches as well as petal yield of the two safflower varieties (Giza 1 and Aceitera) in the two successive seasons (1994/1995 and 1995/1996) are presented in Tables (3, 4, 5 and 6).

1.1. Stem characters :

Statistical analysis from the results in Table (3) reveal that the two varieties (Giza 1 and Aceitera) showed no significant differences in stem length and stem diameter in both successive seasons. These results are true withen each of the sampling dates of growth at 90 and 120 days after sowing in both seasons except at 120 days in the second one. Whereas the local variety (Giza 1) was significantly surpassed the exotic variety (Aceitera) in the two studied growth characters i.e. stem length and stem diameter. The obtained results indicate that the mean values of stem length and stem diameter were higher in the first season than the second one. These results may be due to the differences in the environmental factors in the two

Table (3) : Effect of safflower varieties on stem characters in 1994/1995 and 1995/1996 seasons.

Characters / Varieties	1994/1995 season		1995/1996 season	
	Stem length (cm)	Stem diameter (cm)	Stem length (cm)	Stem diameter (cm)
Sample at 90 days from sowing				
Giza 1	37.70	0.82	18.14	0.57
Aceitera	36.04	0.79	17.82	0.51
L.S.D. at 5%	N.S.	N.S.	N.S.	N.S.
Sample at 120 days from sowing				
Giza 1	112.10	1.19	91.10	0.95
Aceitera	116.14	1.27	68.83	0.73
L.S.D. at 5%	N.S.	N.S.	7.60	0.08

Note : The absence of stem data at 60 days because of the plant was grown in rosette stage.

successive seasons. **Abu-Hagaza (1990), El-Afandy (1990),** and **Ashoub, Abla (1995)** obtained the same results. They indicated that the differences between varieties may be due to the varietal effects.

1.2. Leaf characters :

It is obvious from the obtained results Table (4) that the number of leaves/plant of two varieties was significant only at later stage of growth (120 days from sowing) in the second season. The results indicate that the higher number of leaves/plant was recorded by local variety (Giza 1) as compared to exotic one (Aceitera). Such increase in leaves number was associated with stem length for the same variety at the same age (120 days from sowing) Table (3).

Similar results were observed in leaf area/plant whereas this character was not significantly affected by the two differents varieties, except at later stage (120 days) in the second season. The high value (1671.95 cm^2) was recorded by Giza 1 as compared with Aceitera (1311.11 cm^2). The difference between two varieties in leaf area may be due to the differences in stem length and leaves number for the same variety, Table (3). In Egypt, **Ashoub, Abla (1995)** found that the number of leaves of different varieties was significant. She found Giza 1 recorded highest value of no. of leaves at advanced stage as compared with exotic varieties.

With regard to the leaf area index as affected by the two safflower varieties. The results showed similar trend with those obtained in leaf area and number of leaves/plant. It is obvious that the local variety Giza 1 significantly surpassed the exotic variety (Aceitera) in this character at 120 days from sowing in the second season. The difference between two varieties in leaf area index may be due to the differences in stem length

Table (3) and number of leaves/plant, Table (4) as well as genetical difference. **Ashoub, Abla (1995)** found that leaf area index was not affected by different varieties, under calcareous soil.

As for the specific leaf weight and number of leaves for head production, results in Table (4) show that these two characters were not affected by two different varieties in the different samples for the two successive seasons.

Concerning leaves/stem and branches ratio varieties exhibited highly significant differences in this studied character at later growth stage (120 days from sowing) for both seasons. The greatest value (52.31) in the first season was obtained from local variety and (72.84) from exotic variety in the second one. These results were very logic because the trend of the stem dry weight was opposite with the leaves dry weight for the two varieties Table (5).

1.3. Fresh and dry weight of different parts :

1.3.1. Stem and branches :

The obtained results in Table (5) show that there were significant differences between two studied varieties in fresh and dry weight of stem and branches in the samples taken after 120 days from sowing in both successive seasons. On the other hand the results revealed that the differences between two varieties in the same characters was not significant at 90 days from sowing in both seasons. It could be noticed that the increases in fresh and dry weight of stem and branches at late stage of growth (120 days), may be due to progressive photosynthetic accumulation and meristemic activity during different growth stage. These results are not

Table (4) : Effect of safflower varieties on leaf characters in 1994/1995 and 1995/1996 seasons.

Characters / Varieties	1994/1995 season						1995/1996 season					
	No. of leaves /plant	Leaf area/ plant (cm^2)	Leaf area index	Specific leaf weight (mg/ cm^2)	No. of leaves for head production	Leaves /stem + branches ratio	No. of leaves /plant	Leaf area/ plant (cm^2)	Leaf area index	Specific leaf weight (mg/ cm^2)	No. of leaves for head production	Leaves/ stem + branches ratio
Sample at 60 days from sowing												
Giza 1	8.40	131.28	0.07	3.77	-	-	11.86	81.89	0.05	7.76	-	-
Aceitera	11.75	184.06	0.10	3.84	-	-	10.89	75.67	0.04	8.08	-	-
L.S.D. at 5%	N.S.	N.S.	N.S.	N.S.	-	-	N.S.	N.S.	N.S.	N.S.	-	-
Sample at 90 days from sowing												
Giza 1	15.90	723.49	0.40	2.75	-	63.01	15.99	105.36	0.06	18.22	-	80.96
Aceitera	19.44	722.48	0.40	3.63	-	63.74	14.22	109.10	0.06	17.14	-	81.49
L.S.D. at 5%	N.S.	N.S.	N.S.	N.S.	-	N.S.	N.S.	N.S.	N.S.	N.S.	-	N.S.
Sample at 120 days from sowing												
Giza 1	59.96	1563.42	0.88	8.71	6.67	52.31	83.49	1671.59	0.93	5.16	4.98	61.28
Aceitera	104.77	2265.62	1.26	7.36	12.84	45.52	44.16	1311.10	0.73	5.03	3.73	72.84
L.S.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	3.61	29.92	168.39	0.09	N.S.	N.S.	5.03

Note : The absence of stem and head data under 60 and 90 days from sowing.

Table (5) : Effect of safflower varieties on fresh and dry weight of different parts 1994/1995 and 1995/1996 seasons.

Characters / Varieties	1994/1995 season				1995/1996 season			
	Stem + branches fresh weight (g)	Stem + branches dry weight (g)	Leaves fresh weight (g)	Leaves dry weight (g)	Stem + branches fresh weight (g)	Stem + branches dry weight (g)	Leaves fresh weight (g)	Leaves dry weight (g)
Sample at 60 days from sowing								
Giza 1	-	-	5.56	0.48	-	-	4.26	0.62
Aceitera	-	-	6.76	0.70	-	-	3.97	0.59
L.S.D. at 5%	-	-	N.S.	N.S.	-	-	N.S.	N.S.
Sample at 90 days from sowing								
Giza 1	22.93	2.90	20.27	1.79	15.56	3.59	9.32	1.92
Aceitera	25.74	3.09	21.18	2.14	15.19	3.05	7.89	1.87
L.S.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Sample at 120 days from sowing								
Giza 1	87.97	22.11	32.62	10.68	71.81	13.68	56.04	8.10
Aceitera	117.98	26.75	39.99	11.77	37.06	8.68	32.88	6.47
L.S.D. at 5%	21.76	3.75	4.91	N.S.	11.04	1.33	9.85	1.52

Note : The absence of stem data because of the plant was grown in rosette stage.

agreement with those reported by **El-Afandy (1990),** and **Ashoub, Abla (1995).**

1.3.2. Leaves :

Regarding fresh and dry weight of leaves the results show that there were significant differences in mean fresh and dry weight of leaves/ plant as affected by two varieties in the samples taken at 120 days from sowing in both seasons. These results were true for fresh weight of leaves/ plant in the two successive seasons and for dry weight in the second one only. These increases in fresh and dry weight of leaves/plant in the late stage may be attributed to the increase in number of leaves and leaf area/plant at the same age. Also, it is clear that local variety (Giza 1) was superior the exotic variety (Aceitera) in the second season. By contrast, **El-Afandy (1990),** declined for Giza 1 as compared with other varieties under calcareous soils.

1.4. Petal yield (kg/fed) :

Data presented in Table (6) show the effect of two different varieties on petal yield for the two successive seasons 1994/1995 and 1995/1996.

Analysis of variance indicated that the fresh and dry weight of petal yield was not significantly affected by the two tested varieties for both seaons. It is clear from the obtained results that the greatest fresh and dry weight of petal yield kg/fed. (37.85 and 24.39) and (65.56 and 44.99) were recorded by the local variety (Giza 1) in the two successive seasons repsectively. The increase in the fresh weight and dry weight of petal yield in Giza 1 may be due to the increase in number of head for the same variety (Giza 1) Table (7). But, **El-Afandy (1990),** found that Giza 1 gave the

Table (6) : Effect of safflower varieties on petal yield (kg/fed) in 1994/1995 and 1995/1996 seasons.

Characters	First season 1994/1995		Second season 1995/1996	
Varieties	Fresh weight of petal yield (kg/fed)	Dry weight of petal yield (kg/fed)	Fresh weight of petal yield (kg/fed)	Dry weight of petal yield (kg/fed)
Giza 1	37.85	24.39	65.56	44.99
Aceitera	35.32	22.22	59.51	37.72
L.S.D. 5%	N.S.	N.S.	N.S.	N.S.

lowest mean value for petal yield as compared with other varieties under calcareous soils.

2. Seed yield and its components :

Mean values of seed yield and its components as affected by the two studied varieties in the two successive seasons 1994/1995 and 1995/1996 are presented in Table (7).

2.1. Heads number / plant :

Analysis of variance show that the local variety (Giza 1) recorded high number of heads per plant in the two successive seasons as compared with the exotic variety (Aceitera), but the difference was not significant in the first season (1994/1995). These increase in number of heads/plant by Giza 1 in the second season amounted to 39% as compared with the exotic variety. The superiority of Giza 1 variety may be due to the increase in stem length, number of leaves, fresh and dry weight/plant, leaf area which causes an increase in light intercepting by Giza 1 canopy which help the plant for building metabolites, the difference results were obtained from **El-Afandy (1990)** and **Ashoub, Abla (1995)** whereas found the local variety Giza 1 gave the lowest number of heads as compared with other varieties under the same soil.

2.2. Head weight (g) :

The obtained results reveal that the two evaluated varieties show no significant differences in head weight in both seasons. However, the local variety Giza 1 recorded higher values in the two successive seasons, but the differences were not significant. The similar conclusion was obtained by **Ashoub (1995)**, who found that Giza 1 variety was surpassed the other exotic variety (Aceitera) in head weight.

2.3. Head diameter (cm) :

Statistical analysis show that the two tested varieties had a significant effect on head diameter of safflower only in the first season. These results indicate that the local variety produced big diameter than obtained from the exotic variety, but **El-Afandy (1990)**, found that exotics varieties had the highest mean value for head diameter as compared to Giza 1, **Ashoub (1995)**, found that diameter of head was not affected by different varieties (Giza 1, Aceitera).

2.4. Seeds number/head :

The obtained data indicate clearly that seeds number/had behaved the same trend as that of head diameter. However the local variety was superior on the exotic one in both season, but the difference in the second season was low the level of significant. The increase in number of seeds/ head reached to 35.19 and 53.87 in the first and second season by local variety as compared by exotic one 32.13 and 48.40 respectively, on the other hand, **Ashoub, Abla (1995)**, found that the highest number of seeds/head was obtained by Aceitera variety as compared to Giza 1 variety under the same condition (Mariut).

2.5. Seeds weight/head (g) :

Results in Table (7) reveal that statistical analysis show significant different in seeds weight/head as affected by the two studied varieties. These results are true in the both seasons. The high mean values (2.10 and 3.82) were recorded by local variety (Giza 1) in the two growth seasons as compared with exotic variety (Aceitera) which produced the low value (1.91 and 3.29).

Table (7) : Effect of safflower varieties on seed yield and its components in 1994/1995 and 1995/1996 seasons.

Characters / Varieties	1994/1995 season							1995/1996 season						
	No. of heads/ plant	Weight of head (g)	Diameter of head (cm)	No. of seeds/ head	Weight of seeds /head (g)	Weight of 1000-seed (g)	Seed yield (kg/fed)	No. of heads/ plant	Weight of head (g)	Diameter of head (cm)	No. of seeds/ head (g)	Weight of seeds /head (g)	Weight of 1000-seed (g)	Seed yield (kg/fed)
Giza 1	9.22	4.90	2.80	35.19	2.08	60.04	433.18	18.02	7.39	3.47	53.87	3.82	58.37	673.92
Aceitera	8.19	4.85	2.70	32.13	1.91	61.38	724.53	13.01	6.80	3.33	48.40	3.29	61.96	540.54
L.S.D. at 5%	N.S.	N.S.	0.09	1.29	0.14	N.S.	N.S.	2.73	N.S.	N.S.	N.S.	0.43	0.91	92.15

2.6. Weight of 1000-seed (g) :

From the data presented in Table (7) it is clear that 1000-seed weight behaved the opposite trend as that of seed weight/head. However the exotic variety (Aceitera) surpassed the local variety (Giza 1) in this character in two successive seasons, but the difference was not significant in the first one. In addition, **El-Afandy (1990)**, found that the same results.

2.7. Seed yield (kg/fed.) :

Statistical analysis revealed that seed yield kg/fed. did not behave the same trend in the two studied seasons. It is evident, in the first season, that exotic variety (Aceitera) produced the high seed yield (724.53) while the low yield (433.18) was obtained from local variety (Giza 1) without significant differences. In the second season, opposite resulted was obtained where the local variety resulted the high value (673.22) and the exotic one low value (540.54) and the difference between them was significant. These varied results may be due to the differences in the environmental factors through the two successive seasons, and then to different response of these varieties to its, **Ashoub, Abla (1995)**, found that "seed yield was insignificantly affected by different varieties for both seasons.

3. Oil yield and chemical contents :

Mean values of four chemical characters i.e. protein, phosphorus, oil % and oil yield kg/fed. of the two studied varieties Giza 1 and Aceitera in the two successive seasons 1994/1995 and 1995/1996 are presented in Table (8).

3.1. Protein, Phosphorus and Oil % :

Analysis of variance show clearly that for each character i.e. protein, phosphorus and oil percentage in seeds were not affected by the two

Table (8) : Effect of safflower varieties on oil yield and some chemical content of safflower seed in 1994/1995 and 1995/1996 seasons.

Characters / Varieties	1994/1995 season				1995/1996 season			
	Protein (%)	Phosphorus (%)	Oil (%)	Oil yield (kg/fed)	Protein (%)	Phosphorus (%)	Oil (%)	Oil yield (kg/fed)
Giza 1	11.70	0.42	31.96	138.46	8.64	0.40	31.56	212.67
Aceitera	8.57	0.41	31.86	230.86	8.75	0.39	30.85	166.76
L.S.D. at 5%	N.S.	N.S.	N.S.	81.64	N.S.	N.S.	N.S.	N.S.

different varieties in both seasons. The obtained results indicate that the differences between two varieties were not enough to reach the significant levels at 5%, the difference conclusion were obtained by **El-Afandy (1990)** under Mariut condition.

3.2. Oil yield (kg/fed) :

Concerning oil yield kg/fed. the data in Table (8) indicated that there was significant difference between two varieties in the first season only. In this season the exotic variety produced high oil yield (230.86 kg/fed) compared with local variety (138.46 kg/fed). However in the second season the local variety Giza 1 recorded the high oil yield (212.67 kg/fed) as compared with the exotic one (166.76 kg/fed) but this difference was not significant. These results are logic becaue oil yield may be mainly attributed to the seed yield kg/fed rather than its percentage. **Ashoub, Abla (1995),** found that the varieties could be arranged according to oil yield in descending order as follow, Aceitera and Giza 1, but the oil percentage was not affected by different varieties.

Finally :

Giza 1 variety was surppased the exotic one (Aceitera), for growth characters, petal yield and seed yield.

II. Effect of Nitrogen Fertilizer :

1. Growth characters and petal yield :

Data in Tables (9, 10 and 11) refer to the effect of nitrogen fertilizer on some growth characters at 60, 90 and 120 days from planting in 1994/1995 and 1995/1996 growth seasons.

1.1. Stem characters :

Statistical analysis Table (9), revealed that stem length was not significantly affected by the four nitrogen treatments at 90 and 120 days from sowing in the first season. On the other side the results indicate that this character was significantly affected by nitrogen fertilization in the second one. It is obvious that the two levels of mineral nitrogen i.e. 30 or 60 kg/fed. increased the stem length of safflower as compared to nil nitrogen and nitrogen fixation by bacteria. These results were true for both seasons and for two ages. Such increase may be due, nitrogen caused the increase in meristemic activity, so, the increase in number and length of cells might owe much for this finding. These results are in good agreement with those obtained by **Eweida *et al.*, (1981), Kamel *et al.*, 1982). Ahmed *et al.*, (1985) Kamel *et al.*, (1986), Fayed** and **Mohamed (1987), Sary *et al.*, (1987). Ezz El-Din (1989), Soundra** and **De (1989), Abo-Shetaia (1990), El-Afandy (1990), Leilah *et al.*, (1992), Ashoub, Abla (1995)** and **Memon *et al.*, (1995)**. But the negligible effect by nitrogen found by **Nour-El-Din, Naemat *et al.*, (1983)**. In respect to n-fixating **Madkour *et al.*, (1986)** and **El-Toukhy, Salwa (1997)** in barley, **Reiad *et al.*, (1987)** in maize, and **Ahmed (1995)** in wheat found the increase in plant hight with using nitrogen fixation, but **Hamouda and Zedan (1988)** in wheat plant was observed negligible effect by nitrogen fixation.

As for stem diameter analysis of variance show that this character was significantly affected by nitrogen supply for both seasons at all sampling dates except at 90 days from planting in the first seasons. Result indicate that stem diameter was increase by using mineral nitrogen 30 or 60 kg N/fed. as compared with untreated treatment. Applying 60 kg N/fed. significantly resulted thick stem followed by 30 kg N/fed and N fixation

Table (9) : Effect of nitrogen fertilizer on stem characters in 1994/1995 and 1995/1996 seasons.

Characters / Nitrogen levels	1994/1995 season		1995/1996 season	
	Stem length (cm)	Stem diameter (cm)	Stem length (cm)	Stem diameter (cm)
Sample at 90 days from sowing				
Zero	34.63	0.79	17.36	0.48
N-fixation	35.70	0.74	16.74	0.51
30 kg N/fed.	35.96	0.79	18.79	0.56
60 kg N/fed.	41.13	0.89	19.05	0.62
L.S.D. at 5%	N.S.	N.S.	1.66	0.06
Sample at 120 days from sowing				
Zero	119.50	1.05	71.08	0.70
N-fixation	108.98	1.14	62.85	0.77
30 kg N/fed.	115.48	1.15	86.33	0.88
60 kg N/fed.	112.47	1.38	92.50	1.01
L.S.D. at 5%	N.S.	0.12	9.23	0.13

Note : The absence of stem data at 60 days because of the plant was grown in rosette stage.

while the thin stem was obtained by control treatment. However, the differences between the low mineral of nitrogen and the nitrogen fixation did not reach to the 5% level of significance. These results were true in first and second seasons at all significant samples. Such increase may be due to the increase in the size of vascular bundle with adding nitrogen, **Behairy (1982)**. Similar results were obtained by **Sary *et al.*, (1987), El-Afandy (1990) Leilah *et al.*, (1992)**, while the opposite one were reported by **Kamel *et al.*, (1982)**, who found that stem diameter was decreased by increasing of nitrogen. The negliglible effect was obtained by **Ashoub (1995)**.

1.2. Leaf characters :

Average values of leaf characters i.e. no of leaves, leaf area/plant, leaf area index, specific leaf weight, no. of leaves for head production, and leaf/stem ratio in three samples date 60, 90 and 120 days from sowing in both seasons as affected by the four nitrogen treatments are presented in Table (10).

No. of leaves/plant was significantly affected only at early age (60 days from planting) in the first season and at later age (120 days from planting) in the second season. In these two samples the obtained data indicate that nitrogen fertilization at the rate of 60 kg N/fed produced the higher value of no. of leaves/plant as compared to the other treatments. With regard to the other samples in both season it is clear that the same treatment (60 kg N/fed) increased no. of leaves/plant compared the other treatments but the differences were not significant. Also, it is obvious from the obtained results that there were not significant differences at 5% between low mineral level (30 kg N/fed) and N fixation in all studied samples for both seasons. Such significant and in significant increase may be due to increasing the stem

Table (10) : Effect of nitrogen fertilizer on leaf characters in 1994/1995 and 1995/1996 seasons.

Characters / Nitrogen levels	1994/1995 season						1995/1996 season					
	No. of leaves /plant	Leaf area/ plant (cm^2)	Leaf area index	Specific leaf weight (mg/ cm^2)	No. of leaves for head production	Leaves /stem + branches ratio	No. of leaves /plant	Leaf area/ plant (cm^2)	Leaf area index	Specific leaf weight (mg/ cm^2)	No. of leaves for head production	Leaves /stem + branches ratio
Sample at 60 days from sowing												
Zero	11.21	181.73	0.10	3.96	-	-	11.65	79.04	0.04	7.03	-	-
N-fixation	9.29	134.59	0.07	3.50	-	-	10.99	75.53	0.04	8.25	-	-
30 kg N/fed.	8.94	133.55	0.07	4.09	-	-	11.14	82.34	0.05	7.23	-	-
60 kg N/fed.	10.85	180.82	0.10	3.45	-	-	11.72	78.22	0.04	8.08	-	-
L.S.D. at 5%	1.52	44.32	N.S.	N.S.	-	-	N.S.	N.S.	N.S.	N.S.	-	-
Sample at 90 days from sowing												
Zero	17.35	695.61	0.39	2.57	-	62.69	14.72	109.80	0.06	16.24	-	55.51
N-fixation	18.00	656.97	0.36	2.76	-	63.65	14.45	102.88	0.06	18.38	-	57.97
30 kg N/fed.	16.88	672.47	0.37	2.83	-	61.96	15.67	115.05	0.06	16.43	-	59.90
60 kg N/fed.	18.44	866.91	0.48	2.70	-	73.33	15.57	101.23	0.06	19.79	-	55.02
L.S.D. at 5%	N.S.	N.S.	N.S.	N.S.	-	N.S.	N.S.	N.S.	N.S.	N.S.	-	N.S.
Sample at 120 days from sowing												
Zero	87.58	2079.88	1.16	5.51	10.33	45.46	51.94	1206.78	0.67	4.75	4.31	73.49
N-fixation	71.00	1502.03	0.83	6.53	8.63	45.99	59.92	1450.28	0.81	4.61	5.16	69.84
30 kg N/fed.	72.42	1754.49	0.97	6.27	8.09	44.27	60.29	1390.17	0.77	5.43	3.07	47.08
60 kg N/fed.	98.46	2321.72	1.29	5.44	12.04	47.91	83.17	1918.17	1.07	4.78	4.43	81.09
L.S.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	3.11	14.99	483.17	0.27	N.S.	1.15	5.01

Note : The absence of stem and head data 60 and under 90 days from sowing.

length under the same treatment (60 kg N/fed) Table (9). These results were confirmed by **Ashoub, Abla (1995)**.

With regard to leaf area/plant analysis of variance show that this character significantly affected by studied nitrogen treatments in the first sample for the first season and in the third sample for the second one. The results indicate that applying the high level of mineral nitrogen (60 kg N/fed) increased leaf area/plant at the later stage in the second season, as compared with other treatments. These increases by this treatment amounted to 40%, 25% and 59% comparing with to other treatments i.e., 30 kg N/fed, nitrogen fixation and control respectively. Such increase might be due to the abundance of nitrogen which would encourage the increasing of number and/or cell size as well as no. of leaves under the same treatment. Similar results were obtained by **Kamel *et al.*, (1982), Fayed and Mohamed (1987),** and **Ashoub, Abla (1995)**. In this respect, it is clear that nitrogen fixation insignificantly increased the leaf erea/plant compared with control as well low mineral level (30 kg N/fed) in the third samples of the second season.

Generally, as for the effect of N. fixation treatment on leaf area/plant the obtained results in all studied samples indicate that the differences were not significant at 5% as compared with the two levels of nitrogen (30 or 60 kg N/fed). Similar results were obtained by **Zambre *et al.*, (1990)** and **Ahmed (1995)** in wheat, and **El-Toukhy, Salwa (1997)** in barley. On the other side, in the first season data presented were irrigular and no logic results, whereas the highest value was obtained from control.

As for leaf area index (LAI) results indicate that this character significantly increased with adding mineral nitrogen up to the highest level

(60 kg N/fed.). These results were true only in the second season at later age (120 days from plnting). This increase may be attributed to the increase in average leaf area and no. of leaves under the same treatments, as well as the same age, **Kamel *et al.*, (1982) and (1986), Nour El-Din, Nacmat *et al.*, (1983), Sary *et al.*, (1987), El-Afandy (1990)** and **Ashoub, Abla (1995)** obtained the similar results. In addition, nitrogen fixation treatment recorded the high value as compared to nil nitrogen and the low level of nitrogen supply (30 kg N/fed) for the same sample. The similar results were obtained by **Singh and Bhargova (1994)** for Brassica napus.

Statistical analysis reveal that mean values of specific leaf weight (SLW) in the two successive growth seasons for each sampling date i.e. 60, 90 and 120 days from sowing were not significantly affected by nitrogen application in this study. These results were not agreed by those obtained from **Nour El-Din, Nacmat *et al.*, (1983)** who found that specific leaf weight increased by nitrogen application.

Results in Table (10), indicate that mean values of no. of leaves for head production was significantly affected by nitrogen treatments only in the third sample for the second season. It was remarked that the high value of this character was obtained from nitrogen fixation as compared with using mineral nitrogen as well as the nil nitrogen treatment. These results may be due to the lowest head number under the same treatment (N-fixation), Table (13).

Concerning leaves/stem and branches ratio the results in Table (10) indicate that this character was significantly affected by nitrogen supply at later age (120 days) for both seasons. The greatest value of this character was obtained when plant received 60 kg N/fed in the two successive seasons

followed by N. fixation, control and 30 kg N/fed in the first season and by control, N-fixation and 30 kg N/fed in the second season.

1.3. Fresh and dry weight of different parts :

1.3.1. Stem and branches :

The fresh weight of stem and branches was affected by nitrogen fertilizer only at later age in the second season whereas this character was significant great with nitrogen adding up to 60 kg N/fed. This increase is attributed to the increase for both stem diameter and length, Table (11). On the other hand it was remarked the negligible significant between N-fixation and the low level of mineral nitrogen supply (30 kg N/fed).

Regarding stem and branches dry weight was not affected by nitrogen supply, except at later age in the second season. Raising nitrogen level from zero to 30 kg N/fed increased significantly the stem and branches dry weight, but it was significantly declined when plant received 60 kg N/fed and with N-fixation. Such increase may be due to the important role of this element in the metabolism in plant. On the other hand, the decreasing of this character with using high level of nitrogen (60 kg N/fed) may be attributed to the increase of protoplasm weight mass in relation to the weight of cell wall. It is known that protoplasm contain higher rate of moisture than cell walls, therefore the moisture percentage will increase in plant tissue consequently increasing the succulent plant than the dry weight under high dose of N level, **(Moursi, 1979)**. These results were accordance with those obtained from **El-Afandy (1990)** in fresh and dry weight of stem.

1.3.2. Leaves :

Analysis of variance showed that the fresh and dry weight of leaves were significantly affected by using nitrogen application in the third

Table (11) : Effect of nitrogen fertilizer on fresh and dry weight of plant in 1994/1995 and 1995/1996 seasons.

Characters / Nitrogen levels	1994/1995 season				1995/1996 season			
	Stem + branches fresh weight (g)	Stem + branches dry weight (g)	Leaves fresh weight (g)	Leaves dry weight (g)	Stem + branches fresh weight (g)	Stem + branches dry weight (g)	Leaves fresh weight (g)	Leaves dry weight (g)
Sample at 60 days from sowing								
Zero	-	-	7.85	0.72	-	-	4.09	0.57
N-fixation	-	-	5.07	0.47	-	-	3.81	0.62
30 kg N/fed.	-	-	5.06	0.55	-	-	4.29	0.59
60 kg N/fed.	-	-	6.65	0.62	-	-	4.26	0.63
L.S.D. at 5%	-	-	N.S.	N.S.	-	-	N.S.	N.S.
Sample at 90 days from sowing								
Zero	20.09	2.85	18.76	1.79	15.16	3.21	6.65	1.78
N-fixation	21.58	2.85	20.31	1.82	13.80	3.26	6.54	1.89
30 kg N/fed.	22.93	3.07	18.34	1.90	16.32	3.16	9.78	1.89
60 kg N/fed.	32.76	3.19	25.48	2.34	16.22	3.64	11.45	2.00
L.S.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	1.83	N.S.
Sample at 120 days from sowing								
Zero	97.32	25.19	31.02	11.45	34.69	7.80	30.81	5.73
N-fixation	93.46	21.32	35.69	9.81	43.79	9.58	36.65	6.69
30 kg N/fed.	101.59	24.83	32.95	10.99	58.40	16.04	48.37	7.55
60 kg N/fed.	119.54	26.38	45.56	12.64	80.05	11.31	62.02	9.17
L.S.D. at 5%	N.S.	N.S.	6.89	N.S.	17.74	3.18	13.21	1.74

Note : The absence of stem data because of the plant was grown in rosette stage.

sample for both seasons and in the second sample in the second one. Raising nitrogen supply up to 60 kg N/fed increased significantly the leaves fresh weight. These increase may be due to the increase in no. of leaves and leaf area Table (11). It is clear from the obtained results that the difference between nitrogen-fixation and using the low mineral level (30 kg N/fed) were not significant at third sample for both seasons.

As for the leaves dry weight/plant the data indicate that this character was significantly affected by nitrogen treatments at the third sample in the second season. The high significant value was resulted when plants were received 60 kg N/fed, as compared with nitrogen fixation and control. On the other side the differences between nitrogen fixation and the low level of mineral nitrogen (30 kg N/fed) did not reach to the 5% level of significance. In this respect, **Jone and Tucker (1968)** after **Ashoub (1984)** reported that nitrogen supply increase total nitrogen in above ground plant portion, and thus stimulated the metabolic activity of plant, and was reflected the increase in dry matter for leaves. These results in harmony with those obtained by **Kamel *et al.*, (1982 and 1986), Steer and Harrigan (1986), Fayed and Mohamed (1987), Sary *et al.*, (1987), Ezz El-Din (1989), Soundra and De (1989), El-Afandy (1990), Ashoub, Abla (1995),** but the negligible effect was obtained from **Fayed and Mohamed (1987)**. As for the effect of N-fixation on dry weight, **Nagre *et al.*, (1990)** in sorghum, **Zambre *et al.*, (1990)** in wheat and Singh and **Bhargava (1994)** in Brassica napus they found that dry weight increase by inoculation with bacteria.

1.4. Petal yield (kg/fed) :

Data reported in Table (12) show the effect of nitrogen fertilizer on petal yield for two successive seasons. Statistical analysis revealed significant differences in fresh and dry weight of petal yield as affected by

Table (12) : Effect of nitrogen fertilizer on petal yield (kg/fed) in 1994/1995 and 1995/1996 seasons.

Characters	1994/1995 season		1995/1996 season	
Nitrogen levels	Petal fresh weight (kg/fed)	Petal dry weight (kg/fed)	Petal fresh weight (kg/fed)	Petal dry weight (kg/fed)
Zero	31.90	20.32	48.10	34.37
N-fixation	34.66	21.92	43.13	29.90
30 kg N/fed.	39.57	25.66	70.24	47.45
60 kg N/fed.	40.20	25.34	88.66	53.71
L.S.D. 5%	N.S.	N.S.	12.56	6.66

mineral nitrogen fertilizer for the second season. These characters were increased with increasing N-level up to 60 kg N/fed. The increases in fresh and dry weight of petal by adding 60 kg N/fed amounted to 26.2% and 13.2%, 105.6% and 46.2%, 84.3% and 56.3% as compared with other treatments i.e. 30 kg N/fed, nitrogen fixation and control treatment respectively. The negligible effect of nitrogen on petal yield was recorded by **El-Afandy (1990)**, and **Refaat (1993)**.

2. Seed yield and its components :

Average values of seed yield and its related characters as affected by nitrogen fertilizer in the two successive seasons 1994/1995 and 1995/1996 are presented in Table (13).

2.1. Heads number / plant :

Statistical analysis of the heads number / plant significantly increased with mineral nitrogen supply as compared with N-fixation. The highest value was obtained when plant received 30 kg N/fed. as following by 60 kg N/fed. without significant differences at 5% level. These results were true for both seasons, and its are in harmony with those observed in no. of leaves/plant Table (11), and these might be due to the higher efficiency in building metabolites as a result of increasing of light intercepted by plant and the well penetration within safflower canopy. The previous condition encourage the production of head number. These results confirm the previous results which obtained by **Kamel *et al.*, (1982 and 1986), Abu-Hegaza and El-Metwally (1986), Fayed and Mohamed (1987), Sary *et al.*, (1987), Ashoub, Abla *et al.*, (1988). Ezz El-Din (1989) Abo-Shetaia (1990), El-Afandy (1990), El-Nakhlawy (1991), Rajput *et al.*, (1998), Bansal and Katara (1993)** and **Ashoub (1995)**. On the other hand, **Kandil**

(1981), **Kandil and Sonbol (1981)** and **Nour El-Din, Naemat *et al.*, (1983)** they found the negligible effect of nitrogen on above character.

2.2. Head weight (g) :

Mineral nitrogen caused depression effect in head weight for both seasons. It is clear from this results that the trend of head weight as affected by N fertilization behaved the apposite trend of head number/plant, whereas the highest value was obtained from N-fixation. These results were logic because the low competition between head number on nutrient translocated within plant at the low no. of head. These findings are in harmony with those obtained by **Katol and Meena (1988), Abo-Shetaia (1990), El-Afandy (1990)** and **Ashoub, Abla (1995)**, but **Ashoub *et al.*, (1988)** were recorded the negligible effect of nitrogen fetilizaer on head weight.

2.3. Head diameter (cm) :

The obtained results reveal that there was no relevance between different treatment of nitrogen and head diameter for both seasons. The negligible changes in head diameter by nitrogen fertilization may be due to that this character is a varietal characterstic and it is hardly affected by any improvement in the environmental factor as nitrogen supply. Similar results were obtained by **Kamel *et al.*, (1986), Ashoub, Abla *et al.*, (1988)** and **El-Afandy (1990)**. Different results were recorded by **Hegab *et al.*, (1987), Sary *et al.*, (1987), Katol and Meena (1988)**, whereas the head diameter was increased by nitrogen supply.

2.4. Seeds number / head :

The obtained results show that this character was not significantly affected by all treatments of nitrogen for both growth seasons. These results were in agreement with those obtained by **Kandil and Sonbol (1981), El-**

Ahmer (1983), Abu-Hegaza and El-Metwally (1986), Kamel *et al.*, (1986), Sary *et al.*, (1987), Ashoub, Abla *et al.*, (1988), Abo-Shetaia (1990), El-Afandy (1990), Bansol and Katara (1993), Patel *et al.*, (1994) and **Ashoub, Abla (1995)**.

2.5. Seeds weight / head (g) :

Analysis of variance showed no significant differences between the nitrogen treatments in seeds weight/head. The trend of this character behaved the same trend of seed number/head as affected by nitrogen fertilizer. These results are in agreement with those obtained by **Sary *et al.*, (1987), Katole and Meena (1988), Abo-Shetaia (1990), El-Afandy (1990)** and **El-Nakhlawy (1991)**.

2.6. Weight of 1000-seed (g) :

The weight of 1000-seed was not significantly affected by nitrogen fertilizer for both seasons. The obtained results show that insignificant effect on this character had no trend by nitrogen fertilizer in the first season, while there are gradually increasing by the same treatment in the second one without significant differences. Similar results were obtained by **Kandil (1981), Kamel *et al.*, (1986) and Ashoub *et al.*, (1988). Opposite results were obtained by Eweida *et al.*, (1981). Kandil and Sonbol (1981), Kamel *et al.*, (1982), El-Ahmer (1983), Nour El-Din, Naemat *et al.*, (1983), Hegab *et al.*, (1987), Sary *et al.*, (1987), El-Afandy (1990), El-Nakhlawy (1991), Leilah *et al.*, (1992), Rajput *et al.*, (1992)** and **Bansal and Katara (1993)**. On the other hand, the nitrogen supply was decreased the weight of 1000-seed was recorded by **Ashoub, Abla (1995)**.

Table (13) : Effect of nitrogen fertilizer on seed yield and its components in 1994/1995 and 1995/1996 seasons.

Characters	1994/1995 season							1995/1996 season						
Nitrogen levels	No. of heads/ plant	Weight of head (g)	Diameter of head (cm)	No. of seeds/ head	Weight of seeds /head (g)	Weight of 1000-seed (g)	Seed yield (kg/fed)	No. of heads/ plant	Weight of head (g)	Diameter of head (cm)	No. of seeds/ head (g)	Weight of seeds / head (g)	Weight of 1000-seed (g)	Seed yield (kg/fed)
Zero	8.48	4.95	2.71	31.21	1.96	63.17	593.18	12.05	7.25	3.53	50.38	3.60	57.33	515.16
N-fixation	8.23	5.07	2.75	35.71	2.03	61.50	473.60	11.61	7.32	3.36	49.09	3.53	59.77	492.66
30 kg N/fed.	8.95	4.55	2.69	31.88	1.95	61.50	525.64	19.63	6.98	3.31	51.55	3.53	61.12	687.28
60 kg N/fed.	8.18	4.93	2.82	35.83	2.02	56.67	722.99	18.78	7.14	3.40	53.50	3.57	62.45	733.82
L.S.D. at 5%	0.72	0.39	N.S.	N.S.	N.S.	N.S.	N.S.	2.80	0.40	N.S.	N.S.	N.S.	N.S.	101.27

2.7. Seed yield kg/fed. :

Statistical analysis revealed that nitrogen fertilizer exhibited significant effect on seed yield kg/fed in the second season and insignificant in the first one. It is evident that seed yield gradually increased up to 60 kg N/fed in the two successive seasons. With regard to the second season, it is observed that the high value (733.82 Kg/fed) was resulted when plant received 60 kg N/fed as followed by the treatment of 30 kg N/fed (687.275 kg/fed) without significance differences between the both treatments. These increases in seed yield may be due to the significant or insignificant increases in head number/plant, number of seeds/head as well as 1000-seed weight in the same treatments. Similar results were obtained by **Kandil (1981), Kamel *et al.*, (1982 and 1986), El-Ahmer (1983), Abu-Hegaza and El-Metwally (1986), Sachan (1986), Sagare *et al.*, (1986), Fayed and Mohamed (1987), Hegab *et al.*, (1987), Sary *et al.* , (1987), Ashoub, Abla *et al.*, (1988), Katole and Meena (1988), Mahey *et al.*, (1989), Zaman (1989), Abo-Shetaia (1990), El-Afandy (1990), El-Nakhlawy (1991), Nimje (1991), Leilah *et al.*, (1992), Bansal and Katara (1993), Ibrahim (1994), Petal *et al.*, (1994), Singh, Dalip *et al.*, (1994), Ashoub, Abla (1995), Gajendra Giri (1995), Memon *et al.*, (1995).**

Investigators reported that seed yield was not affected by nitrogen supply **Ezz-El-Din (1989)** and **Refaat, Azza *et al.*, (1993)**. Concerning N-fixation treatment, results indicate that the low value of seed yield/fed was resulted by this treatment. In this respect opposite results were obtained by **Khadse *et al.*, (1991)** on safflower, **Abdalla *et al.*, (1992)** on rape, **Chanhan *et al.*, (1995)** on rape, they found increases seed yield by seed inoculation. Also, the negligible effect was obtained by **Prasad and Prasad (1994)** on cotton seed yield.

3. Oil yield and chemical contents :

Mean percentage of protein %, phosphorus %, oil % and oil yield kg/fed as affected by nitrogen fertilizer in the two successive seasons, Table (14).

3.1. Protein, phosphorus and oil % :

Analysis of variance showed that the differences in protein % were significant for both seasons. With regard to this chemical content, there was a gradually increase with increasing nitrogen supply up to 60 kg N/fed, the high value was 12.10 as followed by 10.63 from 60 and 30 kg N/fed in the first season, and 9.28 followed by 9.17 from 30 and 60 kg N/fed in the second one respectively and without significant differences. Such results are in agreement with those reported by **Nour El-Din, Naemat *et al.*, (1983), Ahmed *et al.*, (1985), Sagare *et al.*, (1986), El-Afandy (1990), El-Nakhlawy (1991), Nimje and Gandhi (1993)**. On the other side, protein % was significant declined by using N-fixation for both seasons.

In this respect, opposite results were obtained **Ishac *et al.*, (1986)** and **Ahmed (1995)** who found that N-content increased by seed inoculation in wheat, and the negligible effect of seed inoculation was recorded by **Fayez *et al.*, (1986)**, in wheat plant.

As for the phosphorus % in seeds of safflower was not affected by nitrogen fertilizer for both seasons. These results were opposite with those obtained by **El-Afandy (1990)**.

The obtained results in Table (14) indicate that the oil % was significant affected by nitrogen application in the second season, wheereas the control treatment recorded the highest value (32.06) and it was significant declined by using nitrogen fixation and nitrogen supply (30 and

Table (14) : Effect of nitrogen fertilizer on oil yield and chemical content of safflower seed in 1994/1995 and 1995/1996 seasons.

Characters	1994/1995 season				1995/1996 season			
Nitrogen levels	Protein (%)	Phosphorus (%)	Oil (%)	Oil yield (kg/fed)	Protein (%)	Phosphorus (%)	Oil (%)	Oil yield (kg/fed)
Zero	9.04	0.41	31.81	188.70	7.32	0.42	32.06	165.14
N-fixation	9.02	0.39	31.80	150.59	8.99	0.43	29.78	146.73
30 kg N/fed.	10.36	0.44	31.60	166.11	9.28	0.39	31.10	213.71
60 kg N/fed.	12.10	0.41	32.44	236.37	9.17	0.36	31.88	233.55
L.S.D. at 5%	2.02	N.S.	N.S.	N.S.	1.12	N.S.	0.103	59.52

60 kg N/fed) this declination may be due the superiority of protein % as compared to nil nitrogen, because it is known the trend of protein behaved opposite trend of oil %. Similar results were obtained from **Katole and Meena (1988) and El-Nakhlawy (1991)**. In another studies, results indicated that there is no signficant effect on oil % was recorded by **El-Ahmar (1983), Sagare *et al.*, (1986), Mahey *et al.*, (1989), Kumar (1991), Refaat, Azza *et al.*, (1993). Singh, Dalip *et al.*, (1994) and Ashoub, Abla (1995)**. While the opposite results were reported by **Nour El-Din, Naemat *et al.*, (1983), Zaman (1989), El-Afandy (1990), Nimje (1991), Zaman and Das (1991)**.

3.2. Oil yield (Kg/fed) :

In respect to oil yield (kg/fed) it is obvious that nitrogen treatment significantly effected on this character in the second season. The result indicate that the application of nitrogen clear increments in seed oil yield (kg/fed). The highest value 233.5 and 213.7 kg/fed were obtained by applying 60 and 30 kg N/fed respectively, without significant differences. The results for oil yield behave the same trend in seed yield kg/fed. These results are logic because oil yield may be related to seed yield. These findings are in accordance with those obtained by **Sagare *et al.*, (1986), Fayed and Mohamed (1987), El-Afandy (1990), Zaman and Das (1991), Leilah *et al.*, (1992), Nimje and Gandhi (1993), Ibrahim (1994) and Ashoub, Abla (1995)**. But, the differences results were recorded by **Refaat, Azza *et al.*, (1993)**, they found that application of nitrogen did not effect on oil yield.

Finally :

1. It could be conluded that the promising and economic level of nitrogen supply is this type of soil for safflower plant was 60 kg N/fed.

Table (15) : Effect of phosphorus fertilizer on stem characters in 1994/1995 and 1995/1996 seasons.

Characters / Phosphorus levels	1994/1995 season		1995/1996 season	
	Stem length (cm)	Stem diameter (cm)	Stem length (cm)	Stem diameter (cm)
Sample at 90 days from sowing				
Zero	37.63	0.77	16.64	0.53
PDB	39.90	0.84	17.90	0.52
15.5 kg P_2O_5/fed.	33.56	0.81	18.92	0.52
31.0 kg P_2O_5/fed.	36.33	0.80	18.47	0.54
L.S.D. at 5%	N.S.	N.S.	N.S.	N.S.
Sample at 120 days from sowin				
Zero	106.52	1.19	73.41	0.75
PDB	116.81	1.24	77.25	0.86
15.5 kg P_2O_5/fed.	114.30	1.24	82.25	0.88
31.0 kg P_2O_5/fed.	118.79	1.25	86.85	0.86
L.S.D. at 5%	N.S.	N.S.	7.36	N.S.

Note : The absence of stem data at 60 days because of the plant was grown in rosette stage.

by **Ahmed *et al.*, (1985) Singh *et al.*, (1985), Sary *et al.*, (1987) and El-Afandy (1990)**, by, differed with those observed by **Abo-Shetaia (1990)** who found that stem height was not significantly affected by adding phosphorus. On the other hand, the differences between phosphate dissolving bacteria (PDB) and the low level of phosphorus (15.5 P_2O_5 kg/fed) did not reach at 5% level of significance. Difference results were obtained by **Abd-El-Hamid, Amal (1994)** in wheat, **Ashoub, Abla and Abd El-Ghany, Bouthaina (1994)** on chick pea and **Tomar *et al.*, (1994 b)** on opium poppy who found that the plant height was increased by phosphate dissolving bacteria.

As for stem diameter, it is clear from the obtained results that there are no relevance between the phosphours fertilizer as mineral or PDB and this character. Opposite result was obtained by **Sary *et al.*, (1987)** who found that stem diameter was significantly increased by increasing phosphorus level.

1.2. Leaf characters :

Average values of leaf characters i.e. number of leaves and leaf area/plant, leaf area index, specific leaf weight, no. of leaves for head and leaf/stem and branches ratio as affected by phosphorus fertilizer in the two successive seasons are shown in Table (16).

Analysis of variance showed that the number of leaves per plant was significantly affected by phosphorus application only in the first season at age 120 days. The mean values resulted by the studied treatments could be arranged in a descending order as following (101.5, 87.8, 81.3 and 58.3) by 31 kg P_2O_5/fed, 15.5 kg P_2O_5 and phosphate solubilizing respectively, but

Table (16) : Effect of phosphorus fertilizer on leaf characters in 1994/1995 and 1995/1996 seasons.

Characters / Phosphorus levels	1994/1995 season						1995/1996 season					
	No. of leaves /plant	Leaf area/ plant (cm^2)	Leaf area index	Specific leaf weight (mg/ cm^2)	No. of leaves for head production	Leaves /stem + branches ratio	No. of leaves /plant	Leaf area/ plant (cm^2)	Leaf area index	Specific leaf weight (mg/ cm^2)	No. of leaves for head production	Leaves /stem + branches ratio
Sample at 60 days from sowing												
Zero	9.90	150.64	0.08	4.30	-	-	11.27	72.10	0.04	8.34	-	-
PDB	9.44	151.97	0.08	3.23	-	-	11.32	78.61	0.04	7.79	-	-
15.5 kg P_2O_5	10.94	171.92	0.10	3.69	-	-	11.33	84.49	0.05	7.17	-	-
31.0 kg P_2O_5	10.02	156.17	0.09	3.76	-	-	11.58	79.94	0.04	7.46	-	-
L.S.D. at 5%	N.S.	N.S.	N.S.	N.S.	-	-	N.S.	N.S.	N.S.	N.S.	-	-
Sample at 90 days from sowing												
Zero	16.75	695.14	0.39	2.71	-	68.70	14.40	105.20	0.06	16.18	-	57.11
PDB	18.25	752.28	0.42	2.64	-	65.56	14.88	108.07	0.06	16.72	-	55.04
15.5 kg P_2O_5	17.63	685.40	0.38	2582	-	66.92	15.60	106.65	0.06	17.46	-	55.60
31.0 kg P_2O_5	18.04	759.14	0.42	2.69	-	61.80	15.54	109.02	0.06	20.14	-	59.98
L.S.D. at 5%	N.S.	N.S.	N.S.	N.S.	-	N.S.	N.S.	N.S.	N.S.	N.S.	-	N.S.
Sample at 120 days from sowing												
Zero	58.83	1398.25	0.78	6.68	7.13	46.52	52.10	1296.11	0.72	4.78	3.59	68.43
PDB	81.33	2073.90	1.15	4.85	8.82	43.29	69.96	1354.34	0.75	5.37	4.23	67.49
15.5 kg P_2O_5	87.79	1855.13	1.03	6.69	10.07	49.52	67.40	1741.69	0.97	4.41	4.34	64.18
31.0 kg P_2O_5	101.50	2330.84	1.29	5.61	11.75	44.56	65.85	1573.25	0.87	5.09	4.26	67.05
L.S.D. at 5%	24.95	524.81	N.S.	N.S.	2.96	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Note : The absence of stem and head data under 60 and 90 days from sowing.

the differences between them did not reach to the 5% level of significance. Similar results were recorded by **Singh *et al.*, (1985)**.

As for leaf area resuts indicate that this character behaved the same trend of the number of leaves, but the two highest values (2330.8 and 2073.9) were recorded from 31 kg P_2O_5/fed and using phosphate solubilizing without significant differences between them. Similar results were demonstrated by **Singh *et al.*, (1985)** who found that leaf area/plant increased by phosphorus fertilization.

Regarding leaf area index (LAI) and specific leaf weight (SLW) the obtained data indicate that the two characters were not significantly affected by phosphorus fertilizer for both seasons. Different results were recorded by **Sary *et al.*, (1987), El-Afandy (1990),** and **Ashoub, Abla (1995)**, they found that leaf area index significantly affected by phosphorus fertilization. In respect to phosphorus solubilizing **Tomar *et al.*, (1994 b)** in Opium poppy, found increasing in leaf area index by PDB.

Concerning no. of leaves for head production results show that this character was significantly affected by phosphorus fertilizer at 120 days from planting in the first season. It is evident that the difference between the three treatments of phosphorus did not reach the 5% level of significance.

Regarding to leaf/stem and branches results indicate that this character was not affected by phosphorus fertilizer at all samples taken for both seasons.

1.3. Fresh and dry weight of different parts :

1.3.1. Stem and branches :

Analysis of variance revealed significant differences in stem and branches fresh and dry weight by different sources of phosphorus fertilization except at medium age (90 days from sowing) in the first season. Raising mineral phosphorus supply from 15.5 to 31 kg P_2O_5/fed was significantly increased stem + branches fresh weight in the first season, but in the second one the differences between the two phosphorus treatments were not significant.

With regard to dry weight of stem + branches the differences between the two treatment were not significant for two seasons. Such increase may be due to that phosphorus encourage the root development and its aid water obsorption and the nutrient uptake from soil and caused increases in fresh and dry matter accumulation for different part i.e. stem. These results are in good agreement with **Sary *et al.*, (1987)**. On the other hand, using seed inoculated by phosphate dissolving bacteria had no significant effect on fresh and dry weight of stem and branches as compared with control treatment in both seasons.

1.3.2. Leaves :

With regard to the fresh weight of leaves, statistical analysis indicate that there are significantly affected by phosphorus fertilization only at early age (60 days) in the first season, and at later age (120 days) in the second one. As for the early age the highest value was recorded by using 15.5 P_2O_5/fed, but in the second season the highest value was resulted from seed inoculated with (PDB). These later finding are very logic because at advance age treatment of seed inoculated recorded higher microbial count

Table (17) : Effect of phosphorus fertilizer on fresh and dry weight of plant in 1994/1995 and 1995/1996 seasons.

Characters / Phosphorus levels	1994/1995 season				1995/1996 season			
	Stem + branches fresh weight (g)	Stem + branches dry weight (g)	Leaves fresh weight (g)	Leaves dry weight (g)	Stem + branches fresh weight (g)	Stem + branches dry weight (g)	Leaves fresh weight (g)	Leaves dry weight (g)
Sample at 60 days from sowing								
Zero	-	-	5.96	0.65	-	-	3.99	0.60
PDB	-	-	4.90	0.49	-	-	3.89	0.61
15.5 kg P_2O_5/fed.	-	-	7.56	0.64	-	-	4.17	0.61
31.0 kg P_2O_5/fed.	-	-	6.21	0.59	-	-	4.40	0.60
L.S.D. at 5%	-	-	1.66	N.S.	-	-	N.S.	N.S.
Sample at 90 days from sowing								
Zero	21.63	2.74	18.64	1.88	13.92	2.98	8.54	1.70
PDB	24.91	3.03	20.74	1.99	15.62	3.28	7.97	1.81
15.5 kg P_2O_5/fed.	26.39	2.88	21.44	1.93	15.74	3.35	8.57	1.86
31.0 kg P_2O_5/fed.	24.42	3.31	22.07	2.05	16.22	3.66	9.33	2.20
L.S.D. at 5%	N.S.	N.S.	N.S.	N.S.	1.17	0.417	N.S.	N.S.
Sample at 120 days from sowing								
Zero	95.64	20.09	32.55	9.35	42.34	9.04	34.87	6.19
PDB	106.39	23.22	36.65	10.05	54.25	10.78	52.81	7.27
15.5 kg P_2O_5/fed.	92.32	25.05	37.08	12.41	60.88	11.97	46.06	7.68
31.0 kg P_2O_5/fed.	117.56	29.37	38.95	13.09	60.27	11.94	44.10	8.01
L.S.D. at 5%	19.31	6.82	N.S.	2.10	14.01	2.25	10.88	1.29

Note : The absence of stem data because of the plant was grown in rosette stage.

than at early age. **Millet (1985), [Ashoub, Abla and Abd El-Ghany, Bouthaina (1994) and Abd El-Ghany, Bouthaina and Ashoub, Abla (1994)]**. These results may be due to the growth of microorganism on the decaying of fibrous root system or the stimulatory effect of root excretion, and these microbes possess the ability to convert insoluble phosphate into soluble form by secreting organic acids which lower the pH and bring about the dissolving of bound form of complex phosphate [CO_3 $(PO_4)_2$] caused finally increases phosphorus ability, **[Saber (1982) and Boutros *et al.*, (1987)]**. On the other hand, raising phosphorus supply from 15.5 to 31 P_2O_5/fed had insignificant declination for the leaves fresh weight for both seasons, in two samples.

Concerning the leaves dry weight results indicate that tested treatments of phosphorus application had significantly effect on this character as compared to without fertilization at later age (120 days from sowing) for both seasons. In the first season obtained results indicate that the dry weight of leaves was increased by increasing mineral phosphorus from 15.5 to 31 P_2O_5 kg/fed more than using the seed inoculated with significant differences. The trend in the second season behaved the same as that of the first one, but the differences between the two source of phosphorus failed to reach the 5% level of significance. Similar conclusion was obtained from **Singh *et al.*, (1985), Sary *et al.*, (1987), Bhilegaonkar *et al.*, (1995)**. But about for PDB, **Abd-El-Ghany, Bouthaina and Ashoub, Abla (1994)** in fodder beet, **Ashoub, Abla and Abd-El-Ghany, Bouthaina (1994)** in chick pea, **Abd El-Hamid, Amal (1994)** in wheat, and **El-Toukhy, Salwa (1997)** in Atriplex found that the fresh and dry weight of differents parts of this plants were affected by this treatment.

1.4. Petal yield (kg/fed) :

Results in Table (18) show mean values of fresh and dry weight of petal yield kg/fed of safflower plants as affected by phosphorus fertilization.

Analysis of variance revealed that there is no significant differences between the studied treatment on the fresh and dry weight of petal yield kg/fed in the two successive seasons. Opposite results were obtained by **El-Afandy (1990)** who found that the above character was increased by raising phosphorus fertilizer.

2. Seed yield and its components :

Data reported in Table (19) indicate the average values of seed yield kg/fed and its related characters i.e. number of head/plant, weight of head, head diameter, number and weight of seeds/head and 1000 seed weight.

2.1. Heads number / plant :

Statistical analysis indicated that the tested treatments of phosphorus fertilizer had no significant effect on heads number/plant. Opposite results were obtained by **Kandil and Sonbol (1981), Singh *et al.*, (1985), Sary *et al.*, (1987), Abo-Shetaia (1990) and El-Afandy (1990).**

2.2. Head weight (g) :

The effect of phosphorus fertilizer had no significant effect on head weight for both seasons, **Abo Shetaia (1990)** and **El-Afandy (1990)** obtained the opposite results.

2.3. Head diameter (cm) :

As for the head diameter the results indicate that this character was not significant affected by the different source of phosphorus fertilizer.

Talbe (18) : Effect of phosphorus fertilizer on petal yield (kg/fed) in 1994/1995 and 1995/1996 seasons.

Characters	1994/1995 season		1995/1996 season	
Phosphorus levels	Petal fresh weight (kg/fed)	Petal dry weight (kg/fed)	Petal fresh weight (kg/fed)	Petal dry weight (kg/fed)
Zero	34.57	23.50	63.23	43.26
PDB	35.83	23.35	62.89	41.51
15.5 kg P_2O_5	40.03	23.73	60.94	40.98
31.0 kg P_2O_5	35.91	22.65	63.07	39.67
L.S.D. 5%	N.S.	N.S.	N.S.	N.S.

Opposite results were obtained by **Sary *et al.*, (1987), Abo-Shetaia (1990)** and **El-Afandy (1990)** who reported that phosphorus fertilizer increased signficiantly head diameter of head.

2.4. Seeds number / head :

Analysis of variance showed the significant difference between the phosphorus treatment in seeds number/head in the first season. The highest value was obtained from seed inoculated by phosphate dissolving bacteria and it was significant declined by using phosphorus supply, at 15.5 kg P_2O_5/fed and 31 kg P_2O_5/fed. Similar results were obtained by **Kandil and Sonbol (1981)**, while the different results were observed by **Singh *et al.*, (1985), Sary *et al.*, (1987)**, and **Abo-Shetaia (1990)**.

2.5. Weight of seeds / head (g) :

Mean seeds weight/head for both seasons were not significant by all treatments of phosphorus. Opposite results were obtained by **Abo-Shetaia (1990)** and **El-Afandy (1990)**.

2.6. Weight of 1000-seed (g) :

Also this component of yield was not significant by the studied treatments of phosphorus. Similar results were obtained by **Kandil and Sonbol (1981)**, but different results were recorded by **Sary *et al.*, (1987)** and **El-Afandy (1990)**.

2.7. Seed yield kg/fed. :

Regarding the seed yield kg/fed was not affected by adding different level of phosphorus and by using PDB, under two growth seasons. These results are in harmony with those obtained by **Sagare *et al.*, (1986)**, while the different results were demonstrated by **Kandil and Sonbol (1981), Singh *et al.*, (1985), Sary *et al.*, (1987), Zaman (1989), El-Afandy (1990),**

Table (19) : Effect of phosphorus fertilizer on seed yield and its components in 1994/1995 and 1995/1996 seasons.

Characters / Phosphorus levels	1994/1995 season							1995/1996 season						
	No. of heads/ plant	Weight of head (g)	Diameter of head (cm)	No. of seeds/ head	Weight of seeds /head (g)	Weight of 1000-seed (g)	Seed yield (kg/fed)	No. of heads/ plant	Weight of head (g)	Diameter of head (cm)	No. of seeds/ head (g)	Weight of seeds /head (g)	Weight of 1000-seed (g)	Seed yield (kg/fed)
Zero	8.25	5.07	2.81	32.04	2.12	61.38	539.61	14.51	7.04	3.36	51.02	3.52	60.44	624.18
P.D.B.	9.22	4.93	2.66	38.13	2.00	62.42	554.51	16.55	7.21	3.39	51.81	3.78	61.66	609.35
15.5 kg P_2O_5 /fed	8.72	4.82	2.73	31.88	1.96	62.25	585.02	15.55	7.22	3.44	50.89	3.58	60.63	608.62
31.0 kg P_2O_5 /fed	8.64	4.67	2.77	32.58	1.88	61.79	636.27	15.47	6.91	3.40	50.80	3.35	57.93	586.76
L.S.D. at 5%	N.S.	N.S.	N.S.	4.80	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

hidroxy acid may chelate with calcium and iron resulting in effective solubilization and utilization of phosphate. **(Boutros *et al.*, 1987)**, also, (2) The bacteria increased the endogenus phytohormones, which plays an important role in formation a big active root system-increasing the nutrient uptake and translocation as well as accumulation within plant to storage part i.e. seed. Similar conclusion about to PDB were observed by **Alagawadi and Gour (1988)** and **Manjunatha and Devi (1990)** in groundnut, who found that P-uptake increased from 88.9 and 155.2 mg/plant to 114.6 and 207.5 mg/plant by without and with seed inoculated treatment respectively. In addition, **Belimov *et al.*, (1995)** they found a better accumulation of phosphorus uptake and increased the total P-content in plant tissues by phosphorus fertilization. But, about for phosphorus addition similar results were obtained by **Singh *et al.*, (1985), Kamel *et al.*, (1986), Kummur *et al.*, (1989)** and **El-Afandy (1990)**.

For the oil percentage data show that this traits was not significantly affected by different treatments of phosphorus fertilizer in the two growth seasons Table (20). Similar results were obtained by **Kamel *et al.*, (1986), Sagar *et al.*, (1986)** and **Gour *et al.*, (1987)**, while different observation were recorded by **Sary *et al.*, (1987), Singh and Singh (1989)** and **Singh *et al.*, (1995)**.

3.2. Oil yield (kg/fed) :

Regarding the effect of phosphorus fertilizer on oil yield kg/fed. the obtained results indicate that this character behaved the same trend of oil percentage. Opposite results were demonstrated by **Sary *et al.*, (1987)** and **El-Afandy (1990)**.

Finally :

1. It could be concluded that the promising and economic level of mineral phosphorus in this study under calcareous soil was 15.5 kg P_2O_5/fed and incremental any doses beyond this limit did not induce any and/or lower significant changes in the growth and yield.

2. The bio-fertilizer (phosphate dissolving bacteria PDB) gave the same results with mineral phosphorus supply at dose 15.5 kg P_2O_5/fed and it is an important economically tool in the strategy for increasing agricultural production. thus, it reduces the use of chemical fertilizer which are expensive in developing countries and ecologically also reduce pollution of environment.

3. It is clear that mean values of growth and yield in the second season was higher than in the first one. These results may be attributed to the changes in the environmental factors through the two seasons Table (2).

IV. Effect of the Interactions :

Only significant interaction effect is discussed in this study.

1. Effect of the interaction between varieties and nitrogen fertilizer :

Table (21) indicate the survey of the interaction between varieties and nitrogen fertilizer on all characters of safflower plants in the two succcssive seasons 1994/1995 and 1995/1996

1.1. Growth characters and petal yield :

The stem diameter in the first season at later age (120 days from sowing) was affected by this interaction Table (22). It was only significantly affected by nitrogen treatments under Aceitera variety. It was gave the thickest and thinnest stem from Aceitera variety when plant receiving the high level of nitrogen supply and using the seed inoculated by bacteria, respectively. On the other hand, this character was not affected by different varieties except at high level of nitrogen supply, it was tended to increase with Aceitera variety, Table (22). The high value was obtained by planting the exotic variety (Aceitera) fertilized by 60 kg N/fed.

Number of leaves/plant at early age (60 days from sowing) and at later age (120 days) in the second season was affected by this interaction, Tables (23 & 24).

At earley age, Table (23) this character significantly affected by nitrogen treatments with two varieties, the highest value when using nitrogen fixation, and the lowest one at 30 kg N/fed. This result was obtained by Giza 1 and it was remarked the opposite one with Aceitera. On the other side, no. of leaves were significant affected by two varieties only when using

Table (21) : Effect of the interaction between varieties and nitrogen fertilizer on all studied characters of safflower in 1994/1995 and 1995/1996 seasons.

Characters	1994/1995			1995/1996		
	Days after sowing			Days after sowing		
	60	90	120	60	90	120
1. Growth characters and petal yield :						
Stem length (cm)	-	N.S.	N.S.	-	N.S.	N.S.
Stem diameter (cm)	-	N.S.	*	-	N.S.	N.S.
No. of leaves/plant	N.S.	N.S.	N.S.	*	N.S.	*
Leaf area cm^2	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Leaf area index	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Specific leaf weight (mg/cm^2)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
No. of leaves for head production	-	-	N.S.	-	-	N.S.
Leaf/stem ratio	-	N.S.	N.S.	-	N.S.	N.S.
Stem fresh weight (g)	-	N.S.	N.S.	-	N.S.	N.S.
Stem dry weight (g)	-	N.S.	N.S.	-	N.S.	N.S.
Leaves fresh weight (g)	N.S.	N.S.	*	N.S.	N.S.	N.S.
Leaves dry weight (g)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Petal yield :						
Petal fresh weight (kg/fed)		N.S.			N.S.	
Petal dry weight (kg/fed)		N.S.			N.S.	
2. Seed yield and its components :						
No. of heads/plant		N.S.			N.S.	
Weight of head (g)		N.S.			N.S.	
Diameter of head (cm)		N.S.			N.S.	
No. of seeds/head		N.S.			N.S.	
Weight of seeds/head (g)		N.S.			N.S.	
Weight of 1000-seed (g)		N.S.			N.S.	
Seed yield (kg/fed)		N.S.			N.S.	
3. Oil yield and chemical contents :						
Protein %		*			N.S.	
Phosphorus %		N.S.			N.S.	
Oil %		N.S.			N.S.	
Oil yield (kg/fed)		N.S.			N.S.	

Notes : N.S. and * mean that not significant and significant respectively.

Table (22) : Effect of the interaction between varieties and nitrogen fertilizer on stem diameter (cm) at 120 days from sowing in the first season 1994/1995.

Varieties / Nitrogen	Giza 1	Aceitera
Zero	1.19	1.30
N-fixation	1.21	1.06
30 kg N/fed	1.33	1.16
60 kg N/fed	1.20	1.55
L.S.D. at 5%	0.16	

Table (23) : Effect of the interaction between varieties and nitrogen fertilizer on no. of leaves/plant at 60 days from sowing in the second season 1995/1996.

Varieties / Nitrogen	Giza 1	Aceitera
Zero	11.92	11.33
N-fixation	12.50	9.47
30 kg N/fed	10.80	11.47
60 kg N/fed	12.16	11.28
L.S.D. at 5%	1.49	

nitrogen fixation it was tended to significant increase with Giza 1 Table (23).

At later age, Table (24) no. of leaves/plant significantly affected by nitrogen supply only with Giza 1, where obtained the highest value when adding 60 kg N/fed followed by using nitrogen fixation. On the other hand, this character was significantly affected by different varieties whereas Giza 1 variety was surpassed Aceitera variety at all treatments of nitrogen, Table (24).

The leaves fresh weight Table (25) at later age (120 days from sowing) in the first season was significantly affected by the above interaction. Nitrogen fertilizer had a significant increase on leaves fresh weight with two varieties by using the high level 60 kg N/fed with Aceitera followed by nitrogen fixation with Giza 1. On the other hand, this character was significantly affected by the two varieties only at high level of nitrogen 60 kg N/fed and without nitrogen, whereas Aceitera was surpassed local variety (Giza 1), Table (25).

1.2. Seed yield and its components :

This interaction had no significant effect on seed yield and its component under two growth seasons.

1.3. Oil yield and chemical contents :

The effect of this interaction had statistical significant effect only on protein % in the first season, while the varieties and nitrogen were act independently on the other chemical content i.e. phosphorus, oil % and oil yield.

Table (24) : Effect of the interaction between varieties and nitrogen fertilizer on number of leaves/plant at 120 days from sowing in the second season 1995/1996.

Varieties / Nitrogen	Giza 1	Aceitera
Zero	62.79	41.08
N-fixation	89.20	30.62
30 kg N/fed	70.16	50.40
60 kg N/fed	111.79	54.54
L.S.D. at 5%	21.21	

Table (25) : Effect of the interaction between varieties and nitrogen fertilizer on leaves fresh weight/plant (g) at 120 days from sowing in the first season 1994/1995.

Varieties / Nitrogen	Giza 1	Aceitera
Zero	25.95	36.08
N-fixation	36.80	34.58
30 kg N/fed	31.20	34.69
60 kg N/fed	36.50	54.69
L.S.D. at 5%	8.37	

Table (26) : Effect of the interaction between varieties and nitrogen fertilizer on protein (%) of safflower seed in the first season 1994/1995.

Varieties / Nitrogen	Giza 1	Aceitera
Zero	8.92	9.15
N-fixation	10.08	7.94
30 kg N/fed	13.29	7.43
60 kg N/fed	14.50	9.69
L.S.D. at 5%	2.85	

Table (27) : Effect of the interaction between varieties and phosphorus fertilizer on all studied characters of safflower in 1994/1995 and 1995/1996 seasons.

Characters	1994/1995			1995/1996		
	Days after sowing			Days after sowing		
	60	90	120	60	90	120
1. Growth characters and petal yield :						
Stem length (cm)	-	N.S.	N.S.	-	N.S.	N.S.
Stem diameter (cm)	-	N.S.	N.S.	-	N.S.	N.S.
No. of leaves/plant	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Leaf area cm^2	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Leaf area index	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Specific leaf weight (mg/cm^2)	N.S.	N.S.	N.S.	N.S.	N.S.	*
No. of leaves for head production	-	-	N.S.	-	-	N.S.
Leaf/stem ratio	-	N.S.	N.S.	-	N.S.	N.S.
Stem fresh weight (g)	-	N.S.	N.S.	-	N.S.	N.S.
Stem dry weight (g)	-	N.S.	N.S.	-	N.S.	N.S.
Leaves fresh weight (g)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Leaves dry weight (g)	N.S.	N.S.	N.S.	N.S.	N.S.	*
Petal yield :						
Petal fresh weight (kg/fed)		*			N.S.	
Petal dry weight (kg/fed)		*			N.S.	
2. Seed yield and its components :						
No. of heads/plant		*			N.S.	
Weight of head (g)		N.S.			N.S.	
Diameter of head (cm)		N.S.			N.S.	
No. of seeds/head		N.S.			N.S.	
Weight of seeds/head (g)		N.S.			N.S.	
Weight of 1000-seed (g)		N.S.			N.S.	
Seed yield (kg/fed)		N.S.			N.S.	
3. Oil yield and chemical contents :						
Protein %		N.S.			N.S.	
Phosphorus %		N.S.			N.S.	
Oil %		N.S.			N.S.	
Oil yield (kg/fed)		N.S.			N.S.	

Notes : N.S. and * mean that not significant and significant respectively.

Table (28) : Effect of the interaction between varieties and phosphorus fertilizer on specific leaf weight (mg/cm^2) at 120 days from sowing in the second season 1995/1996.

Varieties / Phosphorus	Giza 1	Aceitera
Zero	4.97	4.66
PDB	5.69	5.30
15.5 P_2O_5 kg/fed	5.32	4.16
31 kg P_2O_5/fed	4.63	5.97
L.S.D. at 5%	1.11	

Table (29) : Effect of the interaction between varieties and phosphorus fertilizer on dry weight of leaves/plant (g) at 120 days from sowing in the second season 1995/1996.

Varieties / Phosphorus	Giza 1	Aceitera
Zero	7.24	5.13
PDB	7.99	6.55
15.5 P_2O_5 kg/fed	9.50	5.85
31 kg P_2O_5/fed	7.66	8.35
L.S.D. at 5%	1.83	

The results indicate in Table (31) that there was significant response of head number/ plant to phosphorus fertilizer in the local variety, and it was recorded the highest value 10.50 from the PDB. But in Aceitera variety it was noticed from the results that there was no response between all phosphorus treatments and the head number/plant. Also the results indicate that the two varieties had a significant effect on head number only when using PDB, Table (31).

2.3. Oil yield and chemical contents :

The effect of the interaction between varieties and phosphorus fertilizer did not significantly effect on the protein %, phosphorus %, oil % and oil yield kg/fed for both seasons.

3. Effect of the interaction between nitrogen and phosphorus fertilizer :

Table (32) indicate the survey of the interaction between nitrogen and phosphorus fertilizer on all characters of safflower plants in the two successive seasons 1994/1995 and 1995/1996.

3.1. Growth characters and petal yield :

Statistical analysis revealed that this interaction had significant effect in the first season only on stem fresh weight at 90 and 120 days as well as no. of leaves at 90 days from sowing while in the second one only the leaves dry weight at 60 and 90 days was significantly affected by the above interaction.

The stem fresh weight at age 90 days from sowing Table (33) was significantly affected by phosphorus fertilizer only with nitrogen fixation and when the plant received the high level of nitrogen (60 kg N/fed). On the other hand, this character was not affected by the different nitrogen

Table (30) : Effect of the interaction between varieties and phosphorus fertilizer on fresh and dry weight of petal yield (kg/fed) in the first season 1994/1995.

Varieties / Phosphorus	Fresh petal yield (kg/fed)		Dry petal yield (Kg/fed)	
	Giza 1	Aceitera	Giza 1	Aceitera
Zero	30.32	38.80	18.45	28.54
PDB	40.00	31.64	23.89	22.81
15.5 P_2O_5 kg/fed	44.56	35.50	24.68	22.77
31 kg P_2O_5/fed	36.56	35.32	21.86	23.43
L.S.D. at 5%	8.93		6.56	

Table (31) : Effect of the interaction between varieties and phosphorus fertilizer on head number/plant in the first season 1994/1995.

Varieties / Phosphorus	Giza 1	Aceitera
Zero	8.20	8.30
PDB	10.50	7.93
15.5 P_2O_5 kg/fed	9.10	8.33
31 kg P_2O_5/fed	9.08	8.20
L.S.D. at 5%	1.03	

Table (32) : Effect of the interaction between nitrogen and phosphorus on fertilizer on all studied characters in 1994/1995 and 1995/1996 seasons.

Characters	1994/1995			1995/1996		
	Days after sowing			Days after sowing		
	60	90	120	60	90	120
1. Growth characters and petal yield :						
Stem length (cm)	-	N.S.	N.S.	-	N.S.	N.S.
Stem diameter (cm)	-	N.S.	N.S.	-	N.S.	N.S.
No. of leaves/plant	N.S.	*	N.S.	N.S.	N.S.	N.S.
Leaf area cm^2	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Leaf area index	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Specific leaf weight (mg/cm^2)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
No. of leaves for head production	-	-	N.S.	-	-	N.S.
Leaf/stem ratio	-	N.S.	N.S.	-	N.S.	N.S.
Stem fresh weight (g)	-	*	*	-	N.S.	N.S.
Stem dry weight (g)	-	N.S.	N.S.	-	N.S.	N.S.
Leaves fresh weight (g)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Leaves dry weight (g)	N.S.	N.S.	N.S.	*	*	N.S.
Petal yield :						
Petal fresh weight (kg/fed)		N.S.			N.S.	
Petal dry weight (kg/fed)		N.S.			N.S.	
2. Seed yield and its components :						
No. of heads/plant		N.S.			N.S.	
Weight of head (g)		N.S.			N.S.	
Diameter of head (cm)		N.S.			N.S.	
No. of seeds/head		N.S.			N.S.	
Weight of seeds/head (g)		N.S.			N.S.	
Weight of 1000-seed (g)		N.S.			N.S.	
Seed yield (kg/fed)		N.S.			N.S.	
3. Oil yield and chemical contents :						
Protein %		N.S.			N.S.	
Phosphorus %		N.S.			N.S.	
Oil %		N.S.			N.S.	
Oil yield (kg/fed)		N.S.			N.S.	

Notes : N.S. and * mean that not significant and significant respectively.

treatment under all phosphorus treatments except at low level 15.5 P_2O_5 kg/fed, Table (33), whereas highest value was recorded from lower level of phosphorus supply (15.5 kg P_2O_5/fed) and using high level of nitrogen 60 kg N/fed.

With regard to data in Table (34), it reveals that the stem fresh weight at later age (120 days from planting) was significantly increased by raising mineral phosphorus at level 31 kg P_2O_5/fed under nil nitrogen and N-fixation. Under the low level of nitrogen (30 kg N/fed) using PDB recorded the high value but under the high level 60 kg N/fed there was no response between this character and phosphorus fertilizer. On the other hand, this character was significant affect by nitrogen application at all treatments of phosphorus except at high level (31 kg P_2O_5/ fed), it was recorded the highest value with nil nitrogen, Table (34).

Results in Table (35) indicate that the leaves number/plant were significantly increase by raising phosphorus supply from 15.5 to 31 kg P_2O_5/fed under nitrogen fixation. Also applying PDB increased the number of leaves under the two levels of nitrogen application. The high values were recorded by applying N-fixation and 31 kg P_2O_5/fed followed by PDB with the two levels of nitrogen.

Concerning the leaves dry weight Table (36) at age 60 days from sowing in the second season the obtained results reveal that this character was significantly increased by the two mineral phosphorus supply only under control (without nitrogen) and with 60 kg N/fed, Table (36).

At the age of 90 days from planting Table (37), it is noticed that the highest value of leaves dry weight (2.61) was recorded by PDB under the high level of nitrogen supply (60 kg N/fed). On the other hand, the trend of

Table (33) : Effect of the interaction between nitrogen and phosphorus fertilizer on stem fresh weight/plant (g) at 90 days from sowing in the first season 1994/1995.

Nitrogen / Phosphorus	Zero	N-fixation	30 kg N/fed	60 kg N/fed
Zero	22.90	18.71	18.21	26.71
PDB	20.57	20.83	28.81	29.43
15.5 P_2O_5 kg/fed	17.05	16.74	24.19	47.57
31 kg P_2O_5/fed	19.83	30.03	20.49	27.34
L.S.D. at 5%	11.92			

Table (34) : Effect of the interaction between nitrogen and phosphorus fertilizer on stem fresh weight/plant (g) at 120 days from sowing in the first season 1994/1995.

Nitrogen / Phosphorus	Zero	N-fixation	30 kg N/fed	60 kg N/fed
Zero	91.44	60.82	95.20	129.03
PDB	84.70	96.30	131.05	110.04
15.5 P_2O_5 kg/fed	67.50	94.70	87.21	119.77
31 kg P_2O_5/fed	145.00	115.00	89.90	118.87
L.S.D. at 5%	30.81			

Table (35) : Effect of the interaction between nitrogen and phosphorus fertilizer on leaves number at 90 days from sowing in the first season 1994/1995.

Nitrogen / Phosphorus	Zero	N-fixation	30 kg N/fed	60 kg N/fed
Zero	15.16	16.16	16.16	14.50
PDB	15.66	17.33	20.33	20.60
15.5 P_2O_5 kg/fed	16.91	17.50	15.50	19.58
31 kg P_2O_5/fed	16.66	21.00	15.00	19.00
L.S.D. at 5%	3.53			

Table (36) : Effect of the interaction between nitrogen and phosphorus fertilizer on leaves dry weight/plant (g) at 60 days from sowing in the second season 1995/1996.

Nitrogen / Phosphorus	Zero	N-fixation	30 kg N/fed	60 kg N/fed
Zero	0.73	0.50	0.46	0.48
PDB	0.60	0.32	0.39	0.64
15.5 P_2O_5 kg/fed	0.67	0.58	0.42	0.85
31 kg P_2O_5/fed	0.83	0.46	0.49	0.55
L.S.D. at 5%	0.27			

dry weight of leaves tended to increase by raising nitrogen supply from zero to 60 kg N/fed at all phosphorus treatments. Generally these results are in agreement with those obtained by **Ahmed *et al.*, (1985), Sary *et al.*, (1987), El-Afandy (1990), Refaat, Azza *et al.*, (1993)** and **Petal *et al.*, (1995)**, who found that interaction (N x P) had a significant effect on some growth characters.

3.2. Seed yield and its components :

This interaction had no effect on seed yield and its components. These results are agreement with those obtained by **Sagare *et al.*, (1986)** and **Refaat, Azza *et al.*, (1993)**. The opposite results were obtained by **Ahmed *et al.*, (1985), Zaman (1989), Abo-Shetaia (1990), El-Nakhlawy (1991), Purvimath *et al.*, (1993), Mane and Jadhav (1994) and Ekshinge *et al.*, (1995)**. They found that the seed yield and some its components were affected by the above interaction.

3.3. Oil yield and chemical contents :

The effect of this interaction was not significant on protein %, phosphorus %, oil % and oil yield kg/fed. Different results were obtained by **Sagare *et al.* (1986), Ekshinge *et al.*, (1993), Purvimath *et al.*, (1993), and Patel *et al.*, (1995)**.

4. Effect of the interaction among varieties, nitrogen and phosphorus fertilziers :

Table (38) indicate the survey of the interaction between varieties, nitrogen and phosphorus fertilizers on all characters of safflower plants in the two successive seasons 1994/1995 and 1995/1996.

4.1. Growth characters and petal yield :

The results in Table (39 & 40) indicate that the second order interaction (V x N x P) had a significant effect only on specific leaf weight at 120 days from sowing in the second season and the stem fresh weight at the same age in the first one.

The highest value of specific leaf weight (7.75) was recorded when the local variety (Giza 1) received 30 kg N/fed under phosphate dissolving bacteria followed by the exotic one under control treatment (without N or P fertilizer) and when plants fertilized by N-fixation under 31 kg P_2O_5/fed. On the other hand, the lowest value 3.52 and 3.91 were resulted from local variety by applying N-fixation and without phosphorus fertilization and exotic one under control treatment (without N and P fertilizer) respectively.

With regard to the result in Table (40), it is clear that the fresh weight of stem and branches were significantly increased by raising phosphorus up to 31 kg P_2O_5/fed under nitrogen fixation for local variety which recorded the highest value (144.0), while in exotic variety produced the highest value (192.14) by applying 31 kg P_2O_5/fed and without nitrogen fertilization. On the other hand, the above character was not affected by nitrogen at all phosphorus treatments except at 31 kg P_2O_5/fed for two varieties and without phosphorus with Aceitera Table (40).

4.2. Seed yield and its components :

The above interaction had no significant effect on seed yield and its components for both seasons.

4.3. Oil yield and chemical contents :

The second order interaction had no significant effect on protein %, phosphorus %, oil %, and oil yield kg/fed for both seasons.

Table (38) : Effect of the interaction among varieties, nitrogen and phosphorus fertilizer on all studied characters in 1994/1995 and 1995/1996 seasons.

Characters	1994/1995			1995/1996		
	Days after sowing			Days after sowing		
	60	90	120	60	90	120
1. Growth characters and petal yield :						
Stem length (cm)	-	N.S.	N.S.	-	N.S.	N.S.
Stem diameter (cm)	-	N.S.	N.S.	-	N.S.	N.S.
No. of leaves/plant	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Leaf area cm^2	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Leaf area index	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Specific leaf weight (mg/cm^2)	N.S.	N.S.	N.S.	N.S.	N.S.	*
No. of leaves for head production	-	-	N.S.	-	-	N.S.
Leaf/stem ratio	-	N.S.	N.S.	-	N.S.	N.S.
Stem fresh weight (g)	-	N.S.	*	-	N.S.	N.S.
Stem dry weight (g)	-	N.S.	N.S.	-	N.S.	N.S.
Leaves fresh weight (g)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Leaves dry weight (g)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Petal yield :						
Petal fresh weight (kg/fed)		N.S.			N.S.	
Petal dry weight (kg/fed)		N.S.			N.S.	
2. Seed yield and its components :						
No. of heads/plant		N.S.			N.S.	
Weight of head (g)		N.S.			N.S.	
Diameter of head (cm)		N.S.			N.S.	
No. of seeds/head		N.S.			N.S.	
Weight of seeds/head (g)		N.S.			N.S.	
Weight of 1000-seed (g)		N.S.			N.S.	
Seed yield kg/fed		N.S.			N.S.	
3. Oil yield and chemical contents :						
Protein %		N.S.			N.S.	
Phosphorus %		N.S.			N.S.	
Oil %		N.S.			N.S.	
Oil yield (kg/fed)		N.S.			N.S.	

Notes : N.S. and * mean that not significant and significant respectively.

Table (39) : Effect of the interaction among varieties, nitrogen and phosphorus fertilizer on specific leaf weight (mg/cm^2) at 120 days from sowing in the second season 1995/1996.

Varieties	Giza 1				Aceitera			
Nitrogen / Phosphorus	Zero	N-fixation	30 kg N/fed	60 kg N/fed	Zero	N-fixation	30 kg N/fed	60 kg N/fed
Zero	6.12	3.52	6.20	4.06	3.91	5.77	4.16	4.79
PDB	5.21	4.71	7.75	5.10	4.63	6.19	5.39	5.00
15.5 kg P_2O_5/fed	5.47	4.32	5.19	6.33	3.06	3.30	6.07	4.21
31 kg P_2O_5/fed	4.19	4.04	5.35	4.24	7.63	7.30	4.09	4.84
L.S.D. at 5%	2.21							

Table (40) : Effect of the interaction among varieties, nitrogen and phosphorus fertilizer on fresh weight of stem and branches (g) at 120 days from sowing in the first season 1994/1995.

Varieties	Giza 1				Aceitera			
Nitrogen / Phosphorus	Zero	N-fixation	30 kg N/fed	60 kg N/fed	Zero	N-fixation	30 kg N/fed	60 kg N/fed
Zero	87.13	68.50	65.17	90.26	95.66	65.24	125.22	167.86
PDB	67.15	80.67	116.31	101.47	102.33	111.99	151.70	119.47
15.5 kg P_2O_5/fed	62.33	84.50	97.39	89.87	72.74	105.03	77.02	49.66
31 kg P_2O_5/fed	99.00	144.00	72.67	81.08	192.14	87.71	107.19	156.66
L.S.D. at 5% level	54.61							

SUMMARY

SUMMARY

One field experiment was carried out at Mariut Research Station, Desert Research Center, Egypt during the two successive seasons 1994/1995 and 1995/1996 to evaluate two safflower (*Carthamus tinctorius* L.) varieties under different levels of mineral nitrogen and phosphorus and bio-fertilizer (nitrogen fixation and phosphate dissolving bacteria).

The soil of the experiments is calcareous (27.06% $CaCO_3$) with a sandy loam texture, a very low organic matter content (0.37) and pH value (8.20).

Each experiment included 32 treatments which were the combination between the two varieties (Giza 1 and Aceitera), four treatments of nitrogen (zero, biofertilizer, 30 and 60 kg N/fed) as ammonium sulphate 20.6% N and four treatments of phosphorus (zero, biofertilizer, 15.5 and 31.0 kg P_2O_5/fed) as calcium superphosphate.

The experimental design was split-split plot with four replication, where the two varieties were arranged at random in main plot, the levels of nitrogen were assigned at random within the sub-plot, while the P-levels were randomly distributed in the sub-sub plots. The sub-sub plot area was 10.5 m^2.

Results could be summarized as follows :

I. Effect of Varieties :

1. Growth characters and petal yield :

1. The two varieties (Giza 1 and Aceitera) showed no significant differences in stem length and stem diameter in both successive seasons except at 120 days in the second one. The local variety (Giza 1) was