RESULTS AND DISCUSSION

FIRST EXPERIMENT :

I. Effect of Irrigation Treatments on Vegetative Growth and Flowering:

I.1. Mean height of plants :

Data presented in Table (1) show the mean length of safflower plant when treated with different levels of irrigation during the two seasons of experimentation. These data cleared that all irrigation treatments significantly increased the mean plant height over control plant for both seasons. Plant irrigated with 37.5% F.C. were significantly taller than both control or those irrigated with 50% and 75% F.C. While with the second season there were no significant differences between mean length of plants when treated with different levels of irrigation. Although all irrigation levels produced significantly taller plants than control ones. These results were in agreement with those obtained by Andhal and Kalbhor (1978) who noticed that the characteristics of sunflower were unaffected with irrigation schedule. Also Mekki (1984) found that plant height was not affected by irrigation at depletion of 40, 60 and 80% of available soil moisture.

Table (1): Effect of some irrigation treatments on the mean height of safflower (Carthamus tinctorius-L.) plant in metter during 1985 and 1986 seasons.

Treat.	Mean height of plant in (m) (1985)					Mean height of plant in (m) (1986)				
Source	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean
Swiss	1.59	1.61	1.50	1.30	1.50	1.73	1.65	1.43	1.44	1.56
Portuges	1.65	1.66	1.65	1.45	1.60	1.85	1.68	1.78	1.51	1.70
Giza I	1.68	1.57	1.70	1.20	1.53	1.36	1.54	1.73	1.53	1.54
Mean	1.64	1.61	1.61	1.31		1.64	1.62	1.64	1.49	
L.S.D. at 5 % for treat.				0.03					0.05	
L.S.D. at 5 % for sources				0.02					0.04	
L.S.D. at 5 % for source X treat.				0.03					0.07	

Concerning the different plant sources, the tallest plants were obtained with the exotic Portuges plant source which reached 1.60 m mean length while it was 1.50 and 1.53 m for each of the exotic source Swiss and the local var. Giza I in the first season. The same trend of results was also found with the data of the second season, since Portuges plants reached mean height of 1.70 meter while it was 1.56 m. and 1.54 m for each of Swiss and Giza I. It is clear that Portugese was always superior in its height over the other sources.

The obtained results agreed with those found by Khater et al. (1988) who found that Portugese safflower was the tallest one followed by Swiss and Egyptian sources respectively.

For the compound effect of different rates of irrigation and different plants sources of safflower.

It is clear that the trend of results was not constant in the two seasons, Giza I var. produced the tallest plants when irrigated at the level of 75% F.C. in both seasons with significant increase over plants of the same source irrigated at 37.5% or 50% F.C. Portuges source seemed to be unaffected with different irrigation rates in the first season, the mean length of plant was 1.65, 1.66 and 1.65 for 37.5%, 50% and 75% F.C. levels of irrigation

respectivley. While it was completly differed in the second season when Portuges plants produced mean length of 1.85 m. when irrigated at the level of 37.5% F.C. with an increase of 34 cm. over control plant (100% F.C.) and significantly increase over the same source treated at 50% and 75% F.C. The least effect of interaction between the different plant source and different levels of irrigation on the mean height of plant was shown with the exotic source Swiss specially in the first season, when the mean length of plants for the different levels of irrigation were 1.59, 1.61 and 1.50 m. for plant treated with 37.5%, 50% and 75% F.C. compared with 1.30 for control plants (100% F.C.).

With regard to the second season the interaction effect with Swiss source differs so the lowest irrigation level of 37.5% F.C. produced the tallest plant with significant increases over all other treatment, and control plant. From the previous data it is clear that moderate irrigation with adequate water produced plants taller than normal irrigation.

Although plant height of safflower plant of no economic value, but it indicates good vegetative growth and healthy plant of good production. Many workers stated that water stress decreased plant height of sunflower among them Lovett and Desnce (1973), Sionit et al (1973), Savalescu (1976) and Sionit (1977).

I.2. Mean number of branches :

The mean number of branches per plant recorded in Table (2) for the two seasons of this investigation show that with both seasons water regime affected clearly the mean number of branches carried by plant.

The low rate of irrigation 37.5% F.C. decreased the mean number of branches per plant than normal irrigation (100% F.C.) although the decrease was not significant in the first season.

Medium and high rates of 50% and 75% F.C. increased significantly the number of branches over control plants (normal irrigation). The difference between the mean number of branches produced by plants irrigated at 50% F.C. and those irrigated at 75% F.C. was not constant for the two years, although these two treatments stay superior in this respect over each of control or the 37.5% F.C. irrigated plants for both seasons. These results came in accordance with those obtained by Abd El-Hady (1983) on capsicum sp., he found that maximum amount of water gave the least number of branches. Also, Mekki (1990) on rape observed less number of branches per plant by water stress.

Comparing the different soruces under study it is clear that the exotic source Swiss and Portugese produced

Table (2) : Effect of some irrigation treatments on the mean number of branches/safflower (Carthamus tinctorius L.) plant during 1985 and 1986 seasons.

Treat.	Mean No. of branches/plant (1985)					Mean No. of branches/plant (1986)				
Source	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean
Swiss	13.6	14.5	14.5	13.4	14.0	15.3	15.3	15.3	17.0	15.72
Portuges	12.1	15.2	15.9	14.0	14.3	13.6	20.3	22.3	22.0	19.47
Giza I	11.3	15.2	13.8	11.8	13.03	14.3	20.0	20.0	14.3	17.22
Mean	12.3	14.9	14.73	13.06		14.4	18.53	19.2	17.76	
L.S.D. at 5 % for Treat,					1.22					1.23
L.S.D. at 5 % for Source					0.07					1.05
L.S.D. at 5 % for Source X Treat.					1.34					2.10

significantly more number of branches per plant over the local var. Giza I during (1986) season. While data of the second season show that Giza I var. gave more number of branches per plant were signfiicantly increased than the exotic source Swiss but still Portuges superior over all the other sources under study with high significant increase in the mean number of branches per plant for both seasons of experimentation. These results were in agreement with those recorded by Khater et al. (1988) who found that Portugese safflower characterized by higher number of branches.

Concerning the compound effect of water regime and different sources of safflower it is clear that the Portugeseunder the different level of irrigation was always superior in the mean number of branches per plant especially when treated at the level of 75% F.C. These results were clearly noticed in the data of both season. Swiss cultivar seemed to be unaffected by the different levels of irrigation concerning the number of branches. While Giza I var. produced significantly less number of branches when the low level of irrigation 37.5% F.C. was used. The trend of results was nearly the same with both seasons. As a final results it could be concluded that Portugese source gave the highest number of branches at irrigation level of 75% F.C. which reached 22.3 branches per plant, while the least number produced by Giza I when

irrigated at the low level of 37.5% F.C., Many investigators pointed out that the role of moderate irrigation in producing good vegetative growth, among them Richards and Wadleigh (1952) and Stonhill (1957) on sufflower they reported that there was a decrease in plant growth with decreasing soil water.

Effect of different level of irrigation on flowering:

I.3. Number of flowers/plant :

The mean number of flower/plant presented in Table (3) show that the irrigation level of (50% F.C.) seemed to increase the number of flowers/plant over both control plant or each of the other levels of irrigation used, although the increase was not significant regarding to the high level of 75% or 100% F.C. However, it was significant when compared to the low irrigation level of (37.5% F.C.). The least number of flower/plant produced with the lowest level of irrigation which was significantly decreased than all other treatments.

With the data of second season the medium level of irrigation (50% F.C.) came also as the first treatment produced the highest number of flowers/plant with significant increase over control or other treatments (37.5% and 75% F.C.). The low and high levels of irrigation produced less number of flower/plant under control and this was true also with the data of the first season.

Table (3): Effect of some irrigation treatments on the mean number of flower heads of safflower (Carthamus tinctorious L.) plant during 1985 and 1986 seasons.

Treat. / Sources	Mean No. of flower heads/plant (1985)					Mean No. of flower heads/plant (1986)				
	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean
Swiss	35.3	49.6	48.6	53.3	46.7	46.6	62.3	46.0	49.0	50.97
Portuges	37.3	57.6	55.0	55.0	51.22	52.0	65.0	50.3	54.0	55.32
Giza I	42.0	58.0	49.3	51.6	50.22	45.0	60.0	44.3	49.0	49.59
Mean	38.2	55.06	50.96	53.3		48.06	62.0	46.86	50.6	
L.S.D. at 5 % for Treat.				8.49					4.94	
L.S.D. at 5 % for Sources				2.72					3.95	
L.S.D. at 5 % for Source X Treat.				N.S					N.S	

The present data (number of flower/plant) come at the same trend with the previous data of mean number of branches/plant which reflect the habit of this plant. Also, many workers observed the effect of irrigation on flower production among them Berenyi (1970), Somogyi (1974), Strelec and Cerna (1976) and Abd El-Hady (1983) on capsicum, Hussein et al. (1984) on cotton and Ali (1990) who concluded that increasing irrigation level sig.increased the mean number of flowers carried by plant.

Concerning the different sources of the plant in this study, it could be noticed from the data in Table (3) of both seasons that the exotic source Portugese was the top of the other sources in producing the highest number of flower per plant. The superiority of Portugese in producing more number of flower per plant over the others Swiss or Giza I var. was significantly only in the second season, but it was significant over Swiss source only in the first one. These results was in agreement with those obtained by Khater et al (1988) on safflower who found that the number of flower per plant was significantly higher in Portugese safflower than the other sources (Swiss and Egyptian).

The interaction effect, of different irrigation level with different sources under study as appears from the data in Table (3) show that all sources produced the

highest number of flower per plant when treated with the medium level of irrigation, and this was constant with the two seasons. This increase in the number of flower per plant of this level over the others was very clear and highly significant. Moreover, the highest mean number of flower per plant in the first season obtained by the local var. Giza I at the level of (50% F.C.) followed by the exotic sources Portugese in the first season. While the highest values for number of flower per plant in the second season were produced by Portugese followed by the exotic source Swiss. Also all sources produced the least number of flowers per plant when treated with the lower level of irrigation. The decrease in this case was always cleare and significant comparing with control or other treatment specially with Swiss and Portuges in the first season and Swiss and Giza I in the second one.

These data came in a similar trend previously found with the data of mean number of branches per plant, since the flower heads of safflower plant carried at the ends of the main or secondary branches.

I.4.Mean weight of petals/flower :

Mean weight of petals/flower as affected by different irrigation treatments were compiled in Table (4) which gave no constant trend with the two season.

Table (4): Effect of some irrigation treatments on the mean weight of petal produced by one flower head of safflower (*Carthamus tinctorius* L.) plant during 1985 and 1986 seasons.

Treat.	Mean weight of petals/one flower head (gm) (1985)					Mean weight of petal/one flower head (gm) (1986)				
Source	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean	37.5 % F.C.	50 % F.C.	75 % F..C	100 % F.C	Mean
Swiss	0.135	0.116	0.116	0.102	0.117	0.118	0.113	0.066	0.063	0.09
Portugese	0.144	0.133	0.135	0.174	0.147	0.132	0.153	0.150	0.166	0.150
Giza I	0.128	0.109	0.112	0.121	0.117	0.123	0.102	0.128	0.105	0.114
Mean	0.136	0.119	0.121	0.132		0.124	0.122	0.114	0.111	
L.S.D. at 5 % for treat.			0.011					N.S.		
L.S.D. at 5 % for Sources			0.008					0.014		
L.S.D. at 5 % for Soruce X Treat.			0.017					0.029		

Although the weight of dry petal tended to increase as the level of irrigation decreased, the lowest level of irrigation (37.5% F.C.) produced the highest value of petals dry weight/flower than those obtained by the medium or high levels with significant increase. The lowest level of irrigation increased the weight of petal/flower over control plant however not significant. The difference between the medium level of irrigation and the high one in producing petals/flower was not at the same trend in both seasons.

These results came in accordance with those observed by O'sullivan (1979), Palevitch et al. (1980) and Menagem et al. (1981), on capsicum, Hussein et al. (1984) on cotton.

Concerning the different sources, it is clear that Portuges came as the first type in producing the highest mean weight of dry petal/flower in both seasons. The increase over both Swiss or Giza 1 in this concern was significant in both seasons.

It could be noticed that Portugese was almost superior in the prementioned characters also, and this mean that Portugese characterized by strong growth resulted in good and more flowering. Giza I followed Portugese while Swiss came at least in its mean weight of petal per one flower

throughout the two seasons 1985 and 1986, since the mean weight of petals per flower was 0.147, 0.117 and 0.117 for the first season and it was 0.150, 0.114 and 0.090 in the second for Portugese,Giza I and Swiss respectively.

Concerning the compound effect between irrigation and different sources of safflower it could be noticed that the exotic source Swiss under the lowest level of irrigation (37.5% F.C.) produced the highest weight of petal per flower in both seasons while Portugese gave the highest weight of petal per flower with normal irrigation in both seasons. This indecated that Portugese need adequate water for its more vegetative growth than the local variety Giza I which produced the highest weight of petal per flower with the lowest level of irrigation.

I.5. Mean weight of petals/plant :

Yearly yield of petal per plant counted from the successive pickings of petals of the whole flower heads produced per plant was reported in Table (5), clear that the different irrigation treatments have no great effect on the total yearly yield of petal per plant except with the lowest level (37.5% F.C.) which signfiicantly decreased this yield under all other treatments in the first season. However, plants treated with both 50% or 70% of F.C. gave the same yield of petals which was decreased than control

Table (5): Effect of some irrigaiton treatments on the mean yearly yield of petal produced by safflower (Carthomus tinctorius L.) plant during 1985 and 1986 seasons.

Treat. / Source	Mean weight of petal/plant in (gm) (1985)					Mean weight of petal/plant in (gm) (1986)				
	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean
Swiss	4.78	5.72	5.61	5.42	5.38	5.48	7.02	3.05	3.05	4.65
Portuges	5.46	7.05	7.30	9.55	7.34	6.84	9.86	8.26	8.11	8.26
Giza I	5.69	5.69	5.54	6.24	5.79	5.8	6.08	5.72	5.21	5.70
Mean	5.31	6.15	6.15	6.73		6.04	5.65	5.67	5.45	
L.S.D. at 5 % for Treat.			0.837					0.661		
L.S.D. at 5 % for Source			0.568					0.843		
L.S.D. at 5 % for Source X Treat.			1.130					1.680		

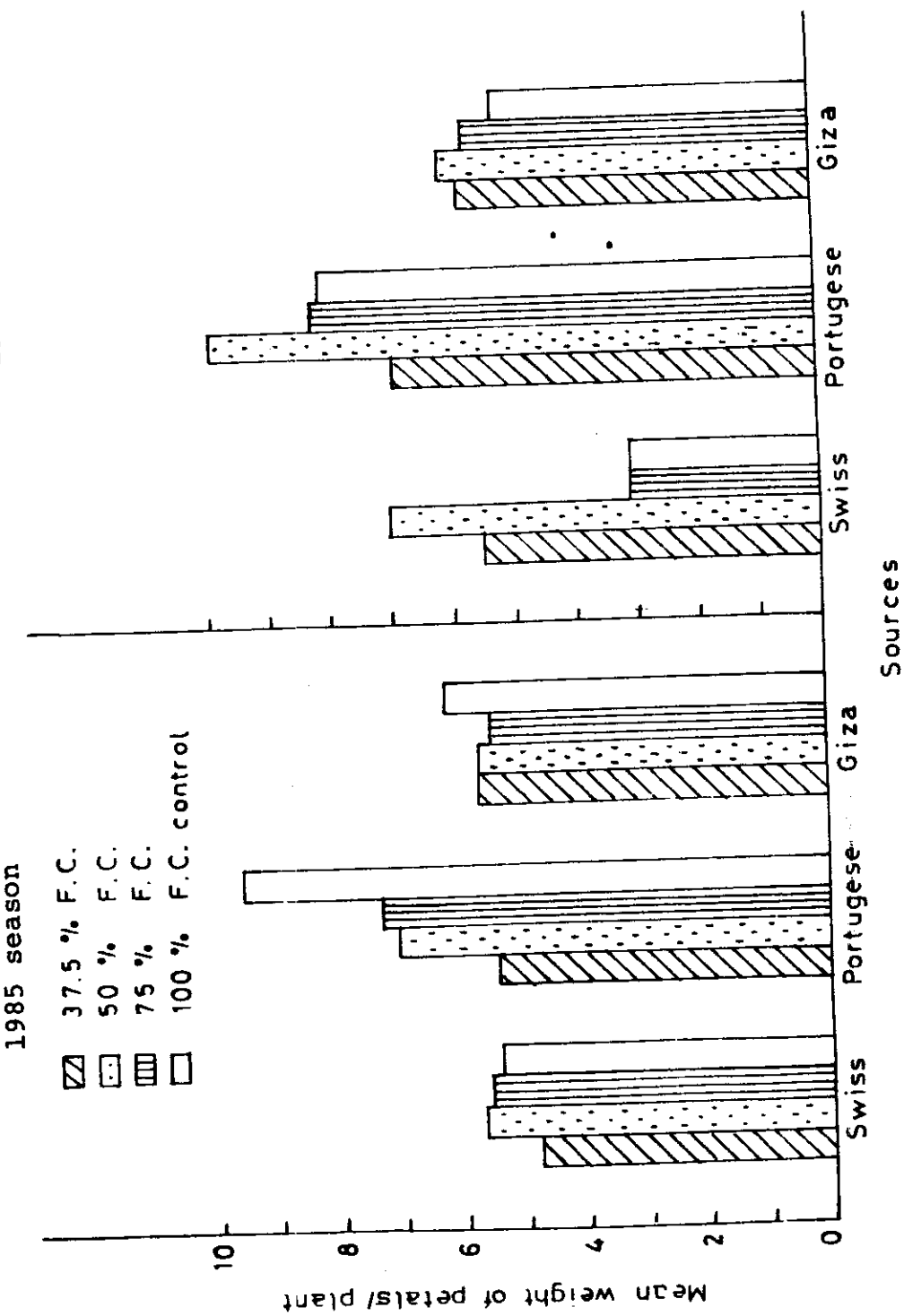

Fig. (1): Effect of some irrigation treatments on the mean weight of petal produced by safflower (carthamus tinctorius L) plants during 1985 and 1986 seasons.

(100 % F.C.) although the decrease was not significant.

In the second season oppsite trend of results was found with the lowest level of irrigation and control one, since the lowest level of irrigation produced yield of petals more than control (100% F.C.). While the medium and high levels still at the same trend with first season.

This unconstant trend may be due to that yield of petal resulted from of two different characters (number of flowers and weight of petals per flower) which affected with the levels of irrigation used in different ways.

The different genotype of safflower under study differed greatly in their yield of petal per plant as shown in Table(5), Fig.(1). The exotic genotype Portugese produced total yield of petals per plant significantly increased over both the other exotic (Swiss) or the local var. Giza I. The later produced yield of petal per plant increased over Swiss although the increase was not significant in the first season. The total yield of petals per plant were 7.34, 5.79 and 5.38 gms for Portugese, Giza I and Swiss and it were 8.26, 5.70 and 4.65 gms for the second season. The trend of results was nearly the same in both seasons concerning the yield of petals per plant.

It could be concluded that the superiority of Portugese in its yield of petals per plant came as a result of its

more number of flower head per plant and higher weight of petals per flower over both Giza I or Swiss.

Although the interaction effect between irrigation levels used and different genotype under study in concern with the yield of petals per plant was not at the same trend in both seasons as shown in Table (5), but it could be generally noticed that Portugese produced the most promoting effect in the yield of petals per plant with increasing the level of irrigation, and this was more clear with data of the first season. The highest values of mean yield of petals per plant obtained with Portugese plant irrigated at the level of (100% F.C.) in the first season and 50% F.C. in the second season. The lowest values of yield of petals per plant obtained by Swiss when irrigated at the level of 37.5% F.C. in the first season and when irrigated at the levels of 75% or 100% F.C. in the second season.

The promoting or reductive effect of high or low levels of irrigation on any genotype and its response to the different levels of irrigation must be due to its own needs of water and its durability to drought which related to genetic factors.

I.6. Mean weight of seeds/flower head :

Data in Table (6) presented mean weight of seeds/flower head clear that moderate irrigation promoted seed formation by flower head. The medium and high levels of irrigation 50% and 75%F.C.significantly weight of seeds/flower significantly increased over the low level (37.5% F.C.) and normal irrigation 100% F.C. The data also indecate that the production of seeds per flower significantly decreased by deficit irrigation, since the lowest level of irrigation (37.5% F.C.) produced the least mean weight of seeds with significant decrease under all other treatments. Similar trend was also observed with the data of second season except with the plants treated at the level of (75% F.C.) which produced weight of seeds/flower increased significantly over the (37.5% F.C.) treated plants.

These results are agreement with the results obtained by Pal and Yadav (1974), Osman and Talha (1975), Radford (1978), Rowson and Turner (1982) Pranty (1983) and Giordano and D'Amoto (1984) all of them reported that the seed yield of sunflower increased by increasing irrigation.

Concerning the production of seeds by flower of the different genotypes (sources) of safflower udner study, it could be noticed from the data in Table (6) that the exotic genotype (sources) Portugese produced the highest

Table (6): Effect of some irrigation treatments on the mean weight of seeds produced by one flower head of safflower (Carthamus tinctorius L.) plant during 1985 and 1986 seasons.

Treat.	Mean weight of seeds/one flower head in (gm) (1985)					Mean weight of seeds/ one flower head in (gm) (1986)				
Source	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean
Swiss	0.43	0.73	0.66	0.51	0.58	0.50	0.78	0.97	0.40	0.66
Portuges	0.52	0.99	0.85	0.76	0.78	0.61	0.95	1.16	0.92	0.91
Giza I	0.69	0.47	0.72	0.64	0.63	0.58	0.52	0.73	0.63	0.61
Mean	0.54	0.73	0.74	0.63		0.56	0.75	0.95	0.65	
L.S.D. at 5 % for Treat.			0.06					0.10		
L.S.D. at 5 % for Sources			0.04					0.04		
L.S.D. at 5 % for Source X Treat.			0.09					0.09		

weight of seeds/flower head with significant increase over both local variety Giza I or the other exotic genotype Swiss in the two seasons of the experiment. The local variety Giza I came after Portugese in producing higher weight of seeds/ flower head with significant increase over Swiss genotype in the first season. The opposite trend of results was found in the second season (1986) concerning the Giza I and Swiss, since the mean weights of seeds/flower head were 0.58, 0.78 and 0.36 in the first season and 0.66, 0.91 and 0.61 gm. in the second season for Swiss, Portugese and Giza I respectivley.

These results were in agreement with those obtained by Khater et al. (1988) who showed that the mean weight of 1000 seeds of Portugese safflower seeds had higher value than Swiss and Egyptian safflower.

The interaction effect between the different levels of irrigation and the different source (genotype) gave pronounced results in increasing the mean weight of seed per flower in most cases. The largest effect of this interaction was noticed with Portugese at the irrigation levels 50% and 75% F.C. throughout the two season. Since it produced weight of seeds per flower increased greatly over all other treatments, so that it reached twice or one and half times as much as it compared with the other.

The least values of seeds weight per flower were obtained by Swiss and Giza I at the irrigation level 37.5% F.C. as shown in Table (6) in both seasons.

It could be concluded that Portagese produced the best results concer the mean weight of seed per flower over other sources, especially with moderate irrigation levels.

This may be attributed to its strong vegetative growth and flower yield previously recorded, and was also recorded by Khater (1988).

I.7. Mean weight of seed/plant :

Table (7) seed yield/plant was greatly promoted by moderate irrigation, hence the medium and high levels of 50% F.C. and 75% F.C. produced higher seed yield/plant over both the low level 37.5% or the normal irrigation 100% F.C. Although the difference between the high level 75% F..C and control 100% F.C. was not significant concerning seed yield/plant, but it was significantly increased over control, when it was compared with the medium level 50% F.C. The later level produced seed yield reached more than twice as much as that produced by plant treated with the low level 37.5% F.C. as shown in Table (7). The data of the second season show similar trend of results, while medium and high levels of irrigation 50% F.C. and

Table (7): Effect of some irrigation treatments on the mean weight of seeds/one safflower (Carthamus tinctorius L.) plant during 1985 and 1986 seasons.

Treat. / Sources	Mean weight of seeds/plant (gm) (1985)					Mean weight of seeds/plant (gm) (1986)				
	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean
Swiss	15.18	36.57	32.26	25.73	27.43	23.08	50.50	44.63	19.36	34.39
Portuges	19.40	57.18	44.91	42.24	40.93	31.60	61.85	58.66	49.80	50.47
Giza I	19.38	27.60	34.16	33.35	28.67	27.63	30.93	30.93	31.20	30.17
Mean	17.98	40.45	37.11	33.77		27.43	44.74	44.74	33.45	
L.S.D. at 5 % for Treat.				4.97				4.32		
L.S.D. at 5 % for Sources				3.21				2.80		
L.S.D. at 5 % for Sources X Treat.				6.43				5.60		

75% F.C. produced the same yield of seeds/plant which was significantly increased over control 100% F.C. These results were in agreement with those obtained by Pal and Yadav (1974) on sunflower who declared that seed yield increased by increasing available moisture up to 60 L level. Also Al Refaie (1986) on soybean found that irrigation at 50 L moisture depletion gave the best seed yield.

Concerning the different genotype (source) and its seed yield/plant, data in Table (7) showed that the Portugese genotype (source) was highly superior in its seed yield/plant over the two other genotypes (source). So the seed yield of Portugese plant reached nearly one and half that produced by Swiss or Giza I plants in the first season (1985) and more than that with the second season. The seed yield/plant for these three genotype (sources) were 40.93, 27.43 and 28.67 gm in the first season and 50.47, 34.39 and 30.17 gm in the second one for Portugese, Swiss and Giza I respectively. These results were in agreement with those obtained by Khater (1988) who recorded that highly significantly increase in seed yield per plant was Portugese safflower than the other sources Swiss and Egyptian.

The interaction between different rates of irrigation and different genotypes (sources) of safflower plants was

of good effect in reflecting the superiority of Portugese under the moderate levels of irrigation, since Portugese plants produced seed yield/plant when supplied with the moderate level of 50% F.C. significantly increased over the two other genotypes at any of irrigation rates under study, in both seasons of these experiments. The same genotype combined with the high level of water 75% F.C. produced also higher seed yield over the other genotypes (sources) at any level of irrigation although not significant in some cases.

It could be shown also that Swiss and Giza I reflect good response to regulation of irrigation rates in producing more seed yield/plant, but not to the depletion of irrigation to the limit of 37.5% F.C. which reduced greatly the seed yield/plant to nearly half its value of the medium rate of 50% F.C. in most cases. Later this may be attributed to low rate of biosynthesis due to the depletion of water in plant tissue reflected lower plant growth and flowering showed in the previous results. These results came in accordance with Deshmukh and Srivastava (1982), Cheng (1984) on sunflower and Mikki (1990) on rape they found that seed yield was decreased by less water treatments. On the other hand Rowson and Turner (1982), D'Amato and Giordano (1983) Prunty (1983) and Giordano and D'Amato (1984) all of them working on sunflower plant and observed that seed yield increased when irrigation rate increased.

II. Effect of irrigation treatment on chemical composition:

II.1. Oil percentage :

Percentage of oil in safflower seed was clearly affected by regulation of irrigation water. Date in Table (8), Fig. (2) Show that oil percentage of seeds was significantly increased when medium level of irrigation (50% F.C.) was used over both control 100% F.C. and other irrigation treatments low 37.5% F.C. or high 75% F.C. No clear difference could be seen in the mean percentage of oil when the rate of irrigation was decreased from the normal control 100% F.C. to the high rate 75% F.C. However, decrease in oil percent of seed was noticed when the rate of irrigation decreased to low level 37.5% F.C. Many workers observed the effect of irrigation on oil content among them Sionit et al. (1973), El-Hinnawy et al. (1981) and Cheng (1984). They mentioned that oil content was decreased by low water treatment. Also, Karami (1977) and Kandil (1984) declared that seed oil content decreased as irrigation intervals increased.

The percentage of oil in the different genotypes (sources) was clearly differed. The highest mean percentage of oil was obtained in Portugese one with signficant increase over both Swiss and Giza I. Also,

Table (8): Effect of some irrigation treatments on oil percentage and oil yield of safflower (Carthamus tinctorius L.) seed during 1986 season.

Treat.	Oil percentage %					Oil yield /plant (gm)				
Source	37.5 F.C.	50 F.C.	75 F.C.	100 F.C.	Mean	37.5 F.C.	50 F.C.	75 F.C.	100 FCC.	Mean
Swiss	29	37	34	27	31.75	4.39	13.54	11.10	6.95	8.99
Portuges	34	41	35	39	37.25	6.58	23.66	15.65	16.98	15.71
Giza I	33	35	32	34	33.50	9.70	9.66	10.87	11.34	10.39
Mean	32.0	37.6	33.6	33.3		6.89	15.62	12.54	11.75	
L.S.D. at 5 % for treat,			3.68					2.64		
L.S.D. at 5 % for source			1.27					1.33		
L.S.D. at 5 % for source X treat.			4.81					2.66		

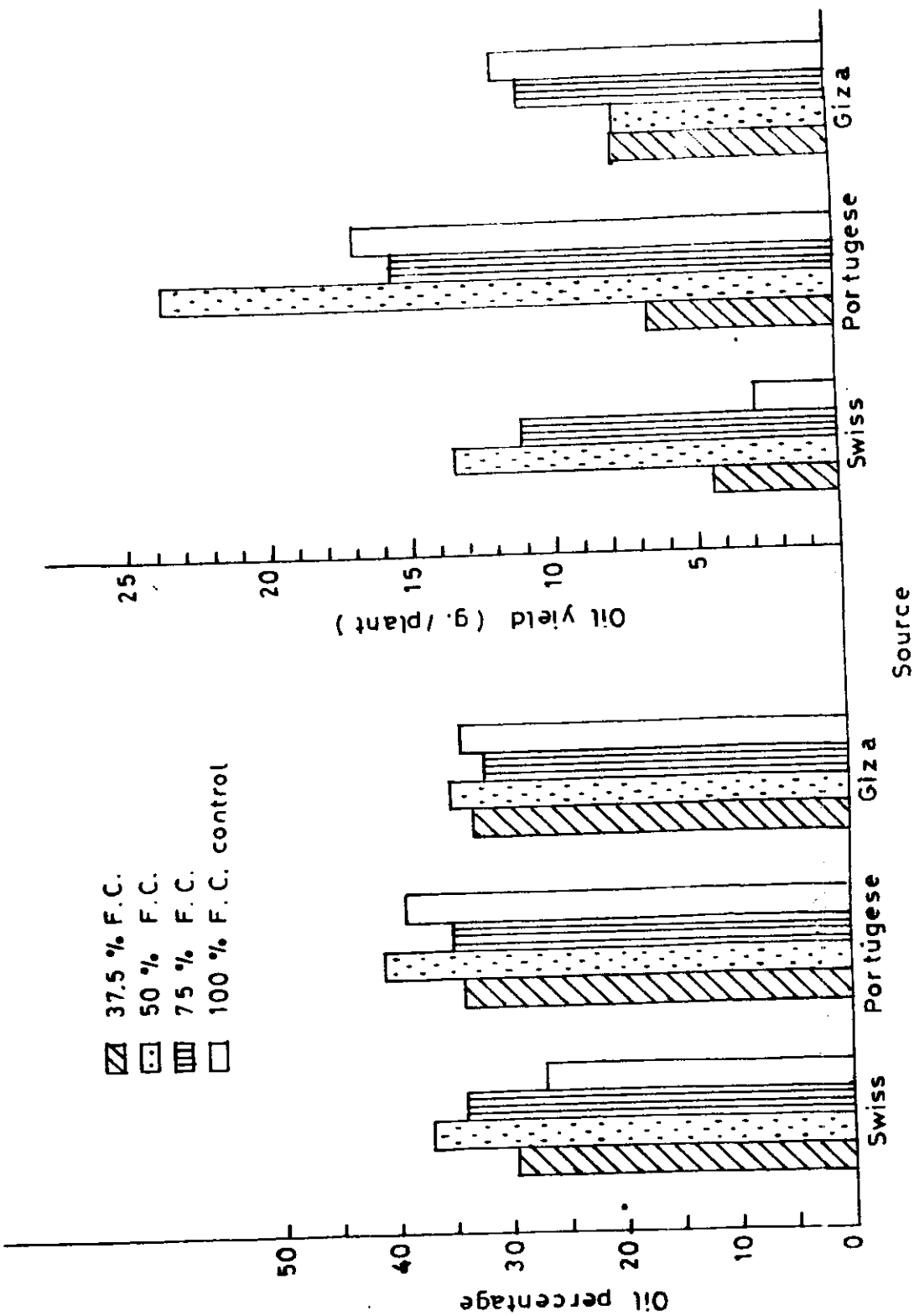

Fig. (2): Effect of some irrigation treatments of oil percentage and oil yield of (carthamus tinctorius L.) seeds during 1986 season.

the mean percentage of oil in Giza I seeds significantly increased over that of Swiss source. The mean percentages of oil in the seed of the three genotypes (Sources) were 37.25%, 33.50% and 31.75% for Portugese Giza I and Swiss respectively during 1986 season. These results were in agreement with those obtained by khater et al (1988) who showed that oil percent was significantly higher in Portugese safflower followed by Egyptian and Swiss sources respectivley.

The compound effect between irrigation treatments and the different genotypes (sources) on the seed oil percent presented in Table (8) show that the most higher percentage of oil was obtained with Portugese when irrigated at the rate of 50% F.C. It significantly increased over all other genotypes (sources) under any of the irrigation levels used. The other genotypes (sources) Swiss and Giza I also produced the highest percentage of oil at the medium rate of irrigation, whereas Portugese and Giza I produced percentages of oil less than control when high level of irrigation was used. Swiss produced percentages increased over control at all levels of irrigation used.

II.1. Oil yield/plant :

Oil yield per plant was greatly affected by irrigation treatments used in this investigation. So, decreasing irrigation level to 75% F.C. increased oil yield significantly over control plant 100% F.C. This increase reached about 50% oil yield of control plant. While decreasing the amount of irrigated water to 50% F.C. caused an increase in oil yield per plant over control one, reached (46.09). On the other hand more decrease in irrigation water to the level of 37.5% F.C. resulted in decreasing oil yield/plant with 18.17% under control plant. The highest oil yield per plant obtained at the medium level of irrigation of 50% F.C. followed by the rate of 75% F.C. These levels produced significantly higher yield of oil per plant over both control or the low level of irrigation 37.5% F.C. as shown in Table (8) and Fig. (2).

The increase in oil yield per plant caused by the irrigation treatments came as a result of increasing oil percent of seed in one side and increasing seed yield/plant on other side. These increases were linear with each other with moderate irrigation treatments 50% F.C. and 75% F.C. resulted in the highest yield of oil/plant for the prementioned treatments. These results came in accordance with Sionit et al. (1973), El-Hinnawy et al (1981) and Cheng (1984) they mentioned that oil content was decreased

by low water treatment. Also, Karami (1977) and Kandil (1984) declared that seed oil content decreased as irrigation intervals increased.

Comparing the different genotypes (sources) in this work, it could be noticed that Portugese was superior in producing the highest oil yield per plant over both the local var. Giza I or the exotic genotype (source) Swiss. The superiority in producing the highest oil yield by Portagese genotype express higher percentage of oil and higher yield of seed per plant. The local var. Giza I produced oil yield per plant significantly higher than the Swiss safflower which gave the least oil yield per plant. The mean oil yield per plant for the two exotic genotypes and local var. were 13.21, 10.39 and 8.99 gm. for plants Portugese, Giza I and Swiss respectively. In all cases oil yield/plant reflects oil percent and seed yield/plant.

Concerning the interaction between the different irrigation treatments and the different genotypes under study, the data in Table (8) show that Portugese at the moderate levels of irrigation 50% and 75 % F.C. produced the highest yield of oil per plant over all other treatments. The yield of oil per plant for Portugese at the level of 50% F.C. reached more than three times as much as its oil yield at both control or low level of 37.5% F.C. Similary trend was also found with Swiss which

produced oil yield/plant at the moderate level of(50% F.C) reached twice as much as control and nearly three times as that produced at the low level of 37.5% F.C. The local var. Giza I gave no significant differences at the different levels of irrigation although it produced higher oil yield per plant at the higher levels of irrigation 75% F.C. and control 100% F.C.

It could be concluded that the exotic source Portugese was the most genotype gave good response in its production of oil, for water regime followed by the local var. Giza I then the exotic source Swiss.

II.3.Protein percent in seeds :

The highest value of proteins percentage in safflower plant seeds was obtained at the moderate irrigaiton level of 50% F.C. which reached 10.16 % followed by the low and high levels of irrigation 37.5 and 75% F.C. at which it reached 9.44 and 9.0 and then the control plants 100% F.C. which reached 8.94, as it is clear from the data illustrated in Table (9). These results were in agreement with those of Galeva et al. (1976) they reported that highest content of protein was obtained from tomatoes fruit when the soil moisture potential prior to irrigation was in the medium to low range.

Table (9): Effect of some irrigation treatments on percent of protein in safflower (Carthamus tinctorius L.) seeds during (1986) season.

Treat. / Sources	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean
Swiss	9.32	7.89	9.61	7.89	8.67
Portugese	10.40	12.55	7.46	8.17	9.64
Giza I	8.61	10.04	10.04	10.76	9.86
Mean	9.44	10.16	9.03	8.94	

Comparing the different plant sources of safflower it could be noted that the seeds of the local var. Giza I was superior in their content of protein over the two exotic sources Swiss or Portugese since the mean protein percentage in Giza one seed reached 9.86% compared to 9.64% and 8.67 for Portugese and Swiss respectively.

The effect of different levels of irrigation on the different plant sources under study concerning protein content was of no constant trend with all plant sources. With the local var. Giza I it is clear that decreasing water rates decreased protein percent in plant seeds. Opposite trend was found with Portugese, since water stress increased protein content in plant seeds. It produced the highest protein percentage at the irrigation rate of 50% F.C. followed by that of 37.5% F.C., and the least protein percentage was at the level of 100% F.C. (normal irrigation). With Swiss source the effect of different levels on the mean protien percentage was of no constant trend, although the highest protein percentage was attained at the lowest irrigation level and the lowest one was observed at control rate of 100% F.C. normal irrigation.

II.4. Effect of some irrigation treatments on nitrogen,phosphorus and potassium percentages in safflower leaves :

Data presented in Table (10) show the effect of four irrigation levels (i.e. 37.5%, 50%, 75% and 100% of F.C. on nitrogen, phosphorus and potassium percentages in the leaves of three cultivars of C. tinctorius at flowering stage.

4. a) Nitrogen percentage :

The results of irrigation levels concerning nitrogen percentage in plant leaves indicated that the highest level of irrigation 100% F.C. produced the highest percentage of nitrogen in leaves, followed by 75% F.C. level then the low level of 50% F.C. The general trend of these results showed that nitrogen percentage in leaves increased as irrigation rate was increased with an exception in the case of the lowest level, 37.5% F.C. which was higher in its content of nitrogen only over the level of 50% F.C. With regard to the effect of irrigation rates a gradual increase was observed in the local variety Giza I as the irrigation rate was increased so that the maximum value was recorded in the control. No obvious trend of results showed, in the other side the lowest irrigation rate at 37.5% F.C. which gave the least percentage in the Swiss and local var. Giza I whereas, the lowest irrigation rate

Table (10): Effect of irrigation rates on the nitrogen, Phosphorus and Potassium in the dried leaves of safflower plant in (1986) season.

Treatment. Sources	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean
		N %			
Swiss	2.30	3.30	2.50	3.60	2.92
Portugese	4.10	2.40	3.06	3.00	3.14
Giza I	2.70	3.30	4.60	4.80	4.85
Mean	3.03	3.00	3.38	3.80	
		P %			
Swiss	0.10	0.10	0.10	0.10	0.10
Portugese	0.10	0.09	0.09	0.075	0.12
Giza I	0.09	0.10	0.14	0.075	0.13
Mean	0.09	0.09	0.10	0.08	
		K %			
Swiss	3.30	3.40	3.70	3.40	3.45
Portugese	3.30	3.20	4.20	4.40	3.77
Giza I	3.00	3.70	4.20	5.30	4.05
Mean	3.20	3.43	4.03	4.36	

37.5 % F.C. gave the highest nitrogen percentage in Portugese.

In conclusion, the application of the lowest irrigation rate decreased N%. These results were in agreements with results obtained by Street and Opik (1984) who reported that the overall protein, and total nitrogen consequently, tends to fall as the water stress is increased.

4.b. Phosphorus percentage :

The results presented in Table (10) indicated that phosphorus percentages in the leaves of C. tinctorius in the control treatment of both the Portugese and local var. were lower than those of the other treatments. The highest value was recorded in case of the 75% F.C. treatment of the local var. Giza I 0.14%. On the other hand, phosphorus content did not varied as a response to the different irrigation treatments in case of the Swiss source. In general, it can be observed that phosphorus content was not greatly affected by the variation in the irrigation treatments. Such inconsistent trend and minute values of Phosphorus contents in the leaves could be attributed to the stage at which the samples were taken (i.e. the

flowering stage) where the leaves became older, consequently, the major part of phosphorus content is translocated from the older tissues (the leaves) to the younger ones (the flowers and seeds). Such explanation is supported by that mentioned by Yagodin (1984) who reported that phosphorus content in the leaves ranged from 0.1 - 1.0% of the dry matter, being higher in the young leaves and lower in the old ones. He also added that phosphorus moves easily in plants so that it is translocated from the older to the younger tissues.

Consequently as crop mature, most of the phosphorus assimilated by the plant is concentrated in the seeds.

4.c. Potassium percentage :

Data in Table (10) reveal that potassium determined in leaves of C. tinctorius was decreased compared to control. The noticable decrease in this concern were observed with 37.5% F.C. treatment in local var. Giza I and Swiss while, in Portugese the previous treatment gave slight increase than that of 50% F.C.

Generally, it could be concluded that the lowest irrigaiton rate gave the least percentage of potassium in the leaves of the three var.under investigation.These results

were in agreement with those obtained by Lashin et al., (1977) on maize who stated that irrigation after a depletion of 25 or 75% of the available soil moisture decreased the concentration of N,P,K in leaf tissues.

II.5. Total carbohydrate in dry leaves :

Table (11) indicate the effect of some irrigation rate on the total carbohydrates in plant leaves of the three sources of safflower plant. The data showed that all irrigation treatments (i.e. 37.5%, 50% and 75% F.C.) led to increase the total carbohydrate content in plant leaves as compared to control plant 100% F.C. The highest carbohydrate content was observed with the moderate level of irrigation of 50% F.C. followed by the lowest one of 37.5% F.C. and then the high level of 75% F.C.

Concerning the different plant sources under study, it is clear from the data presented in Table (11) that the exotic sources Swiss has the highest carbohydrate content in leaves followed by the local var. Giza I. While the exotic sources Portugese came at the least concerning its leaves content of carbohydrates.

Table (11): Effect of some irrigation on total carbohydrate of safflowers (Carthamus tinctorius L.) plant during (1986) seasons.

Treat. / Sources	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean
Swiss	4.5	5.2	3.5	4.3	4.3
Portugese	4.2	3.7	5.3	2.7	4.0
Giza I	2.8	3.7	2.4	3.1	3.0
Mean	3.8	4.2	3.7	3.2	

The effect of different irrigation levels on the different plant sources of safflower under study was of vairous trends. The maximum value of total carbohydrates was obtained by Swiss plants at the level of irrigation of 50% F.C. followed by that at 37.5% F.C. and then control plants 100% F.C. The least value was observed at the level of 75% F.C. Similar trend of results was observed also with the local var. Giza I. On the other side, Portugese plant gave the highest content of carbohydrate at the high level of 75% F.C. and the low one 37.5% F.C. These results are in accordance with Abdalla and Khalifa(1980) and Nour El-Din (1988) on cotton, who reported that total carbohydrates decreased by decreasing irrigation levels.

On the contrary Abed El-Rahman (1990) on carrot found that carbohydrates content were increased by increasing irrigation level.

II.6 Effect of irrigation on chlorophyll (a and b) :

Chlorophyll (a) content in safflower plant leaves was greatly affected by water stress as shown in Table (12). It is clear that chlorophyll (a) content decreased as the level of irrigation decreased. Whereas chlorophyll (b) content nearly attained opposite trend, sicne its content increased as the level of irrigation decreased.

Table (12): Effect of some irrigation treatments on chlorophyll and carotenoids content in fresh safflower (Carthamus tenctorius L.) levels on mg/gm during (1986) season.

Treat. / Sources	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean
		Chlorophyll "a"			
Swiss	1.97	1.61	2.59	1.98	2.03
Portuges	2.08	2.22	1.97	2.33	1.36
Giza I	2.22	2.32	2.46	3.06	2.51
Mean	2.09	2.05	2.34	2.70	
		Chlorophyll "b"			
Swiss	1.15	1.32	0.86	1.08	1.08
Portuges	1.36	0.90	1.28	0.89	1.10
Giza I	1.03	1.51	0.92	0.89	1.08
Mean	1.18	1.24	1.02	0.93	
		Carotenoids			
Swiss	0.12	0.07	0.20	0.006	0.05
Portuges	0.02	0.02	0.06	0.090	0.04
Giza I	0.02	0.08	0.05	0.090	0.06
Mean	0.05	0.05	0.04	0.06	

Although the medium level of irrigation 50% F.C. gave higher content of chlorophyll (b) over the lowest level 37.5% F.C, yet still general trend of results noted that modrate irrigation or decreasing irrigation levels decreased chlorophyll (a) content and increased chlorophyll (b) content than normal irrigation.

These results came in accordance with Savulescu (1976) on sunflower who reported that chlorophyll content was strongly affected by moisture stress and its level remains low even when normal moisture condition was restored.

The decrease in chlorophyll (a) content with decreasing irrigation level may be attributed to the enhancing effect of these treatment on the chlorophyll biosynthesis and or reduction of leaf area.

Concerning the different sources of safflower in this respect it could be noticed that var. Giza I characterized by higher content of chlorophyll (a) than both the exotic sources Portugese or Swiss. Also, Portugese content of chlorophyll (a) was higher than that of Swiss, while chlorophyll (b) content was the same for both Giza I and Swiss, Portugese obtained higher content of chlorophyll (b) over them. The mean values of chlorophyll a & b for each of the thee sources were 2.03, 2.33, 2.51 and 1.08, 1.10, 108 for Swiss, Portugese and Giza I respectively.

carotene of 0.05 mg/gm. which was also decreased under control plants (100% F.C.).

The reduction in carotene content in plant leaves may be due to the reduction of a carbohydrate biosynthesis as a result of lack of water in plant tissue, which indirectly affected carotene content as hydrocarbon substance. These results came in accordance with those observed by Berneyi (1970) who reported that irrigation decreased pigment content of red pepper. Also, Galeva et al. (1976) found that highest content of carotene was obtained from tomatoes when the soil moisture potential prior to irrigation was in the medium to low range.

Comparing the different plant sources concerning their carotene content of leaves, it is clear that the local var. Giza I was the most superior in this character. It followed by the exotic Portugese while the least in this concern was the exotic Swiss.

The interaction between irrigation rates and different plant sources was of great effect concerning carotene content of leaves, since the local var. Giza I produced carotene content of 0.9 mg/gm. at the irrigation level of 100% F.C. decreased to reach 0.02 mg/gm. at the irrigation level of 37.5% F.C. These values were 0.05 and 0.08 at the levels of 75% and 50% F.C. So all irrigation levels

Table (13): Effect of some irrigation treatments on B-caroten percent in the petals of safflower (Carthamus tinctorius L.) plant during (1986) season.

Treat. Sources	37.5 % F.C.	50 % F.C.	75 % F.C.	100 % F.C.	Mean
		1st picking			
Swiss	11.00	11.00	9.50	6.00	9.37
Portuges	10.00	7.85	7.85	11.50	9.30
Giza I	9.50	10.00	11.25	10.00	10.18
Mean	10.16	9.61	9.53	9.16	
		2nd picking			
Swiss	9.00	9.50	5.60	5.60	7.42
Portuges	6.70	7.85	6.85	4.45	6.46
Giza I	7.85	6.70	5.60	5.00	6.28
Mean	7.85	8.01	6.01	5.01	
		3rd picking			
Swiss	4.45	5.60	5.60	5.40	5.26
Portuges	5.60	6.85	5.00	4.45	5.47
Giza I	6.85	4.45	5.45	4.45	5.30
Mean	5.63	5.63	5.35	4.76	
		4th picking			
Swiss	4.45	4.45	5.45	5.40	4.93
Portuges	5.00	5.45	4.45	4.45	4.83
Giza I	6.85	4.45	5.00	4.45	5.18
Mean	5.43	4.78	4.96	4.76	
		5th picking			
Swiss	4.45	4.45	4.45	5.40	4.68
Portuges	3.30	3.30	3.85	3.85	3.57
Giza I	4.45	3.30	3.85	3.85	3.86
Mean	4.06	3.68	4.05	4.36	

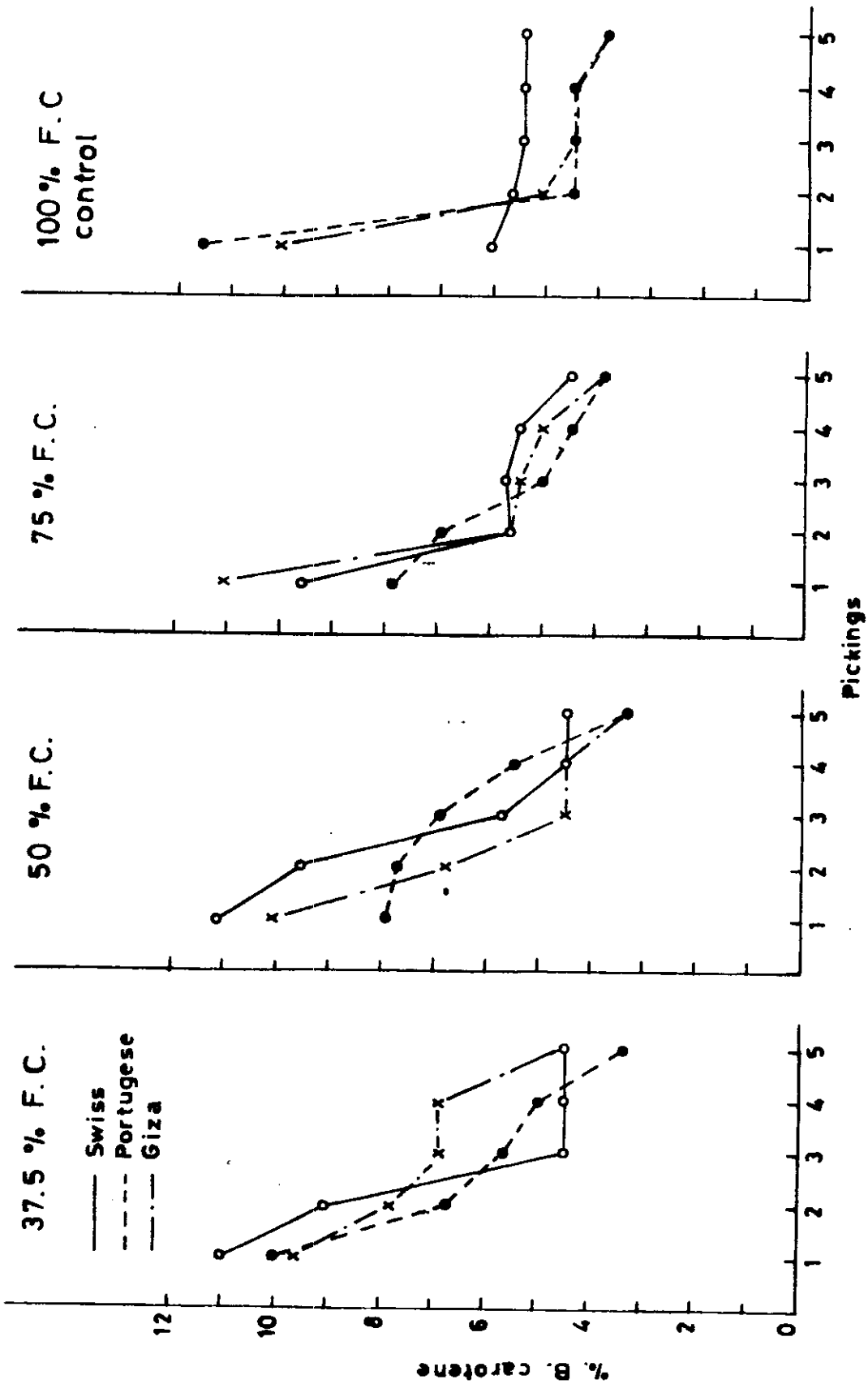

Fig.(3): Effect of some irrigation treatments on B. carotene percent in the petals of safflower (c. tinctorius L) plant during 1986.

with the lowest level of irrigation 37.5% F.C., while the medium level of irrigation and higher one (50% and 75% F.C.) produced nearly the same value of carotene content, which were also higher than control one (normal irrigation).

The second, third and fourth pickings appeared nearly to produce the same trend of results concerning the carotene content of petals as that obtained in the first picking.

Opposite trend was found with the fifth picking since the data show that water stress by using irrigation treatments led to decrease B-carotene content in petal than control (normal irrigation). From the prementioned results it could be concluded that at the first period of the flowering season decreasing the level of irrigation resulted in higher content of carotene, while at the end of flowering season it decreased the carotene content, since the 37.5% and 50% F.C. treated plants produced higher content of carotene over 75% or 100% F.C. (normal irrigation) through out first, second and third pickings. While with fifth picking higher levels of irrigation 100% F.C. (normal irrigation) and 75% F.C. produced the highest values. These results may be attributed to the biosynthesis activity reach its top in plant tissue at the first period of blooming and the plant in such period show good response

to modrate water around roots which provided good airation and more absorbtion while with the end of flowering period biothynsis activity of plant tissue became weaker so any more water may promote these processes. These go parallel with data obtained by Galeva et al. (1976) they found that highest content of carotene was obtained from tomatoes when soil moisture potential prior to irrigation was in the medium to low range. Comparing the different sources of safflower under study in concern with their content of carotene the data in Table (13) show that the carotene content of any source differed from one pick to the other.

Also the content of carotene in one pick differed according to the different plant sources. However, the source Swiss produced higher values of carotene in petals with the second and fifth pickings. Mean while the local var. Giza I produce the higher values of carotene in the first and fourth pickings. Portugese source gave the highest value only in the third picking.

The interaction effect of irrigation treatments and different plant sources on carotene content of petal differed throughout the successive pickings, although all source under study gave general trend in this concern . All sources produced their higher content of carotene in the first picking and then it decreased to produce the lowest values with the fifth picking, Portugese show higher

value of carotene 11.5 mg. in the first picking when normal irrigation was used, while it also gave the least value when irrigated at the levels of 50 and 75% F.C.

In the second picking Swiss gave the higher value of carotene content at the irrigation level of 37.5% F.C. followed by Giza I at the same level of irrigation. The least values in this picking was produced by Portugese at normal irrigation, Giza I at the same level followed by the same var. at the level of 75% and Swiss source at the irrigation levels of 75% and 50% F.C. these values were 4.95, 5.00, 5.60, 5.60 and 5.60 mgs respectively for the prementioned treatments. With the third picking the highest carotene content in petal produced by Giza I var. plants which irrigated at the level of 37.5% F.C. and Portugese plants irrigated at the level of 50% F.C., the values were the same for these two treatments. It was 6.85 mgs the least values obtained by Swiss at the irrigation level of 37.5% F.C., Portugese and Giza I at irrigation level of 100% F.C. (normal irrigation), which was 4.45 mgs for each.

With fourth picking, Giza I var. gave the highest content of carotene at the level 37.5% F.C. it was 6.85. The least carotene content in this picking was obtained by Swiss plants at irrigation level of 100% F.C.

It could be noticed in this picking that the effect of different irrigation level on carotene content of petal became less clear.

The values of carotene content of fifth picking show that the highest value was obtained by Swiss at the level of 100% followed by the same source in most cases of irrigation then Giza I at the irrigation level of 37.5% F.C. It could be concluded that Giza I still superior in its content of carotene when irrigated at low level of water along the successive seasons.

II.8. Effect of irrigation treatments on carthamin content in petals of safflower plant:

Data presented in Table(14),Fig(4)show the carthamin percentages in 5 pickings of the Swiss and Portugese sources in addition to the local variety (Giza I) as affected by different irrigation rates.

Concerning carthamin content in the first picking, it was found, from the average values of the irrigation rates, that the carthamin content in the three rates of irrigation (i.e. 37.5%, 50% and 75% F.C.) was higher than the control. Such general trend applicable in case of the Swiss safflower where the carthamin content of the control was lower than the other treatments. On the contrary,

Table (14): Effect of some irrigation treatments on cartham-in content in the petal of safflower (Carthamus tinctorius L.) plant during (1986) season.

Treat. / Sources	37.5 % F.C.	50 % F.C.	75 % F.C	100 % F.C.	Mean
		1st picking			
Swiss	0.189	0.180	0.134	0.118	0.155
Portuges	0.089	0.091	0.066	0.100	0.086
Giza I	0.077	0.116	0.146	0.121	0.115
Mean	0.118	0.129	0.115	0.106	
		2nd picking			
Swiss	0.194	0.152	0.123	0.123	0.148
Portuges	0.084	0.662	0.116	0.120	0.95
Giza I	0.116	0.124	0.084	0.123	0.111
Mean	0.131	0.112	0.107	0.122	
		3rd picking			
Swiss	0.215	0.127	0.185	0.189	0.179
Portuges	0.066	0.083	0.076	0.070	0.073
Giza I	0.113	0.127	0.161	0.116	0.129
Mean	0.131	0.112	0.140	0.125	
		4th picking			
Swiss	0.171	0.234	0.198	0.159	0.190
Portuges	0.166	0.116	0.109	0.174	0.128
Giza I	0.134	0.212	0.153	0.116	0.153
Mean	0.157	0.187	0.153	0.133	
		5th picking			
Swiss	0.485	0.475	0.340	0.480	0.445
Portuges	0.088	0.094	0.113	0.098	0.098
Giza I	0.222	0.180	0.340	0.208	0.237
Mean	0.265	0.249	0.264	0.262	

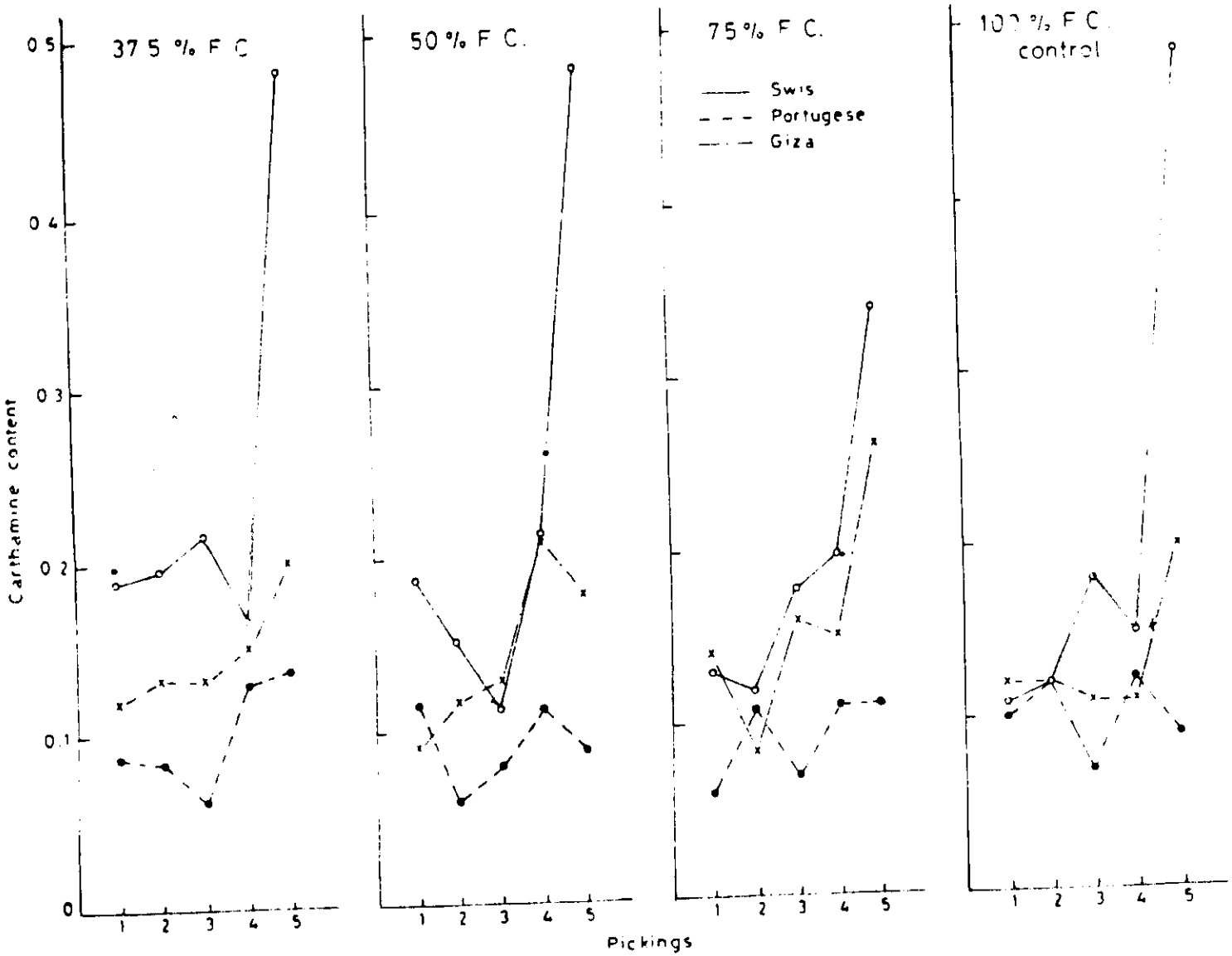

Fig. (4) Effect of some irrigation treatments of carthamine content in the petals of Safflower (carthamus tinctorius L) plant during 1986 season.

adversed trend could be observed in case of the Portugese sources and Giza I variety in which the carthamin content in the control was higher than those of the other treatments in most cases. The exception could be observed in the 75% F.C. treatment with the local variety.

It was obviously observed that the Swiss source was characterized by a high content of carthamin followed by Giza I variety and Portugese sources.

Also, the highest values of carthamin content of petals were those produced by Swiss plant treated with 37.5% and 50% F.C. levels of irrigation.

Regarding the second picking, it could be generally observed from the average values of carthamin content Table (14) that the plants treated at the level of 37.5 F.C. was higher in their content of carthamin ones, while those treated at 50% F.C. and 75% F.C. were lower in their content of carthamin than the control. It could be also observed that the irrigation treatments gave a positive effect with the Swiss source, leading to increments of carthamin contents especially with 37.5% and 50% F.C. treatments respectively.

On the other hand, the previously mentioned trend was not found in case of the Portugese source and the Giza I variety where such treatments led to decrease in the

carthamin contents in most cases. The exception was noticed with Giza I at the level of 50% F.C. which was slightly higher than the control.

The Swiss source was characterized by the highest content of carthamin also in this picking compared to the other sources under study followed by Giza I var. then Portugese. The highest values of carthamin content were observed by Swiss plants treated at levels of 37.5% and 50% F.C. These values were 0.194 and 0.152, while it was 0.123 for control plant.

Concerning the third picking, it could be observed that irrigation treatments led to increase carthamin content in safflower plant petals except with the 50% F.C. treated plant.

The highest content of carthamin in this picking produced by plants treated at the irrigation level of 75% followed by the treatment at the level of 37.5% F.C. and then control 100% F.C.

The least content was produced at the level of irrigation of 50% F.C.

These average values were 0.140, 0.131, 0.125 and 0.131 for plants irrigated at the levels of 75%, 37.5%, 100% and 50% F.C. respectively. The positive effect of

irrigation treatment and the carthamin content of different plant sources under study was recorded with the exotic Swiss plant and the local var. Giza I in most cases. Portugese soruce at the different levels of irrigation provideinconstant trend concerning carthamin content.

Swiss source still characterized by the highest carthamin content till this picking, followed by Giza I var. then Portugese. The mean values of carthamin content in this picking for the different plant sources were 0.189, 0.116 and 0.070 for Swiss, Giza I and Portugese respectively.

The highest value of carthamin content was recorded with Swiss plant source at the irrigation rate of 37.5% F.C.

The data of carthamin content in fourth picking indicate that all irrigation treatment increased carthamin contents over control 100% F.C.

The highest content of carthamin was observed with plants irrigated at the modrate level of 50% F.C. followed by the lowest one of 37.5% F.C. then the high level of 75% F.C.

The values of carthamin content of different irrigation treatments were 0.187, 0.157, 0.153 and 0.133

mg/100 gm petals for plants treated at 37.5%, 50%, 75% and 100% F.C. respectively.

The exotic source of safflower Swiss still superior in its content of carthamin also in the fourth picking over the other source Portugese or the local var. Giza I. Portuges plants produced the least content of carthamin in petal as preformed in the previous picking.

The most prominence effects of irrigation levels on the different plant source were clear when Swiss plant source and Giza I var. plant irrigated at the level of 50% F.C., since carthamin content reached its maximum values in this picking 0.234 and 0.212 mg/100 gm.

Concerning the last picking (5th picking), the average values of carthamin content in petals of plants under test of irrigation rate, generally indicated that most treatment were of closer values with that of control treatment except that of the 50% F.C. treatment which was slightly lower in its carthamin content than the control treatment 100% F.C. Such a general trend is applicable with the plants treated at irrigation levels 37.5% and 50% F.C. for all exotic sources or local var. On the other hand 75% F.C. treatment gave carthamin content values higher than the control in case of Portugese source and Giza I var. and the opposite was true for the Swiss source at the same level.

Swiss source produced the most higher content of carthamin in petals in the fifth picking as previously observed. Although the average values of carthamin content in petals were more higher in this picking (5th) than the previous ones for both Swiss source and Giza I var., yet it became lesser with Portugese. The superiority of Swiss in its content of carthamin reach its maximum with the end of the flowering season. Since Carthamin content of Swiss reached more than twice its content of the local var. Giza I and more than four times that of Portugese. The highest values were recorded in all treatments of the Swiss source of safflower.

From the previous results, it could be concluded that carthamin content in the petals of Carthamus tinctorius L. was increased by the advance of picking date, also the Swiss source gave the highest content of carthamin throughout the flowering seasons followed by Giza I and the Portugese source. Moreover, the Swiss source as well as the Giza I responded positively to the tried treatments, however, the Portugese source did not show consistent trend in this concern, the variation in response to the tried irrigation treatments could be attributed to a genetic make up of each source and variety. It was concluded that carthamin content in the petals increased by advance of picking date, these results came in accordance with Ezz – El-Din (1989) who reproted that

carthamin percent in the petals range from 0.18% to 0.26% during the early stage and 0.18% to 0.31% at the late one.

II.9 Effect of irrigation levels on the chemical composition of seed oil of safflower:

Data presented in Table (15) and illustrated in Figures (5)show the effect of four irrigation levels (i.e. 37.5%, 50%, 75% and control 100% F.C.) on the chemical composition of the seed oil produced from two sources of safflower (Swiss and Portugese) in addition to the local var. Giza I.Analyzed by G.L.C. revealed the presence of (20) peaks from which 19 fatty acids were identified. The indentified fatty acids were the following : Caproic (6C), caprylic (8C), pelargonic (9C), capric (10C), undecylic (11C), lauric, triedecoic (13C) myristic (14C), myristoleic (14:1), pentadecoic (15C), palmitic (16C), palmitoleic (16:1C) margaric (17C), stearic, oleic (18:1C), linoleic (18:2), linolenic (18:3) and arachidic.

The obtained results for each sources or variety will be reviewed and discussed in this concern.

1. The Swiss source :

Concerning the effect of the irrigation levels on the G.L.C. analysis of the seed oil produced from the Swiss

Table (15): Gas chromatographic analysis of safflower seed oil as affected by some irrigation treatments during (1986) season.

No.	Treatments: No. C	R.T. min.	Compound	Relative percentage areas: Swiss 37.5 % F.C.	Swiss 50 % F.C.	Swiss 75 % F.C.	Swiss 100 % F.C.	Portuges 37.5 % F.C.	Portuges 50 % F.C.	Portuges 75 % F.C.	Portuges 100 % F.C.	Giza I 37.5 % F.C.	Giza I 50 % F.C.	Giza I 75 % F.C.	Giza I 100 % F.C.
1	6	1.2	Caproic	-	3.24	21.08	16.56	-	-	23.4	20.93	-	23.17	29.69	16.42
2	8	2.8	Caprylic	2.38	0.37	-	-	3.25	2.86	-	-	2.56	0.63	-	-
3	9	4.0	Pelorgonic	0.66	-	2.57	0.38	-	-	1.26	1.21	-	2.89	1.55	1.99
4	10	5.0	Capric	-	-	1.58	-	-	0.28	-	-	-	0.26	-	-
5	11	6.0	Undecylic	-	-	1.39	-	-	-	-	-	-	0.30	-	-
6	12	4.0	Lauric	-	-	-	-	-	-	-	-	-	-	0.89	-
7	13	8.0	Tridecoic	-	1.50	1.54	-	-	1.50	-	-	1.49	0.40	-	-
8	14	9.0	Miristic	2.14	1.46	1.79	-	-	1.29	-	-	2.12	0.95	-	1.36
9	14:1	9.4	Myristoleic	-	-	-	-	2.01	-	-	-	-	-	-	2.33
10	15	10	Pentadecoic	3.92	2.11	3.07	3.10	3.19	2.68	2.65	-	-	0.25	-	-
11	16	10.8	Palmitic	46.29	40.00	2.71	1.99	49.16	32.89	-	-	37.35	1.81	-	2.43
12	16:1	11.2	Palmtoleic	-	-	-	-	-	-	-	-	-	-	2.33	-
13	17	12	Margaric	-	-	19.03	22.04	-	-	20.02	34.87	-	26.71	23.06	27.39
14	18	13	Stearic	16.48	-	4.77	-	29.50	-	-	-	22.28	-	-	-
15	18:1	13.8	Oleic	16.37	26.54	-	-	18.59	-	-	-	-	-	-	-
16	18:2	14.6	Linoleic	11.75	23.98	-	-	12.88	34.20	-	-	34.19	18.72	-	-
17	18:3	17.0	Linolenic	-	0.57	20.34	20.15	-	4.66	21.64	17.90	-	20.36	18.20	32.30
18	20	19.8	Arachioic	-	-	-	35.89	-	-	-	25.90	-	-	-	15.83

Table (15): Effect of some irrigation treatments on the saturated and unsaturated fatty acids in safflower oil (Carthamus tinctorius L.)plant during (1986) season.

Treatment	Saturated fatty acids	Unsaturated fatty acids
Swiss	%	%
37.5 % F.C.	71.86	28.11
50 %	48.68	51.09
75 %	68.11	23.06
Control 100 %	77.97	20.15
Portugese	%	%
37.5 % F.C.	85.10	14.89
50 %	41.50	57.45
75 %	78.48	21.64
Control 100 %	74.91	25.90
Giza I	%	%
37.5 % F.C.	65.80	34.19
50 %	57.12	39.78
75 %	79.93	20.62
Control 100 %	67.75	36.38

Identified Fatty Acids :

1. Caproic	2. Caprylic	3. Pelargonic	4. Capric
5. Undecylic	6. Lauric	7. Tridecoic	8. Myristic
9. Myristoleic*	10. Pentadecoic	11. Palmitic	12. Palmitoleic*
13. Margaric	14. Stearic	15. Oleic*	16. Linoleic*
17. Linolenic*	18. Arachidic		

* Unsaturated fatty acid.

U- Unknown

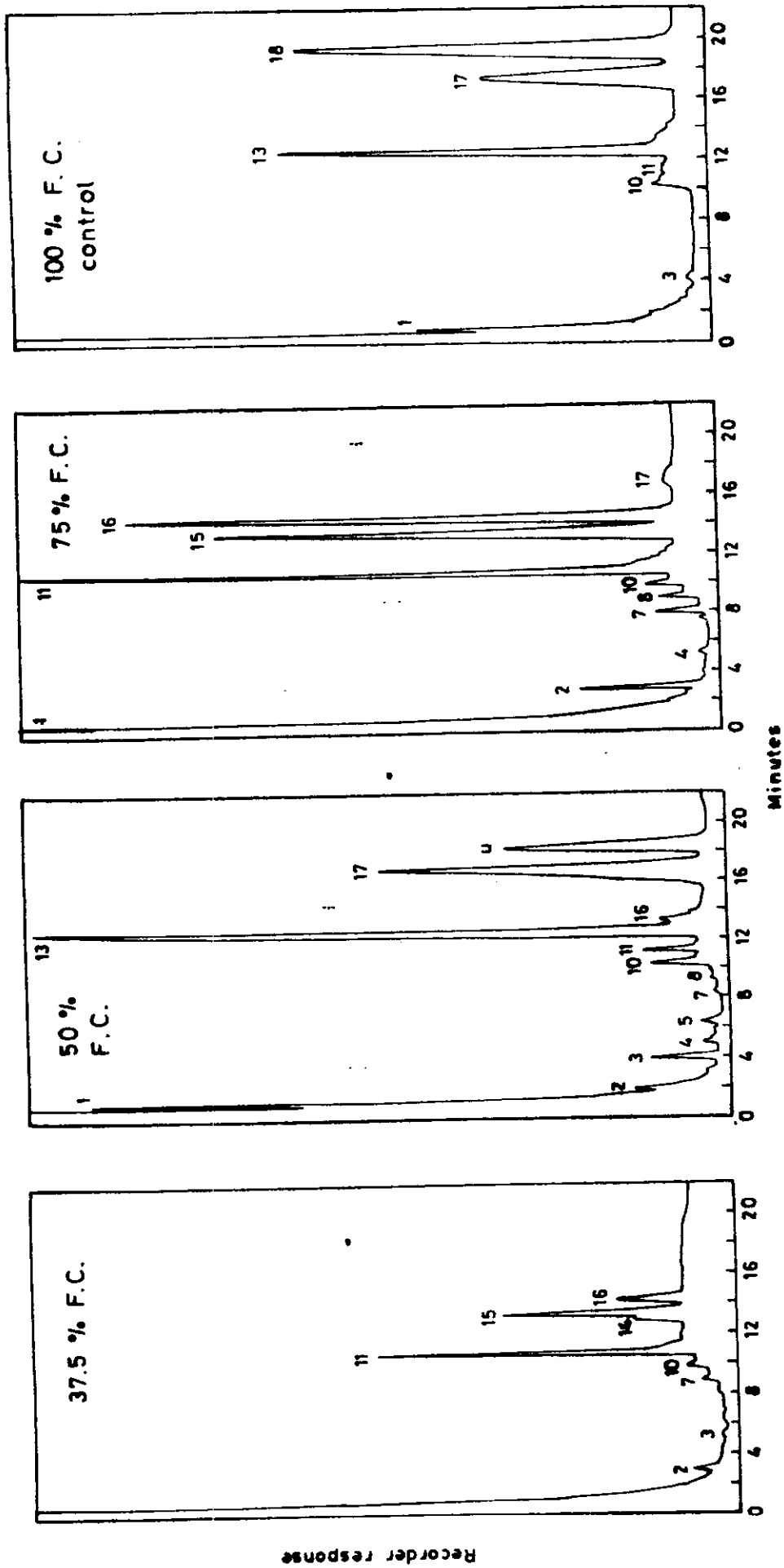

Fig. (5): Chromatograms of Swiss saffower seed oil as affected by some irrigation treatments

source, data shown in Table (15) and illustrated in Figure (5) indicated that the seed oil comprised the formentioned 18 fatty acids except those of lauric, myristaleic, palmitoleic acids which were absent.

The major saturated fatty acids were caproic, palmitic, margaric and arachidic, while the unsaturated ones were oleic, linoleic and linolenic acids.

Regarding the effect of irrigation rates, it can be observed that the relative percentage areas of the saturated fatty acids were lower than the control 100% F.C. in all cases of irrigation levels used 37.5%, 50% and 75% F.C. while with 50% F.C. It was higher than control. Consequently, 50% F.C. had a decreasing effect in this concern. On the other hand 50% F.C. treatment led to an opposite effect on the unsaturated fatty acids, so that the relative percentage areas were higher than the other treatments. It can be observed that palmitic acid existed in both 37.5% and 50% F.C. treatments as a major saturated fatty acids while strearic acid existed only in the 37.5% F.C. treatment as major saturated fatty acids. Also, caproic, margaric were the major saturated fatty acids in both the 75% and 100% F.C. treatments, however, arachidic acid existed only in the control treatment 100% F.C. On the other hand both oleic and linoleic acid were present in higher proportions in case of 37.5% F.C. and 50% F.C. treatments respectively.

Also, linolenic acid existed in higher values as the rate of irrigation was increased to 75% and 100% F.C. treatment, moreover, such an acid linolenic was found in lower value with the 50% F.C. treatment. In this connection, a vinishing effect was appeared in case of two usnaturated acids namely oleic and linoleic acids which dis-appeared in the higher rates of irrigation and were replaced by linolenic acid in both treatments.

2. Portugese source :

It is shown from Table(15),Fig.(6)that the fixed oil produced from the protugese seeds comprised most of the 18 identified fatty acids except those of undecylic, lauric, palmitoleic and arachidic which were absent.

The major saturated fatty acids produced with the irrigation level of 37.5%,, 50% F.C. were caproic and palmitic, margaric in 75% and control, stearic at treatment 37.5% F.C. and arachidic control plants.

With respect to the unsaturated ones they were myristoleic at 37.5% F.C., linoleic 50% F.C. and linolenic 50%, 75% and 100% F.C.

Regarding the effect of irrigation rates, it can be observed that the relative percentage areas of both saturated and unsaturated fatty acids in 50 % F.C. were

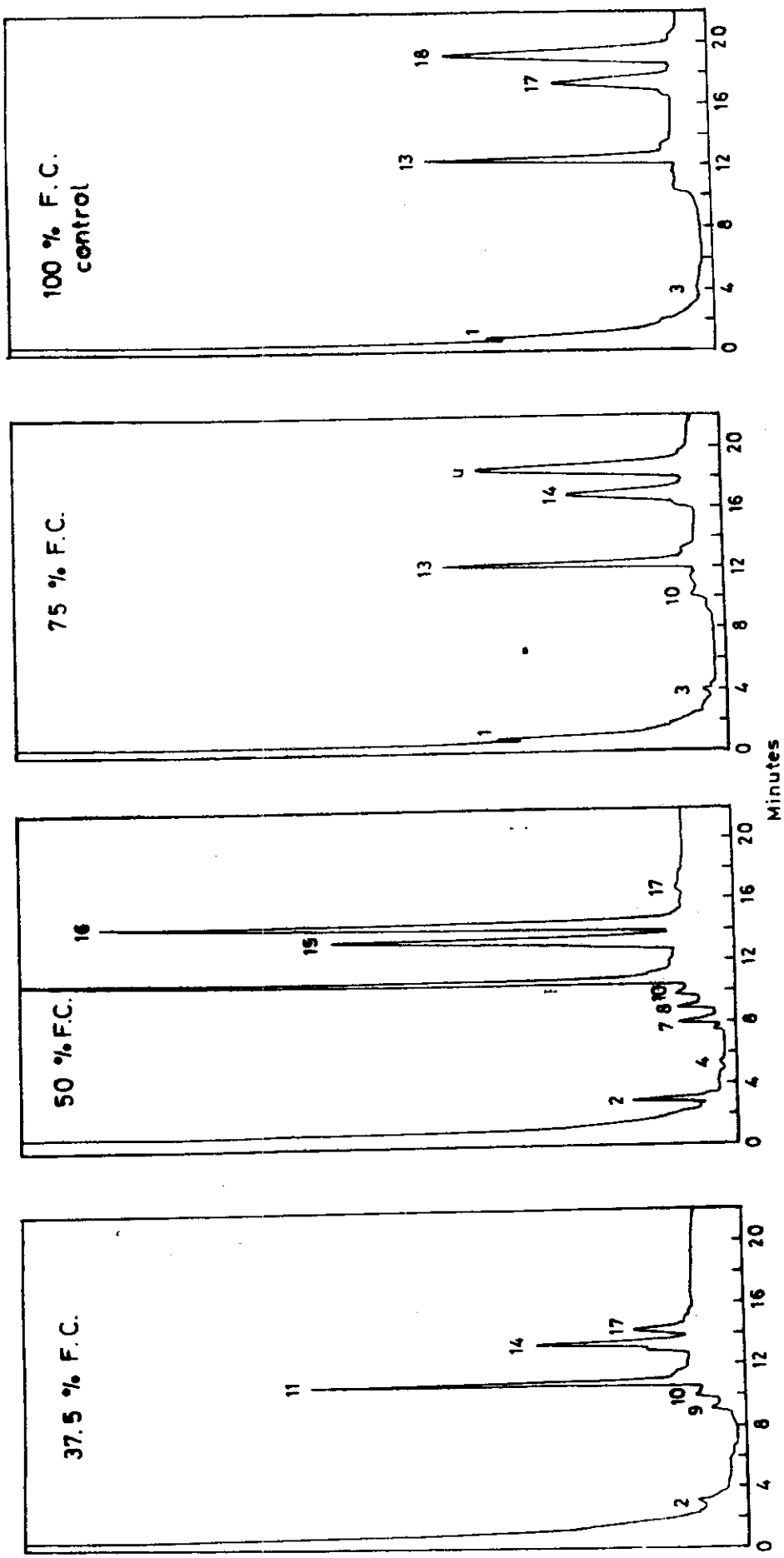

Fig. (6): Chromatograms of Portugese safflower seed oil as affected by some irrigation treatments

affected similarly as that observed in the Swiss source, while the saturated and unsaturated fatty acids of 37.5% and 75% F.C. treatments were of unconstant trend as it compared with control.

The major saturated fatty acids was palmitic in case of 37.5% and 50% treatments, while with the 75% F.C. and control treatments, the major fatty acids were capric margaric and arachidic.

On the other hand the major unsaturated fatty acids were oleic, linoleic and linolenic acids in case of 37.5%, 50%, 75% and control treatments respectively. The vanishing effect appeared in case of caprylic, linoleic and linolenic acids respectively.

3. The local variety Giza I :

It is shown from Table (15) and Figures (7) that the fixed oil produced from the seeds of the Giza I var. comprised all the 18 fatty acids except that of oleic acid which was absent. The major saturated fatty acids were caproic 50%, 75% and 100% F.C., palmitic 37.5% F.C. margaric 50%, 75% and 100% F.C., stearic 37.5% F.C. and arachidic 100% F.C. acids, while the unsaturated ones was linoleic 37.5% and 50% F.C. and linolenic(50%, 75% and 100% F.C.)acids.

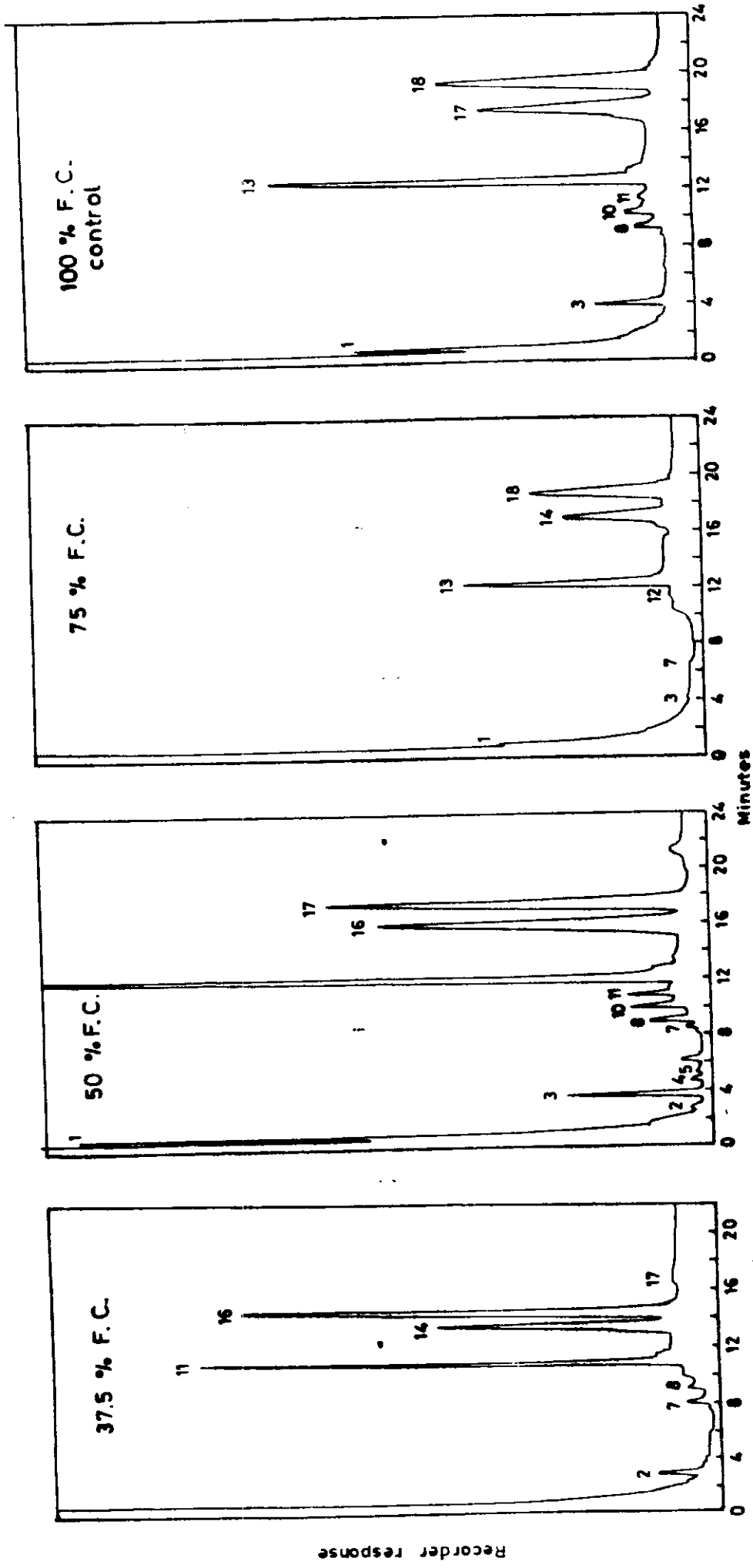

Fig. (7) : Chromatograms of Giza 1 Safflowers seed oil as affected by some irrigation treatments.

Regarding the effect of irrigation rates, it can be noticed that the relative percentage areas of both saturated and unsaturated fatty acids followed a trend similar to that obtained in the Swiss source in most cases. The exception was observed in the 75% F.C. treatment which was higher in saturated fatty acids percentage and lower in unsaturated ones in comparison with the control. The decrement of saturated fatty acids and increment of unsaturated ones were obtained in case of the 37.5% F.C. treatment, similarly as that found in Swiss and Portuges sources. The main saturated fatty acids were palmitic acid in case of 37.5, 50% F.C. treatments, caproic, margaric in case of 50%, 75% and 100% F.C. treatments respectively. Moreover, linoleic acid was found in the 37.5% F.C. as higher percentage than that of 75% F.C. treatment and vanished in the 75% and control treatments.

In general, it could be concluded from the result that increasing the irrigation rates to a moderate amount 75% F.C. led to increase the unsaturated fatty acids at the expense of the saturated ones and the opposite is true if the field capacity was lower or higher than the moderate level 50% F.C. Also, icnreasing the rate of irrigation led to synthesize saturated fatty acids of longer chain and increased the potential of unsaturation only in the fatty acids of both the Swiss and Portuges sources.

SECOND EXPERIMENT :

I. Effect of Nitrogen Fertilization on Vegetative Growth and Flowering of Safflower Plants :

I.1. Plant height :

Data presented in Table (16) indicate the effect of nitrogen fertilization levels (i.e. 0, 80 and 100 kg/fed. on the mean height of safflower plant. The data declared that plant height increased as the nitrogen level increased from N_0 to N_1 and from N_1 to N_2, although the differences between the treatments were not significant in any case.

Similar trend of results was found with the two seasons of the experiment.

Similar results on safflower plant were found by Sounda (1989) who obtained greatest height of plant at a nitrogen level 60 kg/ha. On the other hand Nour El-Din et al. (1983) reported that nitrogen fertilization had no significant effects on the mean height of safflower plant.

Also, many workers pointed out the effect of nitrogen fertilization on increasing plants height among them Nasr et al., (1978), Eweida et al. (1981), Kamel et al., (1982) on safflower they reported that plant height increased significantly when nitrogen application were increased.

Table (16): Effect of nitrogen fertilization levels on the vegetative growth and flowers of safflower (Carthamus tintorius L.) plant during 1985 and 1986 seasons.

Character	Mean height plant in metter		Mean No. of branches/plant		Mean No. of flowers/ plant		Mean weight of petals/plant in (gm)	
Treat.	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
0 kg N	1.32	1.49	20.50	14.9	25.0	27.6	2.66	2.76
80 kg N	1.50	1.55	23.00	18.4	42.0	43.6	4.20	5.05
100 kg N	1.57	1.68	23.70	19.7	54.3	60.6	5.41	7.06
L.S.D. at 5 %	N.S	N.S	2.398	2.137	11.14	10.10	0.963	1.120

I.2.Mean number of branches/plant :

The mean number of branches carried by safflower plant seemed to be affected by nitrogen fertilization added as it was clear from Table (16). It is clear from this data that number of branches per plant increased as the nitrogen level added was increased. Plants fertilized at the level of 80 kg N/fed. produced more number of branches which increased significantly than control plant.

Also, plants treated at the level of 100 kg N/fed. were of more branches than those treated with N_1 level, although the difference was not significant. Same trend of results was found in both seasons 1985 and 1986. These results came in accordance with those observed by Jones and Tucker (1986) and Sounda (1989) on safflower, they reported that the number of branches per plant increased by increasing nitrogen application. On other plants many investigators recorded more number of branches per plant due to the addition of nitrogen fertilizer among them, Sharaf (1965) on geranium Mahmoud (1970) on geranium also, he found that increasing nitrogen rates increased number of branches.

I.3.Mean number of flower heads per plant :

The mean number of flower heads per plant was greatly affected and significantly by nitrogen fertilization as

shown in Table (16). The results pointed out that the number of flower heads increased with every increase of the nitrogen fertilizers added from N_0 to N_1 and from N_1 to N_2 levels. These increases were very pronounced, so that the mean number of branches produced by plant treated at the level N_1 (80 kg/fed.) reached more than one and half that produced by control plant N_0 and it reached more than twice the control plant with plants treated by the higher levels of N_2 (100 kg/fed.).The trend of results was constant with the two years of the experiment. The increasing number of flower heads/plant as a result to the nitrogen level added may be due to the increasing number of branches and the increase of plant heights, since this plant characterized by branches ended by flower heads. The results obtained are in agreement with those obtained by Jones (1968), Gilbert and Tucker (1967), Nasr et al. (1978) and Kamel et al. (1982) who recorded that increasing nitrogen level added to safflower plants increased the flower heads number carried by plant. With other plants, the same trend of results was observed by Osman (1985) on soybean and El-Kayet (1987) on Tagetes.

I.4.Mean weight of petals per plant :

Table (16) the mean weight of petal produced by one safflower plant increased significantly by adding nitrogen

fertilizer. Both the two rates of nitrogen used increased significantly mean weight of petals produced by plant over control. Also, the high rate of nitrogen N_2 (100 kg N/fed.) gave plants with significantly higher mean weight of petals over those produced by the low N rate (80 kg N/fed.). So the production of petal per plant treated at the low rate of nitrogen N_1 came to be nearly twice as much that of control one N_0, and it reached three times control when comparing the production of plants treated with the high level of nitrogen N_2 (100 kg N/fed.) during the second season.

The data of first season confirmed similar trend although the differences were of less values. The mean weights of petal per plant were 2.06, 4.20 and 5.41 gms for the first season and it were 2.76, 5.05 and 7.06 gms in the second season for plants treated at N_0, N_1 and N_2 respectively. These increases in petals weight came as a result of the increasing number of flower heads produced per plant due to the nitrogen fertilization. These results came in agreement with Jone (1966) and Gilbert et al. (1967), Wetslar et al. (1968), Nasr et al. (1978) and Kamel et al. (1982) who observed the role of nitrogen on increasing safflwoer flower heads/plant and then their petals.

I.5. Mean weight of seed yield per plant :

The application of nitrogen fertilization levels was of great pronounced effect on the mean yield of seeds produced by safflower plant as shown in Table (17). The addition of the low level of nitrogen resulted in producing seed yield/ plant reached more than three times as that produced by control plant. Also, the plants treated with the high level of nitrogen (N_2) produced seed yield /plant twice as much that produced by plants treated at the low level (N_1). The trend of results was nearly the same with the two seasons of the experiment.

This increase in the seed yield/plant may be due to the more number of flower heads and also more number of seeds in one flower with higher weight for one seed which resulted from good nutrition. These results are in accordance with those obtained by Werkoven et al. (1963), Yermanos et al. (1964), Wetselar et al. (1968) Quilantion et al. (1971), Tavara (1973), Nour et al. (1978), Ahmed (1979) and Nour El-Din (1983) who concaluded that increasing nitrogen application increased seed yield of safflower plant.

II. Chemical composition :

II.1. Oil percent of seeds :

Oil percent of safflower seeds was greatly effected greatly by nitrogen fertilization as shown in Table (17). The data shown that both nitrogen rates N_1 or N_2 significantly increased oil percent of seeds over that of control plants N_0. The low level of nitrogen N_1 (80 kg/fed.) was superior in increasing oil percentage of

Table (17): Effect of nitrogen fertilization levels on the seed yield/plant and oil content of safflower (Carthamus tinetorius L.) plant during 1985 and 1986 seasons.

Character	Mean weight of seed/plant in (gm)		Oil percentage (%)		Oil yield/ plant		Percent of protein in seeds	
Treat.	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
0 kg N	6.05	7.84	19.3	20.3	1.17	1.59	13.66	14.30
80 kg N	19.16	23.80	26.3	24.3	5.04	5.80	20.62	20.00
100 kg N	43.07	50.71	23.6	23.3	10.20	11.81	15.00	17.50
L.S.D. at 5 %	4.33	7.35	0.759	2.622	1.340	2.188	3.753	3.575

safflower seed, than the high level N_2 (100 kg/fed.) since it produced higher percentage of seed oil with significant difference over that produced by the low level. This was true with both seasons of experiments 1985 and 1986.

The superiority of the low level in producing higher percentage of oil in seeds over the high level may be atributed to that the last was superior in its production of seeds which reached twice as much that produced by the low level, however it produced lesser content of oil.

The results obtained in this concern came in agreement with Kamel and Mohamed (1973), Singh and Kaushal (1974), Applovist (1978), Eweida et al. (1981) on safflower, El-Kady (1987), on sunflower and El-Deeb (1989) on soybean they reported that increasing nitrogen rates decreased oil content of seeds.

II.2 Oil yield per plant :

The data of oil yield produced by safflower plant illustrated in Fig. (17) show that nitrogen fertilization used greatly affected oil yield of safflower plant. Both the two levels of nitrogen added greatly increased and significantly the amount of oil produced by one safflower plant. The low level of nitrogen N_1 (80 kg N/fed.) produced oil yield per plant that reached more than four times as

that produced by control one, while the high level produced yield of oil per plant nearly ten times that of control plant. Also, the high level of nitrogen was superior in its yield of oil per plant than the low level nitrogen N_1(80 kg N/fed.), since it produced yield of oil nearly twice as much as it. This data was confirmed with the two years of experiment. Here it could be noted that although the low level of nitrogen was superior in producing plant with higher percentage of oil in seed, but the high level of nitrogen gave higher yield of oil per plant due to the more production of seed number or weight.

Many investigators observed similar results, among them, Dhota and Ballol (1964), Quilantan and Vilarreal (1971), Sheelavatar (1973), Sounda (1977) Nasr et al. (1978) and Kamel et al. (1982).

II.3.Protein percentage of seeds :

Data presented in Table (17) show the effect of nitrogen fertilization on the protein percentage of safflower seeds. It could be noticed that protein percentage increased by adding nitrogen fertilizer, although the increase over control plants was significantly with the low level N_1 (80 kg N/fed.)only. The low level of nitrogen N_1 (80 kg N/fed.)increased significantly protein

percent in seeds over plant treated with the high level. However, the high level of nitrogen N_2 increased protein percent over the control but this increase was not significant. Similar trend of results was obtained with the data of second season of the experiment.

Many investigators reported that adding nitrogen at the rate of 45 - 60 kg/ha. increased protein percentage in safflower seeds, among them Ignateva and Takareva (1978) on safflower and Ebady (1985) on soybean. The data of protein percent in seeds showed similar trend previously observed with oil percent of seeds. This means that when plant tended to increase the amount of seeds, this came at the expense of the seeds content of both oil or protein, since increasing the nitrogen added more than fixed limit may directs plant towards producing more vegetative parts (shoots and leaves) and more flowers and seeds of lesser contents of its components.

II.4. Effect of nitrogen fertilization on nitrogen - phosphorus, ptoassium in safflower dry leaves :

4. a) Nitrogen percentage :

Table (18) demonstrate the effect of nitrogen levels (0, 80 and 100 kg N/fed.) on the macro elements (N,P,K),

Table (18): Effect of nitrogen fertilization levels on the chemical constituents of (Carthamus tinctorius L.) plant leaves during (1986) season.

Ch.con. / Treat.	N %	P %	K %	Total carbohydrate %	Chl. (a) mg/gm	Chl. (b) mg/gm	Carotene mg/gm
0 kg N	2.8	0.03	3.4	1.0	1.99	0.60	0.03
80 kg N	3.6	0.03	4.0	3.2	2.10	0.88	0.03
100 kg N	3.7	0.08	4.1	3.4	2.16	0.74	0.01

total carbohydrates, chlorophylls (a + b) and carotenoid content in the leaves of Carthamus tinctorius L. plants.

4.a) Nitrogen percentage

The results express the effect of different nitrogen fertilzation levels (i.e. N_0, N_1 and N_2) on the mean percentage of nitrogen in safflower plant leaves. It is clear that both the two levels of nitrogen applied led to increase nitrogen content in the leaves of safflower plant as compared to control ones.

Accordingly the nitrogen percentage in plants treated at the high N level N_2 (100 kg N/fed.) was slightly higher than that obtained by the N_1 (80 kg N/fed.) treated ones. The obtained results are in agreement with those obtained by Nofal (1976), Kandeel (1981), El-Deeb (1982) and El-Kayat (1987) they reported that nitrogen content in plant leaves increased by raising the nitrogen level applied.

4.b) Phosphorus percentage :

Data presented in Table (18) indicate that the high level of nitrogen N_2 (100 kg N/fed.) increased phosphorus percentage as compared to control plants N_0 (0 kg/fed.) however the low level of nitrogen N_1 (80 kg) did not affect

phosphorus content of the plant leaves. These data are in agreement also with those obtained by Nofal (1976) and El-Deeb (1982) who found that increasing N level increased the phosphorus percentage in plant leaves.

4. c) Potassium percentage :

Data represents potassium percent of safflower plant leaves present in Table (18) indicated that both applied levels of nitrogen N_1 and N_2 led to increase the potassium percentages in the plant leaves as compared to control. Also, the highest level of nitrogen applied gave a slight increment in potassium content of plant leaves over the lower level (80 kg/fed.)

The results obtained by Kandeel (1981) who found that raising the nitrogen level led to increase the potassium percentages in plants confirmed our results.

II. 5. Total carbohydrates :

Data presented in Table (18) show also the effect of nitrogen levels added on the total carbohydrate percentage of safflower plant leaves, these data indicate that the applied levels of nitrogen resulted in higher percentages of total carbohydrates over control plants. The high level N_2 (100 kg n/fed.) produced slightly higher

content of total carbohydrate over the lowest N_1, whereas the difference between the total carobhydrate percent for both nitrogen applied plant and control was of great value. Since they produced carbohydrate percentage reached more than three times as much as control plants.

These results indicate that nitrogen fertilization promotes biosynthesis processes led to on increase in total carbohydrats in plant tissues to such limit. And moreover nitrogen addition had no clear effect an increasing the total carbohydrate, sicne plants tended towards more vegetative growth and increasing its organs such as branches and leaves. So, the difference between high and low level of nitrogen were very less in this concern.

These data were in agreement with those obtained by Farid (1979) on mint who found that raising nitrogen level increased the soluble and insoluble carbohydrates (i.e. total carbohydrate) in the leaves.. Moreover, Kandeel (1981) and El-Kayet (1987) reported that total carobhydrate content were increased by increasing the nitrogen feritlization level.

II.6, <u>Chlorophylls and carotenoid percentage in leaves</u> :

Table (18) also show the effect of N fertilization on the photosynthetic pigments content (i.e. chlorophyll (a) chlorophyll (b) and carotenoids).

6. a. Chlorophyll (a) :

From the data, it is shown that highest level of N exhibited high content of chlorophyll (a) followed by the lowest one in comparison with the control. These data were in agreement with those obtained by Salah (1980) Hussein et al (1981) and El-Leithy (1987), they reported that increasing the level of nitrogen increased the percentage of chlorophyll (a).

6. b. Chlorophyll (b) :

From the data in Table (18) it is shown that the lowest level of nitrogen N_1 (80 kg) gave the highest content of chlorophyll (b) in comparison with the control N_0 or the high level N_2 (100 kg N/fed.). The control treatment gave the lowest value of chlorophyll (b). These results are in agreement with those obtained by El-Leithy (1987) who found that the application of high level of nitrogen decreased chlorophyll (b) content in plant.

6.c. Carotenoids :

The results in Table (18) indicate that the least content of carotenoids was found with highest level of nitrogen 100 kg and the lowest one did not affect the carotenoids content of the leaves in comparison with the

control. Such a treatment 80 kg N/fed. resulted in the same carotenoid content as that obtained with control. The obtained results were in agreement with those obtained by Manitesevic and Horgas (1975) who observed that the high nitrogen rate reduced the amount of the coloured carotenes.

From the previous results it could be concluded that the highest level of nitrogen 100 kg/fed. did not greatly affected the chemical constituent in the leaves of Carthamus tinctorius L. as expressed in terms of macro elements (N,P and K), total carobhydrate, and photosynthetic pigments. The lower content of phosphour is logically expected regarding to the flowering stage at which the samples were taken. At such a stage the phosphorus was moved from the older tissue (the leaves) to the younger one (the flower and seeds), so that the phosphorus became in the lowest level in the leaves (Yagodin, 1984).

At the same time we could not neglect the role of the high level at nitrogen on previously mentioned results, since it increased vegetative growth and flowering. Accordingly the yield of petals and seeds per plant and also seed oil yield per plant.

II.7. Effect of nitrogen fertilization on B-carotene in petals flowers of safflower:

Table (19) show the effect of two levels of nitrogen fertilization in addition to the control on B-caroten content of petals flowers of C. tinctorius. It can be observed that both levels 80 kg and 100 kg resulted in higher values than control in the 1st and second picking however, the opposite was true for the third, fourth and fifth picking where the values of B-carotene were lower than control.

Regarding the N_1 (80 kg/fed.) treatment, it is shown that the 1st and second pickings showed increments over the control, whereas those of the third, fourth and fifth picking were lower than the control.

Concerning the N_2 (100 kg/fed.) treatment, it can be observed a higher value in the 1st picking followed by a severe decrement in the second picking. Such decrement continued in the third and fourth pickings then still constant in the last picking. In this connection, peak concentrations of B-carotene in petals flower of safflower plant can be observed at different dates of pickings for each level applied. In case of the control, the maximum concentration was recorded in the third and fourth pickings while a peak concentration was recorded in the second

Table (19): Effect of nitrogen fertilization levels on B-caroten percent in ray flowers of (Carthamus tinctorius L.) plant during (1986)season.

Picking Treat.	1st picking	2nd picking	3rd picking	4th picking	5th picking
0 kg N	4.45	4.45	5.60	5.60	5.00
80 kg N	5.45	6.70	5.00	4.45	3.85
100 kg N	11.00	5.00	4.45	4.45	4.45

picking of the 80 kg N level. Moreover, the high level of nitrogen N_2 (100 kg/fed.) resulted in the highest value of carotene content in the 1st picking followed by a severe decrement in the second picking. As observed from the average value of each picking, a gradual decrease in B-carotene content with the advance in picking date so that the highest content was recorded in the first picking and the lowest one in the last picking. It could be concluded that nitrogen fertilization increased slightly the mean percentage of B-carotene throughout the five pickings of the season over control, although each level applied differ in its maximum concentration. Also, the high level of nitrogen fertilizer N_2 produced the highest percentage of B-carotene over both N_1 level or control N_0.

II.8. Effect of nitrogen fertilization on carthamin content in safflower:

Data express the effect of nitrogen fertilization on the carthmine percentage in petals flower of safflower plant presented in Table (20) show that levels of fertilization (i.e. 80 kg and 100 kg) led to decrease carthamine contents in most cases in comparison with the control (N_0). The exceptions were found in case of third picking of N_2 treatment (100 kg/fed.) and fourth picking in both levels of nitrogen. Regarding the N_1 level treated

Table (20): Effect of nitrogen fertilization levels on the carthamin percent in petals of (Carthamus tinctorius) plant during (1986) season.

Picking Treat.	1st picking	2nd picking	3rd picking	4th picking	5th picking
0 kg N	0.142	0.153	0.1106	0.113	0.163
80 kg N	0.105	0.113	0.106	0.149	0.152
100 kg N	0.109	0.108	0.135	0.135	0.159

plants the carthamine content was lower than control in most cases, the exception was in the fourth and last picking. While with the N_2 level treated plant, the carthmine was higher than control in case of the third and fourth picking however, in case of 1st and last picking a decrement below the control was observed in this concern.

Generally, it can be noticed that carthamine content was increased with advance in picking date. Consequently, the higher values were recorded in the last picking of both levels applied as well as in the control. It could be also noticed that nitrogen fertilizer have no clear effect on increasing the mean percentage of carthamine throughout the whole season, since the mean percentages of carthamine in safflower petals of plants treated with both nitrogen levels used N_1 or N_2 were slightly lower than control N_0.

From the results of carthamine and B-carotene content, it could be noticed that carthamine content was increased by advancing the picking date. On the contrary an adversed trend was observed in the case of carotene. Such results might indicate that there is some reversed relationship between the rate of synthesis of carthamine and carotenoid pigment in this plant.

II.9. Effect of nitrogen fertilization on the chemical composition of safflower seeds fixed oil:

Data presented in Table (21) and illustrated in Figure (8) show the effect of the three levels of nitrogen (i.e., 0, 80 and 100 kg/fed.) on the G.L.C. analysed of seed oil produced from Giza I var. of safflower. The chromatograms revealed the presence of (14) peaks from which 12 fatty acids were identified. Names, number of peaks and number of carbon atoms are shown in Table (19). The obtained results indicated that the major saturated fatty acids were caproic and arachidic in all treatments in addition to margaric acid which only appeared in the control N_0 (0 level). Regarding the effect of N fertilization on the saturated and unsaturated fatty acids, it is clearly observed that increasing the level of fertilization decreased the saturated fatty acids. On the other hand, the unsaturated fatty acids were increased as a responses to the increase of nitrogen levels.

As a conclusion, it can be said that the higher levels of nitrogen led to synthesize more unsaturated fatty acids at the expense of the saturated ones. Also, the highest level of nitrogen 100 kg/fed. provoked the synthesis of low potnetial unsaturated acids (oleic) however, the lower levels of nitrogen 80 kg/fed. had the adversed effect so that the identified fatty acids in such treatments were of high degree of unsaturation, linolenic acid.

Table (21): Effect of nitrogen fertilization levels on the G.L.C. analysis of seed oil of safflower (Carthamus tinctorius L.) var. Giza I during (1986) season.

Per. No.	Rt. min.	No. C	Compound	Nitrogen levels		
				Control	80 kg %	100 kg %
1	1.2	6	Caproic	31.16	18.7	22.83
2	2.8	8	Caprylic	-	-	-
3	4.0	9	Pelargonic	1.22	3.9	2.28
4	5.0	16	Capric	-	-	-
5	6.0	11	Undecylic	-	-	-
6	7.0	12	Lauric	-	-	1.007
7	8.0	13	Tridecoic	-	-	1.180
8	9.0	14	Myristic	-	2.2	-
9	9.4	14:1	Myristoleic	-	-	-
10	10.0	15	Pentadecoic	5.4	3.0	4.40
11	10.8	16	Palmitic	2.93	-	-
12	11.2	16:1	Palmitoleic	2.82	4.2	5.44
13	12.0	17	Margaric	22.76	-	-
14	13.4	18	Stearic	-	-	-
15	13.8	18:1	Oleic	-	-	30.94
16	14.6	18:2	Linoleic	-	-	-
17	17.0	18:3	Linolenic	16.11	29.2	-
18	19.8	20	Arachidic	17.61	25.3	25.76
Saturated fatty acids				81.08	63.10	57.40
Unsaturated fatty acids				18.93	33.40	36.38

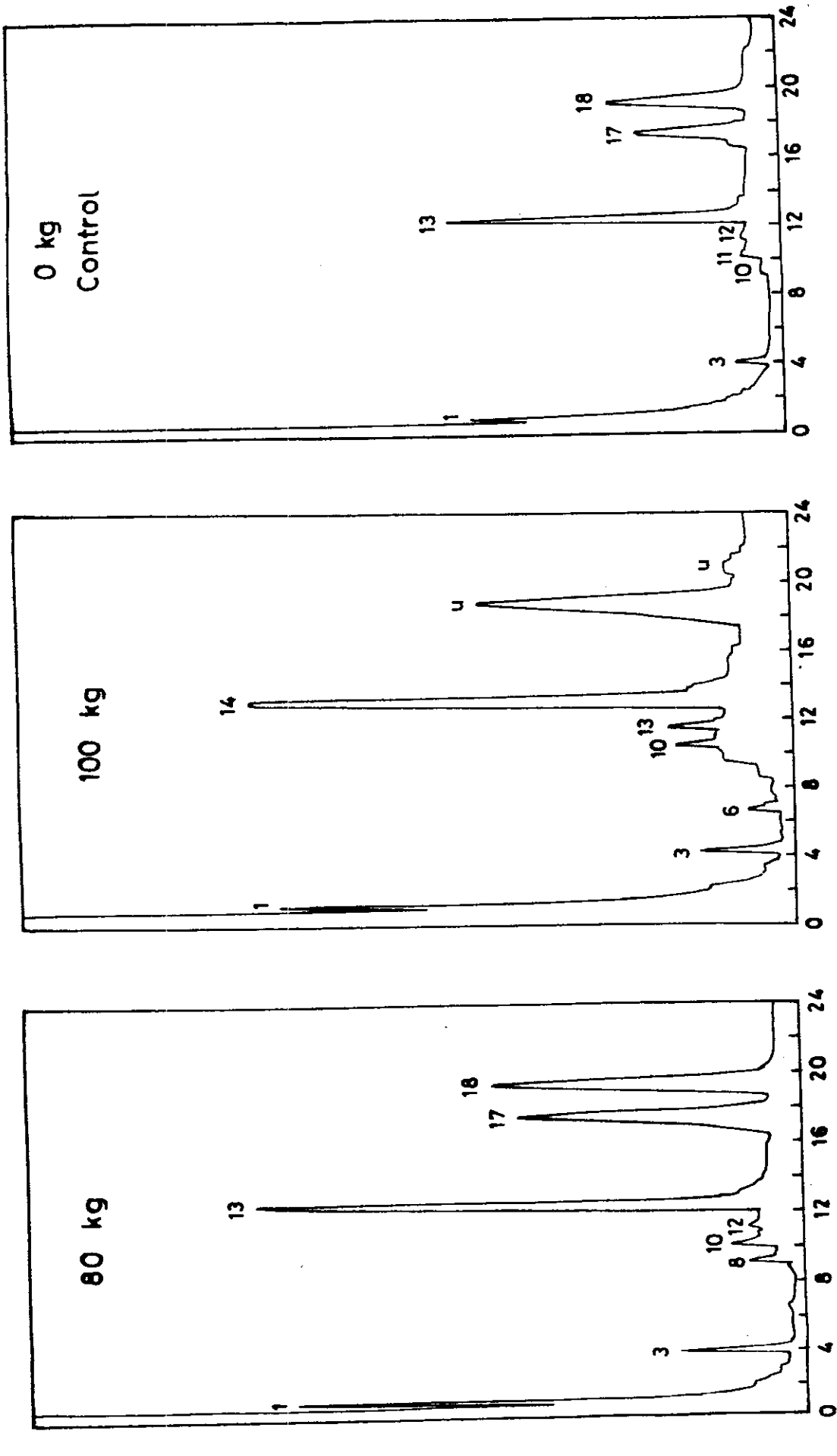

Fig.(8) : Chromatograms of Giza 1 safflower seed oil as affected by two levels of Nitrogen.

SUMMARY

Effect of some irrigation treatment on vegetative growth and flowering and chemical composition :

1. Regular irrigation resulted in good vegetative growth characters for all plant sources under study, since mean plant height and mean number of branches/ plant increased with medium and low levels of irrigation than the high level 75% F.C. or the highest one (control) 100% F.C.

2. The Portugese plants were superior in their height and number of branches over other sources. The best results in this concern were observed with the high and medium level of irrigation. The Swiss sources came after and then the local var. Giza I.

3. All irrigation treatment increased the mean number of flower heads/plant over control. The highest number of flower/plant was obtained with the lowest irrigation plants followed by those treated at the medium, high and highest level (control) respectively.

4. Mean weight of petals/flower icnreased with low level of irrigation 37.5% F.C. as compared to the medium or high level and control (the highest). Portuges plant produced mean weight of petals/flower higher than over those of Giza I and Swiss plants.

5. The highest yield of petals/plant was obtained with the lowest level of irrigation (37.5% G.V.) than the medium and high levels (50% and 75% F.C.) which obtained same yield of petals/plant this was also increased over control. Comparing the plant sources, Portuges plant produced the highest yield of petals/plant with significant increase over both Swiss source and local var. Giza I. The latter came as the second and Swiss as the third in yield of petal/plant.

6) The mean weight of seeds/flower and seed yield/plant increased with appling moderate levels of irrigation 50% and 75% F.C. followed by control (100% F.C.). The least mean weight of seed/flower and plant was obtained with the lowest level of irrigation (37.5% F.C.)

Also seed weight/flower and seed yield/plant produced by Portuges plant were superior over other sources followed by Giza I var. and Swiss source respectively.

Chemical composition :

1. The results showed that decreasing the irrigation rate decreased the percentage of chlorophyll (a) while it increased clear chlorophyll (b) percentage.

2. The highest level of irrigation 100% F.C. produced the highest percent of caroten in leaves.

3. The local var. Giza characterized by the highest percent of chlorophyll (a) in leaves and also the highest percent of carotene, while Portuges plant characterized by the highest percent of chlorophyll (b).

Oil content :

1. The low level of irrigation resulted in the lowest percent of oil in seeds as compared to other treatments.

2. Comparing the plant sources, the Portuges plants produced the highest oil percent in seeds followed by the local var. Giza I then Swiss plant.

3. The highest yield of seed oil/plant was obtained with the medium level of irrigation 50% F.C., followed by the high one 75% and then the control plant 100% F.C. The least oil yield/plant was obtained with the lowest level of irrigation 37.5% F.C.

4. Portuges plant source produced also the highest oil yield/plant followed by Giza I and Swiss.

Pigment content in Petals :

1. Caroten content of petals increased with decreasing the level of irrigation. The lowest level produced the highest percent of caroten in petals, and this trend still constant at the beginning of the flowering season through the successive picking from the first to the fourth. While with the fifth picking the least one at

the end of the following season the mean percent of carotene in petals increased with the high level 75% and 100% F.C.

Concerning plant sources, the Swiss plants was of highest percent of carotene in petals followed by the local var. Giza 1 and Portugese.

Generally it could be notice that carotene content of petals under different treatments of irrigation and with different plant sources, was higher at the beginning of the flowering season and decreased gradually to the end of the flowering season (last picking).

Corthamin percentage in petals was higher in plants treated at medium or low level of irrigation 50% and 37.5% F.C. than with high levels 75% and 100% F.C.

Swiss source was superior in its content of Carthamin throught out all the flowering season, followed by the local var. Giza I and Portuges.

Generally it could also noticed that carthamin content in petals increased gradually as the flowering season came to its end.

Gas-chromatographic analysis of fixed oil :

The fractionation of seed oil by Gas chromatographic cleared that the oil of carthamus seed contain 18 fatty acids saturated and unsaturated. It could be noticed that increasing irrigation rate 75% F.C. increased the percent of unsaturated fatty acids in seed oil and also the saturated fatty acids of longer chain.

Second: Effect of Nitrogen fertilization level:

1. The vegetative growth of Carthamus tinctorius L. plant, as plant high or number of branches carried by plant affected greatly and significantly by applying nitrogen fertilizers The high rate of nitrogen was more effective in increasing both height of plant or the number of branches by the low level or control plant.

2. Nitrogen fertilization treatment resulted in higher number of flower heads/ plant. The increase was more clearer with the high level than the low one.

3. The seed yield/plant increased by adding nitrogen fertilization over the untreated plants. The high level of nitrogen 100 kg/fed. produced plant with higher seed yield than those obtained by the low one 80 kg N/fed.

4. The mean percentage of oil was higher in seeds of plants treated at the low level of nitrogen 80 kg N/fed. than

both those of control 0 kg N/fed. or of high level 100 kg N/fed. The later produced also higher oil percentage in seeds over control.

5. The total yield of oil/plant increased significantly with the high level of nitrogen 100 kg N/fed.over control or the low level of nitrogen, although the low level increased oil percentage, since the seed yield was higher with the high level of nitrogen.

6. Nitrogen fertilization affected positively protein percent of seeds, and the low level of 80 kg N /fed. was more effective in increasing protein percentage over the high level 100 kg N or control N_0.

7. Nitrogen fertilization with both levels used resulted in an increase in the major elements content (N,P,K) of leaves although the high level of nitrogen was more effective in this concern than the low one.

8. The total carbohydrate content in plant leaves, increased by nitrogen application. The high level of nitrogen 100 kg N/fed. was more effective than the low one. The least charbohydrate percent was observed from control plant leaves.

9. The chlorophyll (A) percent increased in plant leaves by increasing nitrogen levels applied. While chlorophyll (Б) percent increased when the low level of nitrogen was used.

10. Nitrogen application resulted in decreasing in the saturated fatty acids in the seed oil while the unsaturated fatty acids increased.

11. It could be noticed that carotene percentage in petals decreased gradually in the successive pickings. The least values for carotene percentages were obtained at the end of the flowering season.

12. Carthamin percentage of Carthamus tinctorius L. dry petals decreased as a result to apply nitrogen at its two rates, although the high level increased carthamin percentage over control plant in the third and fourth picking.

It could be noticed also that carthamine percentages were on the other side carotene percent since it increased gradually towards the end of the flowering season.