RESULTS AND DISCUSSION

The first experiment: (Pots experiment):

Effect of some chemical materials on tomato plants grown under saline conditions

1-Vegetative growth characteristics:

1.1Effect of salinity:

Data on the effect of different levels of sodium chloride salinity on vegetative growth characteristics of tomato plants are presented in table (5) and figure (1). It is clear that, there was a progressive reduction in all studied growth parameters as salinity level increased. This trend held true during both seasons of the experiments. As average of both seasons, the reduction in plant height of tomato plants grown under 3000, 6000, 9000 and 2000 p.p.m NaCl reached 6.67, 15.56, 23,48 and 35.44 % as compared with those of control, respectively. In this respect, the corresponding values of the reduction were 5.99, 15.93, 23.63 and 30,99% in case of root length and 12.26, 19.77, 25.98 and 30.34 % in case of number of leaves per plant and 12.09, 19.78, 27.47 and 38.46% in case of number of branches per plant and 13.22, 24,93, 32.64 and 40.50% in case of fresh weight of shoot and 11.30, 18.64, 24.86 and 29.94 % in case of fresh weight of root and 18.64, 36.44, 50.00 and 61.02 % in case of dry weight of shoot as well as 21.05, 34.21, 42.11 and 52.63 % in case of dry weight of root and 2.17, 7.73, 10.87 and 15.46 % in case of shoot / root ration as compared with those of control, respectively.

The adverse effect of salt stress on plant growth is attributed to one of more of follows:

Table (5): Vegetative growth characteristics of tomato plants as affected by irrigation with saline water and spraying with different chemical materials during 1996 and 1997 seasons.

Seasones	1996									1997								
Treatments / Salinity	Plant height (cm)	Root length (cm)	No.of leaves/ plant	No.of branches /plant	Fresh weigh of shoot (gm)	Fresh weigh of root (gm)	Dry weight of shoot (gm)	Dry weight of root (gm)	Shoot /root ratio on F.W. basis	Plant height (cm)	Root length (cm)	No.of leaves / plant	No.of branches plant	Fresh weigh of shoot (gm)	Fresh weigh of root (gm)	Dry weight of shoot (gm)	Dry weight of root (gm)	Shoot/ root ratio on F.W. basis
0	43.1	28.5	21.6	4.8	37.6	9.1	6.4	2.0	4.18	43.8	29.9	21.9	4.3	35.0	8.6	5.4	1.8	4.10
3000 p.p.m	39.9	27.0	19.4	4.3	33.4	8.1	5.4	1.6	4.15	41.2	27.9	19.2	3.7	29.6	7.6	4.2	1.4	3.95
6000 p.p.m	35.3	23.3	17.3	3.8	28.5	7.3	4.2	1.3	3.93	38.0	25.8	17.6	3.5	26.0	7.1	3.3	1.2	3.70
9000 p.p.m	31.4	20.9	16.1	3.5	25.2	6.8	3.3	1.2	3.69	35.1	23.7	16.1	3.1	23.7	6.5	2.6	1.0	3.69
12000 p.p.m	27.1	18.5	15.4	3.0	23.0	6.4	2.6	1.0	3.59	29.0	21.8	14.9	2.6	20.2	6.0	2.0	0.8	3.42
L.S.D. at 5%	1.2	0.5	0.8	0.5	1.2	0.2	0.3	0.1	0.30	1.4	0.8	0.7	0.5	1.8	0.2	0.3	0.1	0.28
Chemical materials																		
Control 0	33.4	21.0	16.9	3.2	28.5	6.7	3.7	1.0	4.23	36.0	22.2	17.8	3.2	26.6	6.0	3.0	0.8	4.36
Phosphoric acid 10m.M	41.2	26.0	21.7	4.3	36.4	8.5	5.4	1.7	4.26	43.8	27.8	21.6	3.7	33.4	8.2	4.4	1.5	4.04
Phosphoric acid 20m.M	39.1	25.0	20.8	4.0	34.1	8.4	5.4	1.7	4.06	43.8	28.0	20.6	3.4	29.2	7.9	4.2	1.5	3.67
Proline acid 30m.p.p.m	37.0	22.5	19.1	3.7	31.0	6.9	4.6	1.2	4.46	40.2	27.4	18.2	3.4	29.4	6.5	3.7	1.1	4.45
Proline acid 60 p.p.m	36.3	21.9	17.6	3.6	29.5	6.7	4.3	1.2	4.33	41.2	26.0	16.6	3.4	28.0	6.2	3.6	1.0	4.42
Paclobutrazol 100p.p.m	31.8	25.2	15.4	4.5	24.5	8.4	3.8	1.8	2.87	30.5	25.3	15.8	3.9	21.2	7.9	2.9	1.5	2.66
Paclobutrazol 200p.p.m	28.8	24.0	14.0	4.0	23.1	7.2	3.5	1.4	3.14	26.6	24.0	15.0	3.2	20.6	7.3	2.7	1.3	2.79
L.S.D. at 5 %	1.0	1.2	0.9	0.4	1.1	0.2	0.3	0.1	0.13	1.7	1.1	0.8	0.4	1.3	0.2	0.2	0.1	0.20

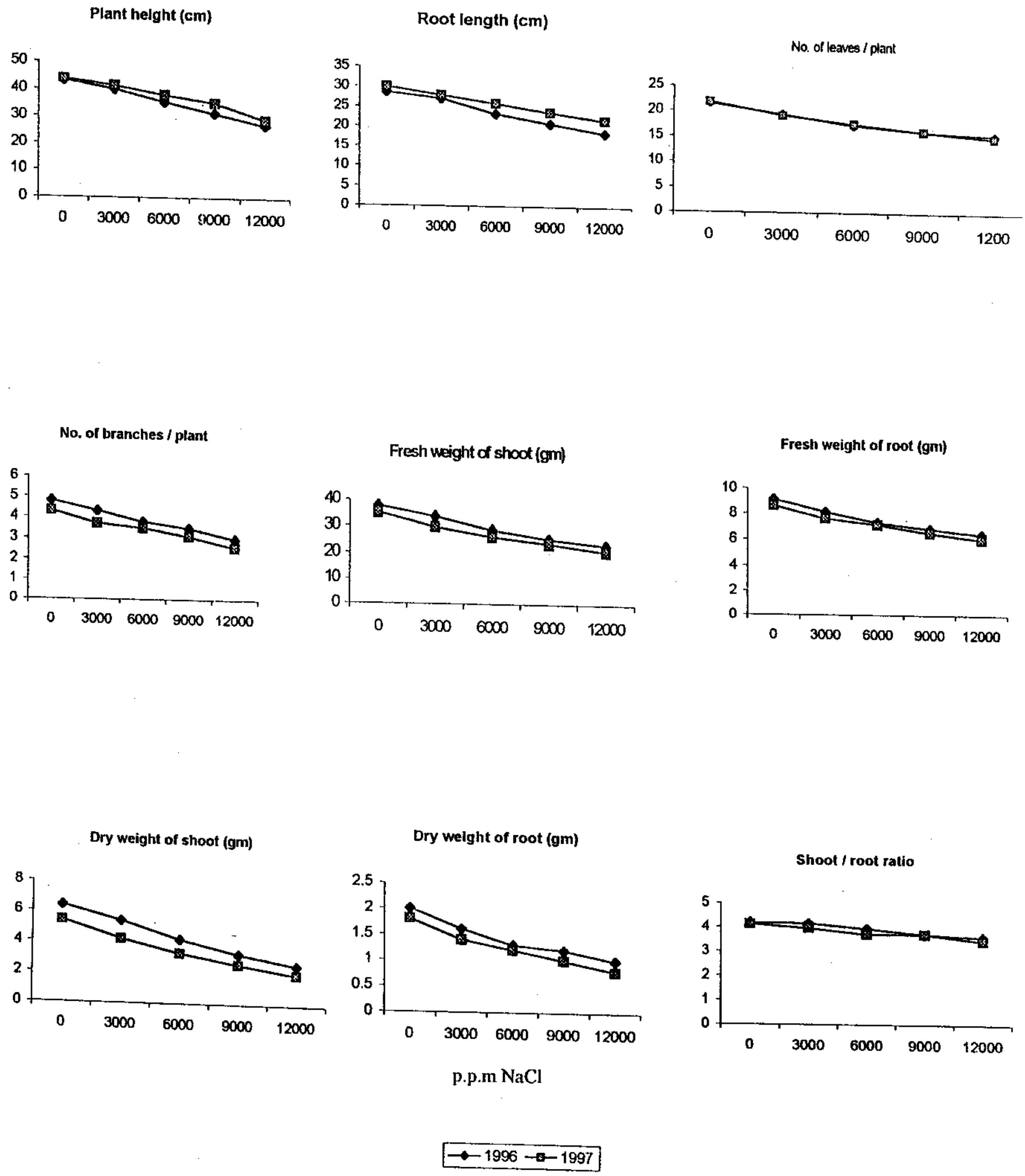


Fig. (1): Effect of salinity levels on vegetative growth characteristics of tomato plants.

-The specific toxic effect of ions excessively absorbed from the saline solution of the soil, to the process of building up the osmotic potential of the plant cells.

-The imbalance in nutritional cations in tissues of the salt affected plants.

-The reduction in carbon fixation in photosynthesis.

-The inhibition in cell division and cell elongation that reflect on reduction in cell size and number of cells per unit area.

-The imbalance in hormons content in plants, as salinity increased it caused a decrease transport of kinetin from root to leaves, and an increase in leaves content of abscisic acid **(Bernstein, 1975)**.

The retarding action of salinity is much more sever at the late than at the early stage of growth obviously due to cumulative effect of the salt. These results are generally in agreement with those reported by **Pokroveskaya (1954 & 1957) ; Strogonov, (1962); Greenway (1963).and Al-Lawendy (1990)** on sugar beet. In this connection, many investigators came to the similar findings on tomato plants, **El-Rawahy et al. (1990 & 1992); El-Sherif et al. (1990); Adams, (1991); Caro et al.(1991); Sarg (1991); Helmy (1992) Soliman and Doss (1992); Bolarin et al. (1993); Rizk (1993); Alarcon et al.(1994); Abdel–Latif (1995); Abaza (1996); Satti et al.(1996); Wanas (1996) and Yong et al. (1996).**

1.2. Effect of chemical materials:

The effect of different chemical materials on vegetative growth of tomato plants are presented in Table (5) and Figure (2). It evident that the application of these materials caused a passive effect in most vegetative growth parameters of tomato plants compared with control.

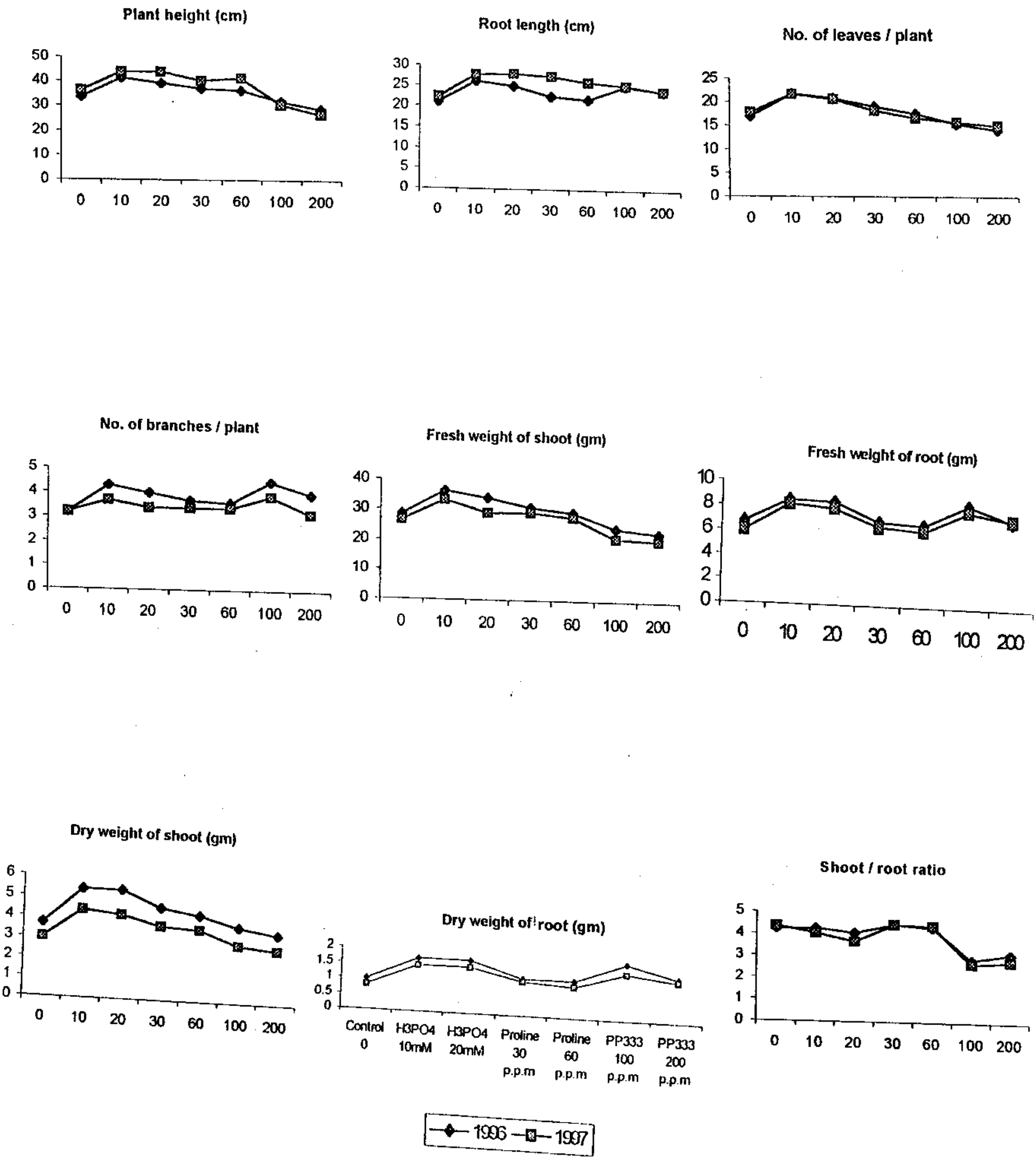


Fig. (2): Effect of chemical materials and vegetative growth characteristics of tomato plants.

In this respect, the increments in most growth parameters were occurred as a result of application of these chemical, especially phosphoric acid (10 and 20 mM) and proline acid (30 and 60 p.p.m). Differences reached mostly the 5% level of significance during both seasons of this experiment.

With respect to the effect of phosphoric acid, it is worthy mention that, the application of phosphoric acid resulted in the more pronounced effect on most studied vegetative growth characteristics, especially the low level (10 mM) than the other treatments including the control. Proline treatment exhibited a favourable and higher effects on most studied growth characters compared with control, especially when low level of proline acid (30 p.p.m) was used, but, in most cases, it came after phosphoric acid treatments.

Concerning the effects of paclobutrazol, it is clearly show that, there were a retarding effect on plant height, number of leaves per plant, fresh and dry weight of shoot when PP_{333} was used, but it had a favourable effect, compared to the control in root length and weight (fresh and dry) and consequently shoot/ root ratio. Growth retardants (such as PP_{333}), especially with high concentrations correlated with increasing lateral growth (number of lateral branches), it may be contributed in breaking of apical dominance and increase bottom branches.

The favourable effect of phosphorus on vegetative growth characteristics might be due to its vital and essential role in cell division and due to its effect in the absorbtion of the other nutrients and consequently increase growth characters of tomato plants. Also the beneficial effect of applying phosphorus on the dry weight of leaves per plants was expected, since phosphorus is known to be essential for increasing plant capacity in building metabolities. **(Table et al., 1991)**. The effect of phosphoric acid on plant growth characteristics are in harmony with those mentioned by **Abdalla et al., (1979)** on tomatoes, **Delbert and Hemphill (1982)** on different species of vegetable crops, **Lunin and Gallatin (1965), Farrag (1970), Shafshak (1989), Table et al. (1991) on beans, Teneb et al.(1995)** on cowpea plants, **Thomson and Kelly (1957), Amer (1964), Lipkind and Dzhumaeva (1973) and Abo Soliman et al.(1990)** on cotton plants.

Concerning the benficial effect of proline acid on vegetative growth characteristics,it is worthy to mention that the proline acid acts as a storage compound for reduced carbon and nitrogen, as has in fact been postulated for water and osmotic stressed plants. Thus, free proline was found to be increased under salt stress conditions **(Singh et al.,1973; Stewart and Lee,1974, Chu et al.,1976 and Cavalieri and Huang, 1977)**. One way to overcome the salinity is to increase the concentration of cellular osmotic components by synthesis and accumulation of organic solutes **(Flowers et al.,1977 and Mass et al.,1977)**. In this connection the amino acid proline is considered to have such and osmo– regulatory function **(Treichel, 1975)**, whereas proline is synthesized and accumulated under water and salt stresses to depress the internal osmotic potential and so maintain a positive gradient for water uptake. This osmotic adjustment is an adaptive mechanism by which the plant is able to withstand salt stress conditions **(Mengel and KirKby, 1979)**. Obtained results are in agreement with those reported by **(Tal and Katz, 1980; Tipirdamaz and Karakullukcu, 1993 and Abdel-Latif, 1995)** working on tomato plants and **Wageeh (1994)** on wheat plants.

With respect to the retarding effect of paclobutrazol on vegetative growth of different crops, it is evident from the previously studies that paclobutrazol (also known as PP_{333}, PBZ or cultar) is one of the most potent which are inhibitors of endogenous gibrellin biosynthesis (**Daliziel and Lawrence, 1984; Davis et al.,1988 and Davis and Curry, 1991**). The present results are in harmony with those reported on tomato by (**Borkowski, 1992 a & b; El-Desouky, 1992; Latimer, 1992; Grimstad, 1993; Asao et al., 1996 and Wanas, 1996**) as well as **Arora et al. (1989)** on summer squash ; **Nerson et al., (1989) on muskmenlon; El-Bassiouny (1992) on strawberry ; Wanas (1992)** on pea and **Ismaeil (1995)** on broad bean.

The interaction effect between salinity and chemical materials (Tables 6 and 7) show significant differences in plant height, root length and fresh weight of the shoot in the second season and root dry weight in the first season, as well as shoot dry weight and shoot /root ratio in both seasons of this study. Differences between salinity and chemical materials did mot reach the 5% level of significance with other vegetative characteristics.

-It is clearly show that salinity treatment continued to play as an adverse effect to all growth characters that studied in this study, so deleterious effects increased with increasing salinity level.

-Application of the different chemical materials especially phosphoric and proline acid and somewhat PP_{333} especially the low concentrations minimized the harmful effect of salinity up to the highest level of it, whereas, PP_{333} treatment especially with high concentration remained to improve the root characters.

Table (6): Effect of interaction between salinity and chemical materials on vegetative growth characteristics of tomato plants during 1996 season.

Season	1996									
Salinity	Chemical materials	Plant height (cm)	Root length (cm)	No.of leaves/ plant	No.of branches / plant	Fresh weight of shoot (gm)	Fresh weight of root (gm)	Dry weight of shoot (gm)	Dry weight of root (gm)	Shoot / root ratio on F.W.bassis
0 p.p.m	0	40.3	27.0	20.0	4.0	36.0	8.0	5.7	1. 5	4. 51
	Phosphoric acid 10mM	48.3	29.7	26.0	5.3	45.3	10.4	7.7	2.4	4.39
	Phosphoric acid 20mM	46.3	29.0	24.7	5.0	42.7	10.2	7.9	2.4	4.18
	Proline acid 30 p.p.m	44.3	28.0	23.3	4.7	39.7	8.2	6.5	1.6	4.84
	Proline acid 60 p.p.m	43.3	27.3	22.6	4.3	38.7	8.0	6.6	1.6	4.85
	PP_{333} 100 p.p.m	40.0	29.3	18.0	5.7	31.3	10.0	5.5	2.7	3.13
	PP_{333} 200 p.p.m	39.3	29.7	16.7	5.0	30.0	8.9	5.2	1.9	3.37
3000 p.p.m	0	38.6	25.3	18.0	3.7	31.7	7.8	4.3	1.2	4.03
	Phosphoric acid 10mM	45.0	28.3	24.3	4.7	40.7	9.1	6.8	1.9	4.47
	Phosphoric acid 20mM	43.3	27.7	23.0	4.3	37.3	8.8	6.6	1.9	4.24
	Proline acid 30 p.p.m	41.0	26.6	20.3	4.0	34.0	7.3	5.3	1.3	4.64
	Proline acid 60 p.p.m	40.3	26.0	19.3	4.0	33.3	7.1	5.3	1.3	4.70
	PP_{333} 100 p.p.m	37.6	28.0	16.3	5.0	29.0	8.9	4.8	2.0	3.26
	PP_{333} 200 p.p.m	33.3	27.7	15.0	4.7	28.3	7.7	5.0	1.6	3.70
6000 p.p.m	0	33.3	20.3	16.3	3.3	29.3	6.2	3.8	1.0	4.74
	Phosphoric acid 10mM	41.3	25.7	20.7	4.0	35.3	8.3	5.2	1.7	4.24
	Phosphoric acid 20mM	39.9	24.7	20.3	4.0	33.7	8.2	5.3	1.5	4.19
	Proline acid 30 p.p.m	37.0	22.3	18.0	3.7	29.7	6.8	4.3	1.1	4.37
	Proline acid 60 p.p.m	36.3	21.7	16.3	3.7	27.0	6.6	3.9	1.1	4.09
	PP_{333} 100 p.p.m	31.6	24.7	15.7	4.3	23.7	8.2	3.6	1.6	2.88
	PP_{333} 200 p.p.m	28.3	24.0	14.0	4.0	21.3	7.0	3.2	1.3	3.03
9000 p.p.m	0	30.3	17.7	15.3	2.7	23.7	6.0	2.8	0.8	3.95
	Phosphoric acid 10mM	37.7	24.0	19.3	4.0	31.0	7.7	3.9	1.5	4.05
	Phosphoric acid 20mM	36.3	23.3	18.7	3.7	30.3	7.6	4.0	1.3	3.99
	Proline acid 30 p.p.m	33.7	19.0	17.7	3.3	27.0	6.3	3.6	0.9	4.27
	Proline acid 60 p.p.m	32.0	18.3	15.0	3.3	25.7	6.2	3.2	1.0	4.14
	PP_{333} 100 p.p.m	27.0	23.7	14.0	4.0	20.7	7.8	2.9	1.5	2.65
	PP_{333} 200 p.p.m	23.3	20.3	13.0	3.7	18.7	6.6	2.4	1.2	2.83
12000 p.p.m	0	24.3	15.0	15.0	2.3	22.0	5.6	2.0	0.7	3.96
	Phosphoric acid 10mM	33.6	22.3	18.3	3.7	29.6	7.1	3.4	1.2	4.18
	Phosphoric acid 20mM	30.3	20.7	17.7	3.3	26.7	7.2	3.2	1.2	3.72
	Proline acid 30 p.p.m	29.3	16.7	16.3	3.0	24.7	5.9	3.2	0.8	4.18
	Proline acid 60 p.p.m	29.7	16.0	15.0	2.7	23.0	5.9	2.6	0.8	3.88
	PP_{333} 100 p.p.m	23.0	20.3	13.3	3.7	18.0	7.3	2.3	1.3	2.46
	PP_{333} 200 p.p.m	19.7	18.7	12.7	3.0	17.3	6.2	1.9	1.0	2.80
L.S.D. at 5 %		n.s	n.s	n.s	n.s	n.s	n.s	0.6	0.2	0.41

Table (7): Effect of interaction between salinity and chmical materials on vegetative growth characteristics of tomato plants during 1997 season.

Season		1997								
Salinity	Chemical materials	Plant height (cm)	Root length (cm)	No.of leaves/ plant	No.of branches / plant	Fresh weight of shoot (gm)	Fresh weight of root (gm)	Dry weight of shoot (gm)	Dry weight of root (gm)	Shoot / root ratio on F.W.bassis
0 p.p.m	0	43.3	26.7	21.3	4.3	35.3	7.5	5.0	1.4	4.71
	Phosphoric acid 10mM	52.3	31.7	26.3	4.7	42.3	10.0	6.5	2.0	4.24
	Phosphoric acid 20mM	46.7	31.3	25.7	4.3	39.7	9.7	6.6	2.1	4.10
	Proline acid 30 p.p.m	42.0	31.3	23.3	4.3	40.7	7.9	5.9	1.5	5.15
	Proline acid 60 p.p.m	49.0	28.3	20.7	4.3	37.7	7.6	5.7	1.4	4.96
	PP_{333} 100 p.p.m	40.0	31.3	18.7	4.7	25.3	9.6	4.0	2.1	2.64
	PP_{333} 200 p.p.m	33.7	28.7	17.7	3.7	24.3	8.3	3.8	1.9	2.91
3000 p.p.m	0	39.7	23.3	19.7	3.3	31.3	6.4	4.0	1.0	4.89
	Phosphoric acid 10mM	47.0	28.0	22.7	4.0	37.3	8.7	5.4	1.7	4.30
	Phosphoric acid 20mM	48.7	29.3	22.3	3.7	31.0	8.4	4.8	1.6	3.69
	Proline acid 30 p.p.m	44.0	30.7	19.0	3.7	32.3	7.0	4.5	1.2	4.62
	Proline acid 60 p.p.m	42.0	28.7	17.0	4.0	30.7	6.8	4.3	1.1	4.56
	PP_{333} 100 p.p.m	35.3	28.7	17.3	4.3	23.3	8.3	3.5	1.7	2.79
	PP_{333} 200 p.p.m	32.0	26.7	16.7	3.3	21.7	7.7	3.1	1.6	2.82
6000 p.p.m	0	38.0	22.0	18.0	3.3	25.7	6.0	2.6	0.8	4.28
	Phosphoric acid 10mM	43.0	28.0	21.0	3.7	32.7	8.2	4.3	1.4	3.98
	Phosphoric acid 20mM	46.3	28.0	20.0	3.3	28.7	8.0	4.0	1.5	3.58
	Proline acid 30 p.p.m	40.0	28.0	17.0	3.3	27.7	6.5	3.5	1.0	2.27
	Proline acid 60 p.p.m	42.3	25.3	16.0	3.7	26.3	6.2	3.4	0.9	4.26
	PP_{333} 100 p.p.m	30.0	25.7	16.0	4.0	20.7	7.8	2.8	1.4	2.66
	PP_{333} 200 p.p.m	27.0	24.0	15.3	3.3	20.7	7.2	2.7	1.2	2.87
9000 p.p.m	0	32.3	20.7	16.3	3.0	23.0	5.3	1.9	0.5	4.35
	Phosphoric acid 10mM	41.0	26.0	19.7	3.3	30.7	7.4	3.5	1.2	4.14
	Phosphoric acid 20mM	42.3	26.3	18.3	3.3	24.7	7.1	3.0	1.2	3.46
	Proline acid 30 p.p.m	40.7	24.3	16.3	3.0	25.3	6.0	2.7	0.9	4.24
	Proline acid 60 p.p.m	40.7	25.0	15.3	3.0	24.7	5.7	2.7	0.8	4.37
	PP_{333} 100 p.p.m	27.0	20.7	14.0	3.7	19.0	7.3	2.3	1.2	2.59
	PP_{333} 200 p.p.m	22.0	23.0	13.3	3.0	18.7	7.0	2.1	1.1	2.66
12000 p.p.m	0	26.7	18.3	14.0	2.3	18.0	5.0	1.3	0.4	3.60
	Phosphoric acid 10mM	35.7	25.3	18.3	3.0	24.0	6.8	2.5	1.1	3.55
	Phosphoric acid 20mM	35.3	25.0	17.0	2.7	22.3	6.3	2.4	1.0	3.52
	Proline acid 30 p.p.m	34.7	23.0	15.7	2.7	21.3	5.4	2.0	0.7	3.95
	Proline acid 60 p.p.m	32.0	23.0	14.0	2.3	20.7	5.2	1.9	0.7	3.99
	PP_{333} 100 p.p.m	20.0	20.3	13.0	3.0	17.7	6.7	1.9	1.0	2.64
	PP_{333} 200 p.p.m	18.3	17.7	12.3	2.7	17.7	6.5	1.8	1.0	2.82
L.S.D. at 5 %		3.8	2.6	n.s	n.s	2.9	n.s	0.5	n.s	0.45

-It is worth mentioning that application of phosphoric acid as spraying on tomato plants with any of used concentrations overcome the deleterious effect of salinity of vegetative growth up to the level of 6000p.p.m of NaCl salinity, so that tomato plants grow normally as plants that grown under normal conditions (control), that irrigated with tap water.

2. Chemical composition of leaves:

2.1. Photosynthetic pigments:

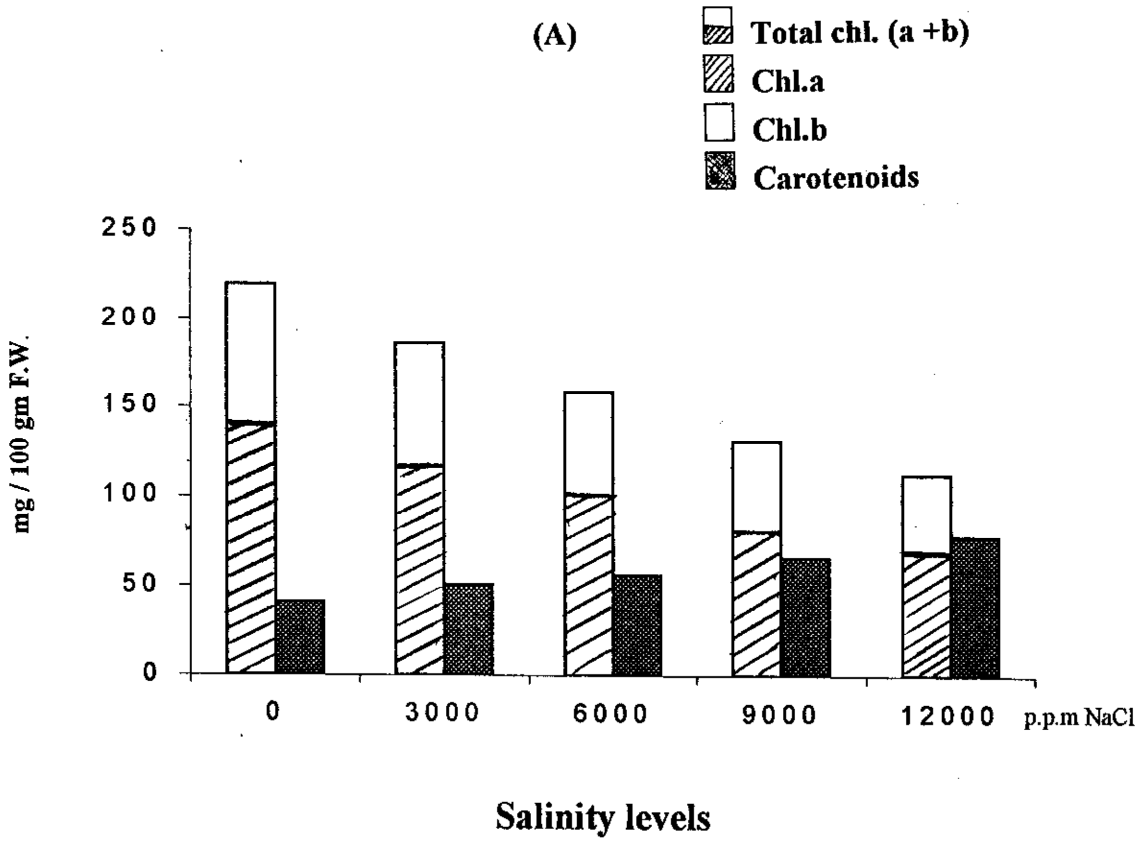
2.1.1. Effect of salinity:

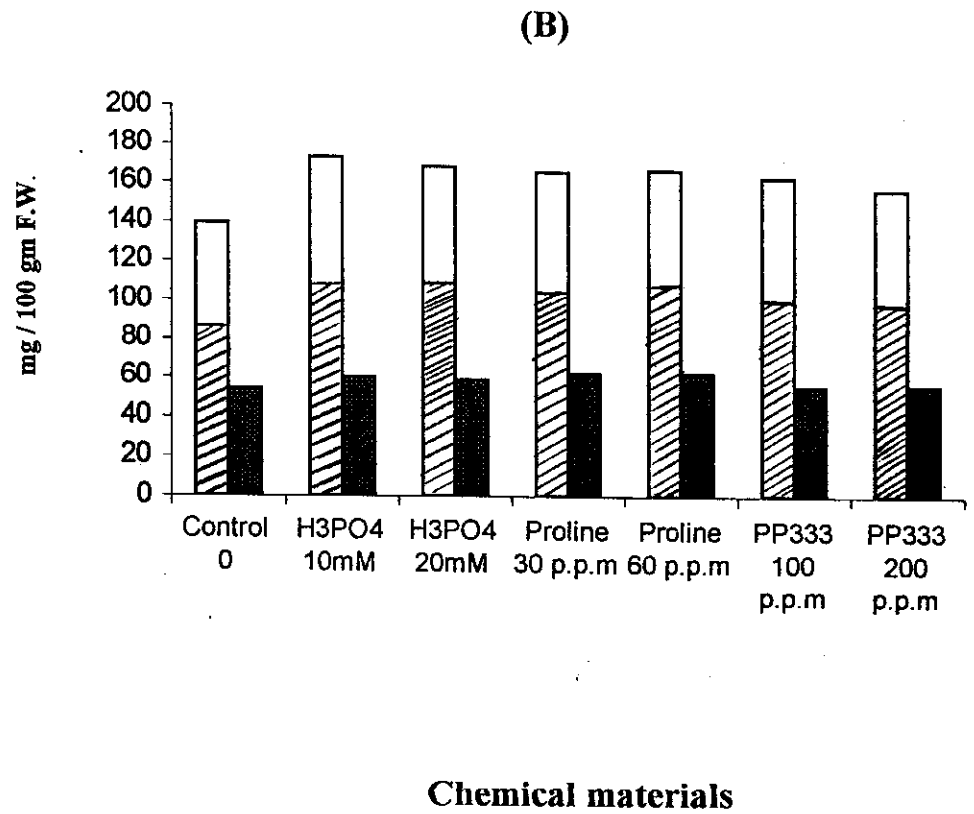
Data presented in Table (8) and Figure (3) show clearly that, using saline water for irrigation of tomato plants resulted in a significant and continuos decrease in the concentration of both chlorophyll a,b and consequently total chlorophyll compared to the control. On the contrary, the same table and figure indicated that oppositely to that observed in case of increasing salinity level led to increase in leaves content of carotenoids. The highest increase in this regard was obtained when plants were irrigated with the highest salinity level i.e. 12000 p.p.m NaCl. These results are going in the same trend in both seasons of 1996 and 1997. Obtained results about the effect of salinity on these pigments might be attributed to that the role of salinity in this respect it caused an adverse effect on water relationship of plant and consequently decrease photosynthesis process. Also those harmful effects of salinity might be attributed to the inhibitory effects of chloride on the activity of iron containing (cytochrom oxidase). This enzyme under chloride salinity may affect the rate of chloroplast structure and chlorophyll accumulation. On the other hand, salinity adversely affect the photosynthetic area as well as the rate of carbon assimilation, the lowest photosynthetic ability under

Table (8): Photosynthetic pigments (mg /100gm F.W.) of tomato leaves as affected by irrigation with saline water and spraying with different chemical materials during 1996 and 1997 seasons.

Seasons	1996				1997			
Treatments / Salinity	Chlorophyll (a)	Chlorophyll (b)	Total Chlorophyll	Carotenoids	Chlorophyll (a)	Chlorophyll (b)	Total Chlorophyll	Carotenoids
0 p.p.m	144	81	225	41	142	73	215	41
3000 p.p.m	119	64	182	51	125	65	190	55
6000 p.p.m	102	56	158	57	102	56	158	55
9000 p.p.m	82	48	130	66	81	50	131	66
12000 p.p.m	71	43	113	77	64	46	110	79
L.S.D. at 5 %	3	2	4	2	2	1	3	2
Chemical materials								
Control 0	90	50	139	55	86	52	138	53
Phosphoric acid 10m.M	106	65	170	58	114	62	176	62
Phosphoric acid 20m.M	108	58	166	60	111	59	170	58
Proline acid 30 p.p.m	103	61	164	61	107	59	166	62
Proline acid 60 p.p.m	108	56	164	64	111	56	167	60
Paclobutrazol 100p.p.m	108	59	167	56	96	60	156	54
Paclobutrazol 200p.p.m	103	60	163	55	95	59	154	57
L.S.D. at 5 %	3	2	3	2	2	2	3	2

Fig. (3): *Effect of salinity levels (A) and chemical materials (B) on photosynthetic pigments of tomato leaves (as average of both seasons).*





salt stress conditions was due to stomatal closure, inhibition of chlorophyll synthesis or due to decrease in the absorption of minerals needed for chlorophyll biosynthesis, i.e. iron and magnesium.

The results about the effect of salinity on chlorophyll are in agreement with those reported by many investigators on tomato plants among them **(Guerrier,1985; Sharf et al., 1985; Sarg, 1991; Rizk, 1993; Abdel-Latif, 1995; Abaza, 1996 and Wanas, 1996) and Akhavan et al., (1991)** on common bean.

Concerning the effect of salinity on carotenoids content, results are in harmony with those reported by **Sharaf et al.(1985) and Abaza (1996)** on tomato plants.

2.1.2. Effect of chemical materials:

Data presented in Table (8) and Figure (3) show that application of tested chemicals led mostly to significant increases in tomato leaves content of chlorophyll a,b as well as total chlorophyll (a + b) and carotenoids. It is evident from the previously data that, application of phosphoric acid was the best favourable effect in comparison with other treatments especially with low concentration (10mM) on chlorophyll pigments. Proline acid treatment was distinguished with the two concentrations (30 and 60 p.p.m) by its effects on increasing carotenoids pigments especially in the first season.

Paclobutrazol treatment exhibited the lowest effects on photosynthetic pigments compared to the other chemical treatments, but it still higher than control. The favourable effects of application these materials on photosynthetic pigments may be attributed to the physiological role of these chemicals in plant tissues.

With respect to the phosphoric acid it plays an essential role in absorption of the other nutrients and a vital role in cell division, thus it will contribute in seedlings development and consequently increase the leaf area which reflect in increasing photosynthesis pigments. Whereas the favourable effect of proline acid may be due to that the proline is synthesized and accumulated under water and salt stress to depress the internal osmotic potential and so maintain a positive gradient for water uptake that is essential for photosynthesis process. The results about the effect of proline acid on photosynthetic pigments are in agreement with those reported by **Abdel–Latif (1995)** on tomato plants. Moreover, the results about the effect of paclobutrazol are in accordance with those of (**Borkowski et al.,1989; El-Desouky, 1992 and Wanas, 1996)** working on tomato plants and **El- Desouky and Abd El-Dayem (1992 a)** on sesame and **Ismaeil (1995)** on broad bean.

With respect to the effect of the interaction between salinity levels and chemical materials on photosynthetic pigments of tomato plants (Table 9), data indicate that the differences between treatments were significant during both seasons of this work. It is evident from such data that, the lowest content of chlorophyll a, b and total (a + b) was found under 12000 p.p.m of salinity without application any of chemical materials (81 mg as average of both seasons).

The highest content of chlorophyll a, b and total (a + b) was found under irrigation with tap water accompanied with spraying with proline acid (low concentration 30 p.p.m 239 mg total chlorophyll), followed with paclobutrazol (low concentration 100 p.p.m 224 total chlorophyll) under the same treatment (tap water) as average of both seasons.

Table (9): Effect of interaction between salinity and chemical materials on photosynthetic pigments (mg/100 gm F.W.) of tomato leaves during 1996 and 1997 seasons.

Seasons		1996				1997			
Salinity	Chemical materials	Chlorophyll (a)	Chlorophyll (b)	Total Chlorophyll	Carotenoids	Chlorophyll (a)	Chlorophyll (b)	Total Chlorophyll	Carotenoids
0 p.p.m	0	130	73	203	39	128	68	196	38
	Phosphoric acid 10mM	137	79	216	42	141	75	216	46
	Phosphoric acid 20mM	133	74	207	45	142	70	212	44
	Proline acid 30 p.p.m	154	91	245	47	156	77	233	43
	Proline acid 60 p.p.m	154	74	228	50	162	71	233	36
	PP_{333} 100 p.p.m	152	85	237	33	137	74	211	42
	PP_{333} 200 p.p.m	150	92	242	31	126	79	205	38
3000 p.p.m	0	104	58	162	46	112	63	175	45
	Phosphoric acid 10mM	119	73	192	51	131	70	201	55
	Phosphoric acid 20mM	121	65	186	54	122	65	187	49
	Proline acid 30 p.p.m	116	69	185	54	142	67	209	56
	Proline acid 60 p.p.m	123	60	183	55	129	62	191	51
	PP_{333} 100 p.p.m	125	61	186	54	125	66	191	45
	PP_{333} 200 p.p.m	122	60	182	43	116	62	178	49
6000 p.p.m	0	90	48	138	53	85	50	135	52
	Phosphoric acid 10mM	108	67	175	52	108	63	171	56
	Phosphoric acid 20mM	110	56	166	59	113	60	173	55
	Proline 30p.p.m	102	55	157	59	110	51	161	57
	Proline 60p.p.m	105	54	159	61	109	52	161	62
	PP_{333} 100p.p.m	102	55	157	54	90	58	148	48
	PP_{333} 20p.p.m	100	56	156	58	102	58	160	52
9000 p.p.m	0	72	37	109	61	64	43	107	58
	Phosphoric acid 10mM	85	55	140	69	105	52	157	68
	Phosphoric acid 20mM	90	52	142	62	96	53	149	60
	Proline acid 30 p.p.m	79	47	126	71	70	50	120	77
	Proline acid 60 p.p.m	82	48	130	76	83	50	133	69
	PP_{333} 100 p.p.m	89	50	139	60	72	52	124	55
	PP_{333} 200 p.p.m	78	49	127	63	74	53	127	72
12000 p.p.m	0	52	33	85	74	43	34	77	73
	Phosphoric acid 10mM	80	49	129	74	84	50	134	84
	Phosphoric acid 20mM	85	45	130	80	80	49	129	83
	Proline acid 30 p.p.m	65	44	109	74	58	48	106	78
	Proline acid 60 p.p.m	75	44	119	77	71	45	116	80
	PP_{333} 100 p.p.m	72	42	114	80	58	50	108	80
	PP_{333} 200 p.p.m	67	41	108	81	56	43	99	74
	L.S.D. at 5 %	6	5	8	5	5	5	7	5

It is clearly show, that the harmful effect of salinity on chlorophyll pigments was more pronounced than all chemicals in this respect.

Concerning carotenoids pigments, data indicated that, increasing salinity levels led to increasing leaves content of carotenoids. This increment continued with spraying tomato plants with chemical materials. In this connection, the highest values (82 mg) were observed when phosphoric acid (high concentration 20 mM) was used followed by paclobutrazol (low concentration 100 p.p.m) 80mg under the highest level of salinity 12000 p.p.m.

2.2.Mineral composition of leaves:

2.2.1. Effect of salinity:

Data on the effect of sodium chloride salinity on tomato leave content of N, P, K, Ca, Mg, Na and Cl are presented in Table (10). It is obvious from data that increasing salinity level led to significant and gradual reduction in leaves content of N, P, K, Ca and Mg. The lowest values of these elements were observed with the highest salinity level (12000 p.p.m) compared with control (tap water). These results are going in the same trend in the two seasons of this study. The obtained results are in agreement with those reported by **(El-Kholi et al.,1982; Morishita et al.,1986; Hummadi and Ghliem, 1987; Martinez and Cerda, 1987; Adams, 1988; El-Rawahy et al.,1990; Sarg, 1991; El-Rawahy et al., 1992; Helmy, 1992; El-Sherif et al.,1993; Rizk,1993; Badia and Meiri , 1994 ; Abdel-Latif, 1995, Abaza, 1996 and Satti et al., 1996)** working on tomato plants. On the contrary, some investigators showed that increasing salinity levels led to the increase of nitrogen **(Alam et al., 1989 and Abaza, 1996)** on tomato, phosphorus **(Al-Lawendy 1985 &**

Table (10): N,P,K, Ca, Mg,Na and Cl content (mg / 100gm D.W.) of tomato leaves as affected by irrigation with saline water and spraying with different chemical materials during 1996 and 1997 seasons.

Seasons / Treatments / Salinity	1996 N	1996 P	1996 K	1996 Ca	1996 Mg	1996 Na	1996 Cl	1997 N	1997 P	1997 K	1997 Ca	1997 Mg	1997 Na	1997 Cl
0 p.p.m	3561	258	2656	2263	764	216	556	3748	273	2713	2262	844	215	562
3000 p.p.m	3424	235	2437	2020	683	490	1236	3523	236	2514	2088	759	475	1197
6000 P.P.M	3011	211	2291	1820	587	816	1446	3124	221	2346	1822	624	825	1512
9000 p.p.m	2780	199	2089	1643	511	1163	1506	2840	204	2163	1690	486	1204	1581
12000 p.p.m	2583	164	1909	1545	410	1489	1740	2471	181	1803	1571	374	1590	1665
L.S.D. at 5%	21	5	37	32	9	10	7	26	4	25	17	16	8	6
Chemical materials														
Control 0	2864	192	2168	1664	496	908	1342	2856	196	2136	1748	502	950	1338
Phosphoric acid 10m.M	3346	236	2378	1928	624	800	1248	3366	243	2546	1960	642	819	1274
Phosphoric acid 20m.M	3302	218	2342	1876	632	817	1255	3286	233	2318	1932	638	845	1275
Proline acid 30 p.p.m	3028	216	2310	1916	608	823	1325	3110	225	2206	1888	640	845	1320
Proline acid 60 p.p.m	2952	218	2298	1884	576	830	1328	3104	207	2286	1854	624	872	1332
Paclobutrazol 100p.p.m	3032	209	2320	1928	206	821	1286	3132	234	2366	1920	664	841	1290
Paclobutrazol 200p.p.m	2980	205	2118	1812	596	845	1294	3136	225	2296	1908	612	860	1294
L.S.D. at 5 %	24	5	34	30	11	12	10	27	4	27	28	15	10	5

1990) working on different kinds of legumes and sugar beet, as well as Ca **(Abdel –Latif, 1995)** working on tomato plants.

Regarding the effect of salinity levels on tomato leaves content of Na and Cl, it is evident from data presented in Table (10) that such effect was significant during both seasons of 1996 and 1997. The highest values of these elements were recorded under the highest level of salinity (12000 p.p.m NaCl), in these conditions, Na and Cl content in tomato leaves reached seven and three folds respectively as average of both seasons in comparison with control, where increased Na content from 216 to 1540 mg, whereas Cl content increased from 559 to 1703 mg as average of both seasons. Obtained results are going in the same trend in the two seasons of this work. These results are in harmony with those reported by **(Mahmoud et al.,1986 b; Morishita et al., 1986 Hummadi and Ghleim, 1987; Subba-Rao et al.,1987; Alam et al.,1989; Sarg, 1991; El-Rawahy et al.,1992; Helmy, 1992; El-Sherif et al.,1993 Rizk, 1993; Badia and Meiri; 1994; Abdel-Latif, 1995; Abaza, 1996; Perez-Alfocea et al.,1996 and Satti et al.,1996)** all working on tomato plants.

2.2.2. Effect of chemical materials:

Data presented in Table (10) show the effect of different chemical materials on the accumulation of studied elements in tomato leaves. Obtained results show that, using any of these materials led mostly to a significant increase in the content of N,P,K,Ca and Mg compared with the control. The highest values of N,P,K and Ca were recorded with tomato leaves produced from plants received (10 mM) phosphoric acid (3356, 239, 2462 and 1944 mg/100gm dry weight, respectively as average of both seasons), whereas, the highest value of

Mg was found in corresponding way with the (20mM) phosphoric acid (635 mg/100 gm dry weight). Tomato leaves from plants did not received any chemicals exhibited the least values in this respect (2860, 194, 2152, 1706 and 499 mg/ 100 gm dry weight) for N,P,K,Ca and Mg, respectively as average of both seasons. Tomato plants that treated with other treatments lie in between in this respect. These results about the effect of phosphoric acid on N,P,K,Ca and Mg elements content are in agreement with those reported by **(Abdalla et al.,1979; Abd-El-Zaher,1989; Shafshak,1989 and Taya et al.,1994)** with N, they worked on tomato, eggplant, broad bean and tomato, respectively, and P (**Farrag, 1970** on broad bean, **Patel and Wallace, 1976 and Abd-alle et al.,1979** on tomato; **Delbert and Hemphill, 1982** on cucumber, carrot, lettuce and onion; **Shafshak, 1989** on broad bean and **Masaguer et al.,1991; Taya et al.,1994 and Satti and El-Yahyai, 1995** all working on tomato), and with leaves content of K (**Farrag, 1970** on broad bean; **Abdalla et al.,1979** on tomato; **Shafshak, 1989** on broad bean; **Awad et al.,1990 and Taya et al.,1994** on tomato), and Ca (**Patel and Wallace, 1976** on tomato).

Concerning the effect of proline acid on leaves content of N,P,K,Ca and Mg elements, it clearly show that application of the two concentrations of proline acid (30 and 60 p.p.m) resulted in an increase in tomato leaves content of all previously mentioned elements, these increases were significant in the both seasons for all tested elements. Obtained results are in agreement with those reported by **Wageeh (1994)** on wheat and **Abdel –Latif (1995)** on tomato, they noticed that proline acid increased leaves content of N,P,K and Mg, whereas it decreased leaves content of Ca **(Abdel-Latif, 1995).**

With respect to the effect of PP_{333} on tomato leaves content of N,P,K,Ca and Mg, it is evident from the same table that spraying tomato plants with the two concentrations of PP_{333} (100 and 200 p.p.m) resulted in a significant increase in most leaves content of those elements. These results hold true during both seasons of this work. Such results are in agreements with those reported by **El-Desouky and Abd-El-Dayem (1992 b)** on rapeseed **and Ismaeil (1995)** on broad bean. On the contrary **Ismaeil** in the same study indicated that the content of K was inversely proportional to paclobutrazol concentration.

Concerning the effect of chemical materials on tomato leaves content of Na and Cl, data presented in Table (10) show clearly that application of these materials resulted in a significantly reduction when compared with the control. The least values of both N and Cl contents were recorded with phosphoric acid treatments. This reduction was more pronounced with the low concentration (10mM) compared to the higher one (20mM). At the same trend, the low concentrations of each of proline acid and paclobutrazol (30 and 100 p.p.m, respectively) recorded the least values in Na and Cl content of plant leaves in comparison with the corresponding higher concentrations of each (60 and 200 p.p.m, respectively). These results were going in the same trend during the two seasons of 1996 and 1997.

The effects of chemical materials on the nutritional status of tomato leaves could be attributed to that accumulation of ions for osmotic adjustment and restriction of Na and Cl accumulation in immature leaves appear to be involved in phosphorus, proline and paclobutrazol enhancement of salt tolerance in tomato plants. The results about the positive effect of phosphoric acid on Na and Cl accumulation are in harmony with those reported by **Awad <u>et</u> <u>al</u>. (1990)** on tomato. On the contrary, **Patel** and **Wallace (1976)** noticed that as P level increased, Na and Cl concentration increased in tomato plant tissues.

Regarding the effect of proline acid, results in this regard are in agreements with those indicated by **Abdel-Latif (1995)** on tomato plants.

Regarding the effect of interaction between salinity levels and different chemical materials on tomato leaves content of N,P,K,Ca and Mg, data tabulated in Table (11) show that, the highest values of studied minerals were observed in tomato leaves produced from plants received phosphoric acid at 10 mM under irrigation with tap water conditions (3860, 282, 2940 and 2420 mg / 100 gm dry weight as average of both seasons) for N,P,K and Ca, respectively. Meanwhile, using 30 p.p.m proline acid gave the highest value of leaves content of Mg (865 mg/ 100gm dry weight as average of both seasons) under irrigation with tap water . The least values in this respect were those from plants irrigated with highest level of salinity (12000 p.p.m NaCl) without treating with any chemical materials (2345, 149, 1740, 1340 and 265 mg/ 100gm dry weight as average of both seasons) for N,P,K,Ca and Mg, respectively.

Table (11): Effect of interaction between salinity and chemical materials on N,P,K,Ca, Mg, Na and Cl content (mg/ 100. gm D.W.) of tomato leaves during 1996 and 1997 seasons.

Seasons		1996							1997						
Salinity	Chemical materials	N	P	K	Ca	Mg	Na	Cl	N	P	K	Ca	Mg	Na	Cl
0 p.p.m	0	3400	217	2390	2060	680	224	565	3560	253	2460	2200	740	223	577
	Phosphori 10mM	3750	282	2900	2500	780	214	542	3970	282	2980	2340	840	210	544
	Phosphori acid 20mM	3730	258	2680	2300	780	215	549	3870	268	2720	2200	810	213	551
	Phosphori acid 30 mM	3570	282	2820	2300	810	213	563	3770	279	2510	2300	920	213	570
	Phosphori acid 60mM	3410	262	2520	2400	800	216	562	3740	278	2680	2280	860	215	576
	PP_{333} 100 p.p.m	3550	243	2820	2240	760	219	556	3670	277	2960	2380	900	214	556
	PP_{333} 200 p.p.m	3520	264	2460	2040	740	213	556	3660	275	2680	2140	840	218	560
3000 p.p.m	0	3210	216	2260	1680	590	550	1274	3200	211	2360	2060	640	534	1217
	Phosphoric acid 10mM	3660	278	2540	2120	700	450	1196	3710	258	2700	2120	760	454	1176
	Phosphoric acid 20mM	3610	227	2470	2040	700	462	1191	3640	251	2530	2040	750	466	1186
	Proline acid 30 p.p.m	3450	231	2440	2140	720	496	1252	3480	235	2430	2100	860	464	1210
	Proline acid 60 p.p.m	3280	249	2360	2180	700	506	1239	3530	214	2420	2080	720	480	1217
	PP_{333} 100 p.p.m	3430	223	2600	2080	690	480	1238	3530	253	2620	2120	800	452	1187
	PP_{333} 200 p.p.m	3330	221	2390	1900	680	486	1263	3570	229	2540	2100	780	476	1187
6000 p.p.m	0	2740	196	2230	1600	480	915	1499	2680	191	2180	1700	520	906	1529
	Phosphoric acid 10mM	3370	251	2400	1820	660	774	1374	3340	232	2550	1800	680	774	1494
	Phosphoric acid 20mM	3280	212	2410	1880	640	792	1390	3310	240	2350	1840	560	813	1485
	Proline acid 30 p.p.m	2990	196	2290	1940	600	807	1492	3080	228	2340	1860	660	810	1526
	Proline acid 60 p.p.m	2888	204	2280	1740	570	816	1505	3120	201	2390	1800	600	831	1523
	PP_{333} 100 p.p.m	2890	215	2280	1900	590	798	1430	3160	231	2260	1880	680	807	1510
	PP_{333} 200 p.p.m	2930	205	2150	1860	570	810	1434	3180	222	2350	1880	580	834	1517
9000 p.p.m	0	2590	183	2130	1540	430	1240	1557	2530	177	2030	1540	380	1328	1640
	Phosphoric acid 10mM	3130	210	2100	1620	560	1124	1450	3120	224	2450	1780	500	1148	1533
	Phosphoric acid 20mM	3050	206	2140	1640	600	1152	1462	2980	207	2170	1820	540	1184	1531
	Proline acid 30 p.p.m	2600	190	2050	1700	500	1144	1527	2780	207	2030	1640	440	1180	1616
	Proline acid 60 p.p.m	2680	206	2270	1620	450	1136	1537	2710	179	2240	1630	520	1232	1624
	PP_{333} 100 p.p.m	2730	209	2060	1740	510	1152	1495	2870	227	2110	1620	540	1168	1559
	PP_{333} 200 p.p.m	2680	187	1870	1640	530	1190	1512	2890	209	2110	1800	480	1188	1562
12000 p.p.m	0	2380	150	1830	1440	300	1610	1818	2310	148	1650	1240	230	1760	1728
	Phosphoric acid 10mM	2820	157	1950	1580	420	1440	1680	2690	219	2050	1760	430	1510	1622
	Phosphoric acid 20mM	2840	186	2010	1520	440	1465	1684	2630	198	1820	1760	440	1550	1624
	Proline acid 30 p.p.m	2530	182	1950	1500	410	1455	1792	2440	176	1720	1540	320	1560	1681
	Proline acid 60 p.p.m	2510	169	2060	1480	360	1475	1796	2420	161	1700	1480	420	1600	1721
	PP_{333} 100 p.p.m	2560	156	1840	1680	480	1455	1710	2430	170	1880	1600	400	1565	1636
	PP_{333} 200 p.p.m	2440	148	1720	1620	460	1525	1708	2380	192	1800	1620	380	1585	1643
L.S.D. at 5 %		53	11	77	68	25	28	21	61	9	62	63	34	22	12

Concerning the effect of interaction between salinity levels and different chemical materials on leaves content of Na and Cl, data presented in Table (11) show that the differences were significant in this respect during both seasons. The least values were observed with spraying with phosphoric acid 10mM under irrigation with tap water (212 and 543 mg/ 100 dry weight as average of both seasons) for Na and Cl, respectively. In this respect, the highest values (1685 and 1773) for Na and Cl, respectively were observed in tomato leaves produced from plants that untreated with chemical under the highest level of salinity (12000 p.p.m). Tomato plants that treated with other treatments lie in between in this respect.

With respect to the effect of salinity levels on the relationship between Na^+ and other cations (K^+, Ca^{++} and Mg^{++}) in tomato leaves, it is obvious from the data that presented in Table (12) that, such ratios were significantly increased with increasing salinity levels in both tested seasons of this study (1996 & 1997). The obtained results are in agreement with those reported by **(Guerrier, 1984; Taleisnik-Gertel, 1984; Feigin et al., 1987; Hashim et al.,1988 a & b; Badia and Meiri, 1994 and Abdel-Latif, 1995)** on tomato, they noticed that Na^+: Ka^+ ratio in shoots can be used as an ionic indicator of tomato tolerance to salinity.

Concerning the effect of different chemical materials on the Na^+: K^+, Na^+ : Ca^{++} and Na^+: Mg^{++} ratios, data presented in Table (12) show clearly that such effects resulted in significant reduction in all studied ratios in both seasons of 1996 and 1997. The only exception is that the 200 p.p.m paclobutrazol effect on Na^+:K^+ ratio tended to approach that of the control in the first season in which differences were insignificant. The lowest values of Na^+: K^+, Na^+ : C^{++} and Na : Mg^{++} were observed in tomato leaves that produced from plants received phosphoric acid at 10mM showing 0.360, 0.457 and 1.533 respectively, as average of both seasons, Whereas, the highest values in this respect were recorded in tomato leaves produced from plants that untreated with chemicals (control) and reached 0.466, 0.610 and 2.547 for Na^+: K^+, Na^+: Ca^{++} and Na^+ Mg^{++}, respectively as average of both seasons. Tomato plants that treated with other treatments lie in between in this respect.

With respect to the effect of interaction between salinity levels and different chemical materials on Na^+: K^+, Na^+: Ca^{++} and Na^+ :Mg^{++} ratios, data presented in Table (13) show clearly that such effects were significant during both seasons. It is worth mentioning that increasing salinity levels led to progressively and continually increase in the previous ratios.

Spraying tomato plants with any of the tested chemicals resulted in considerable reduction in the Na: cations ratios in most cases.

Application phosphoric acid exhibited the most favourable effect in this respect, under conditions of 12000 p.p.m NaCl, plants that spraying with phosphoric acid (low concentration 10mM) recorded the lowest values of Na^+ : K^{++} and Na^+ :Ca^{++} ratios, whereas spraying with 20 mM phosphoric acid resulted the lowest value of Na^+ :Mg^{++} ratio (0.738, 0.885 and 3.428) as average of both seasons of this work for Na^+ : K^+, Na^+: Ca^{++} and Na^+: Mg^{++} respectively. In this connection the highest values of Na^+: other cations were recorded under 12000 p.p.m NaCl condition without any of spraying chemicals.

With respect to the effect of paclobutrazol on proline content in tomato leaves such effects are in agreement with those reported by **Wanas (1996)** on tomato plants.

Concerning the effect of interaction between salinity levels and chemical materials on leaves content of free proline, data presented in Table (13) show clearly that the differences in this respect were significant during the two seasons of this study. The highest value of leaves content of free proline was observed when proline acid (30 p.p.m) was applied under the highest level of salinity i.e. 12000 p.p.m (1.573 mg /gm fresh weight) as average of both season, whereas the least value was recorded with paclobutrazol application at 100 p.p.m when using tap water in irrigation (0.812 mg/ gm fresh weight) as average of both seasons.

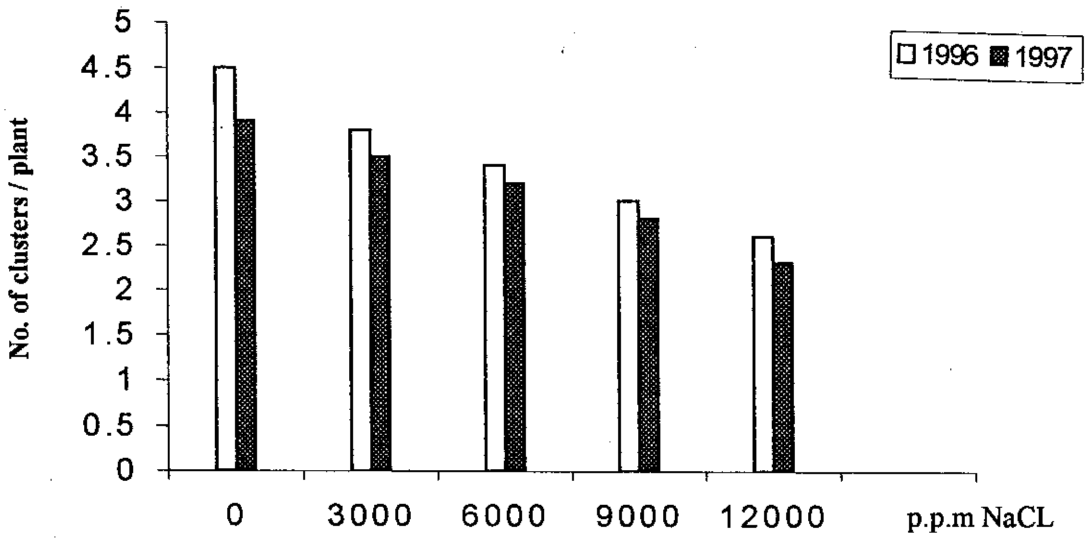
3.Flowering characteristics:

3.1.Effect of salinity:

Data presented in Table (14) and Figures (4 and 5) show the effect of salinity levels on number of clusters and flowers per plant. Such characteristics tended to decrease significantly as the level of salinity increased during both seasons of this study. These results might be attributed to either the adverse role of salinity on imbalance in nutritional cations in tissues of the salts affected plant and the retardant effects on plant growth that may be reflect on the reduction in flowering parameters, or due to the imbalance in hormons content in plants, as salinity increase. In such case salinity caused a decrease transport of kinetin (which is essential in flowering and fruiting processes) from root to leaves and an increase in leaves content of abscisis acid. Obtained results are in agreement with those

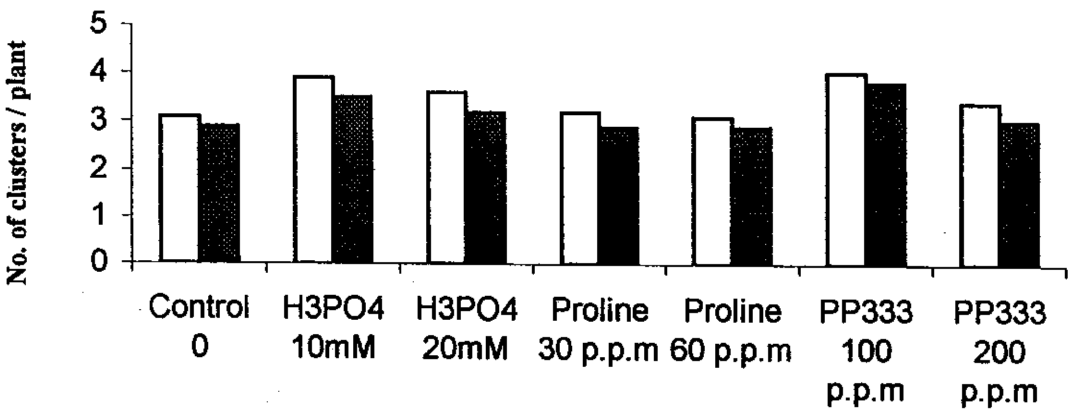
Fig (4): *Effect of salinity levels (A) and chemical materials (B) on number of clusters / plant.*

(A)



Salinity levels

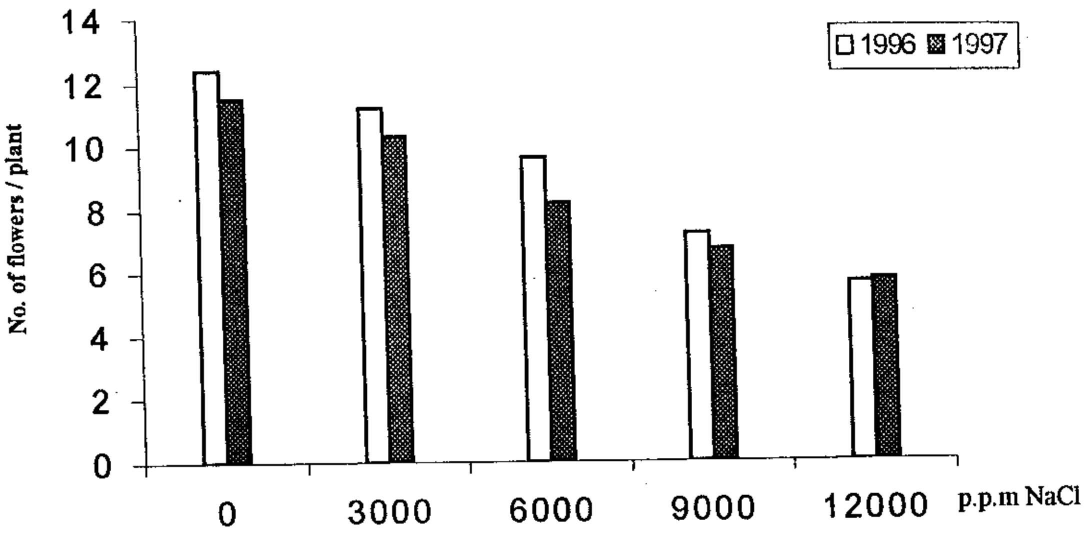
(B)



Chemical materials

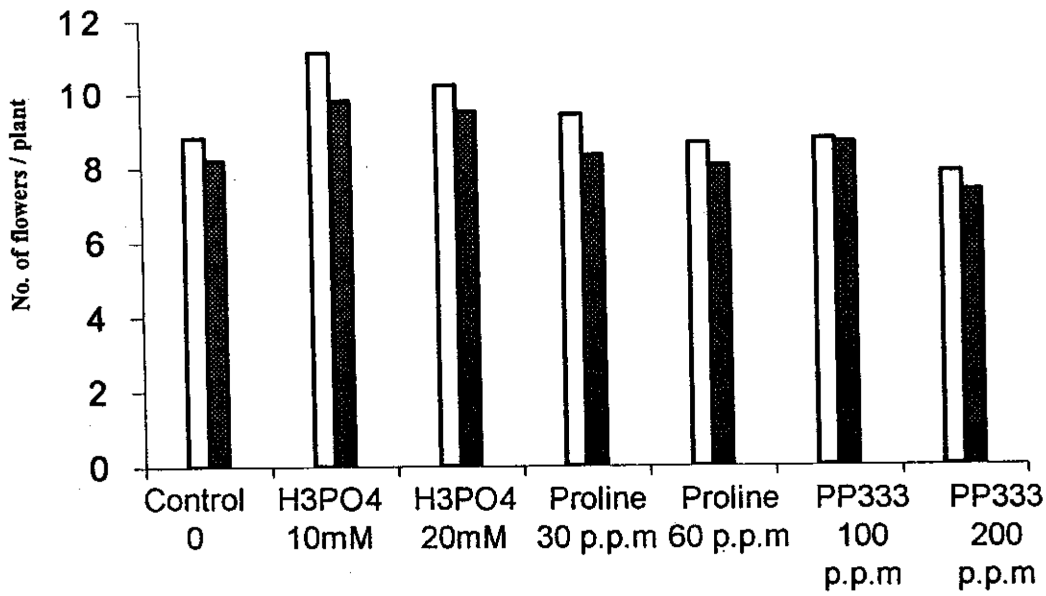
Fig. (5): *Effect of salinity levels (A) and chemical materials (B) on number of flowers / plant.*

(A)



Salinity levels

(B)



Chemical materials

reported by **(Mohamed, 1987; Abaza, 1996 and Wanas, 1996)** on tomato plants.

3.2.Effect of chemical materials:

Data presented in Table (14) and Figure (4) show the effect of different chemical materials on number of clusters of tomato plants. As average of both seasons, the highest value of number of clusters (3.9) was recorded in tomato plants that received the low concentration of paclobutrazol i.e. 100 p.p.m followed by phosphoric acid at 10 mM (3.7) whereas, the least value in this respct was observed in tomato plants that untreated with chemicals (3.0).

With respect to the effect of application of chemical materials on number of flowers per plant, data presented in Table (14) and Figure (5) indicate that such effects were only significant with phosphoric acid treatments (10 and 20 mM), whereas, application of other chemicals i.e. proline acid or paclobutrazol did not induce significant effect. Obtained results on the effect of phosphoric acid are in agreement with those reported by **Amer (1964)** on cotton, **Abd El-Zaher (1989)** on eggplant and **Selim (1990)** on pea plants. The obtained results about the effect of paclobutrazol on number of clusters and floweres are in harmony with those reported by **Salem et al., (1991)** on Gomphrena globosa plants, **El-Desouky and Abd El-Dayem (1992 a)** on sesame, **Wanas (1992)** on pea, **Ismaeil (1995)** on broad bean and **Wanas (1996)** on tomato plants.

Concerning the interaction between salinity levels and chemical materials (Table, 15) , no significant effects on number of clusters and flowers per plant could be detected during both seasons of this work.

Table(14): Flowering and yield and its components of tomato plants as affected by irrigation with saline water and spraying with different chmical materials during 1996 and 1997 seasons.

Seasons	1996							1997						
Treatments	No.of clusters /plant	No.of flowers /plant	No.of fruits /plant	Average fruit weight (gm)	Fruit length (cm)	Fruit diameter (cm)	Plant yield (gm)	No.of clusters /plant	No.of flowers /plant	No.of fruits /plant	Average fruit weight (gm)	Fruit length (cm)	Fruit diameter (cm)	Plant yield (gm)
Salinity														
0 p.p.m	4.5	12.4	6.9	34.0	4.3	4.0	236	3.9	11.5	7.3	31.7	4.6	4.3	233
3000 p.p.m	3.8	11.2	6.2	30.9	4.0	3.8	195	3.5	10.3	6.1	29.1	4.2	3.9	180
6000p.p.m	3.4	9.6	5.0	26.4	3.8	3.4	135	3.2	8.2	4.6	23.8	4.0	3.7	112
9000 p.p.m	3.0	7.2	3.5	22.5	3.5	3.2	80	2.8	6.7	3.5	21.4	3.8	3.5	77
12000 p.p.m	2.6	5.6	2.7	18.0	3.3	3.0	50	2.3	5.7	2.8	17.5	3.6	3.1	50
L.S.D. at 5%	0.1	0.5	0.3	1.1	0.5	0.3	7	0.3	0.4	0.5	1.7	0.3	0.1	6
Chemical materials														
Control 0	3.1	8.8	4.5	24.8	3.4	3.0	122	2.9	8.2	4.4	24.1	3.7	3.4	115
Phosphoric acid 10m.M	3.9	11.1	5.7	30.4	4.5	4.1	183	3.5	9.8	5.9	28.3	4.3	4.2	176
Phosphoric acid 20m.M	3.6	10.2	5.3	28.4	4.1	3.8	161	3.2	9.5	5.3	27.2	4.3	4.0	154
Proline acid 30 p.p.m	3.2	9.4	5.0	26.9	3.7	3.5	141	2.9	8.3	4.9	25.4	4.1	3.9	133
Proline acid 60 p.p.m	3.1	8.6	4.7	25.0	3.5	3.1	124	2.9	8.0	4.6	24.3	3.9	3.7	122
Paclobutrazol 100p.p.m	4.0	8.7	4.8	27.1	4.1	3.8	140	3.8	8.6	4.8	24.3	4.1	3.7	123
Paclobutrazol 200p.p.m	3.4	7.8	4.2	22.0	3.4	3.0	102	3.0	7.3	4.2	19.3	3.7	3.1	89
L.S.D. at 5 %	0.4	0.7	0.4	1.5	0.4	0.4	10	0.3	0.6	0.4	1.4	0.5	0.5	8

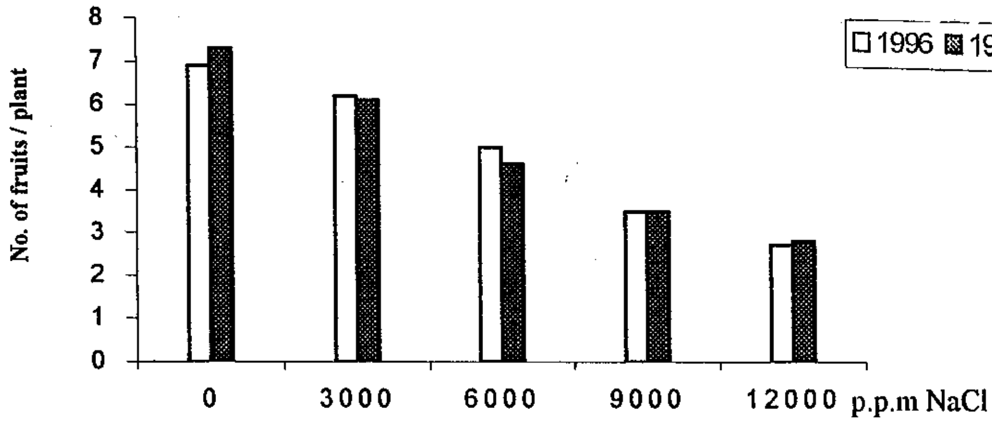
4. Yield and its components:

4.1 Effect of salinity:

Data in Table (14) and Figures (6,7 and 8) show the effect of salinity levels on yield and its components of tomato plants. It is evident from such data that number of fruits per plant, average fruit weight, length and diameter as well as plant yield were progressively and significantly reduced as salinity levels increased. These results are going in the same trend during the two seasons of 1996 and 1997. Such results may be attributed to the adverse effects of salinity on plant growth (Table,5) and photosynthetic pigments (Table,8) as well as mineral content of leaves (Table,10) which may be consequently reduce plant yield. Obtained results about the effect of salinity on number of fruits per plant and average fruit weight are in harmony with those reported on tomato plants by **(Rosario et al., 1990; Adams, 1991; Caro et al.,1991 Davis et al.,1991; Ohta et al.,1991; Soliman Doss, 1992; Alarcon et al.,1994; Abdel- Latif, 1995; Abaza, 1996 and Wanas, 1996)**. The results about the effect of salinity level on tomato plant yield (Table 14), are in line with those reported on tomato plants by **Adams, (1988); Mizrahi et al. (1988); Adams and Ho (1989); Awwad et al. (1991); Sarg (1991); Soliman and Doss (1992); Rizk (1993); Sarg et al. (1993); Alarcon et al. (1994) Faiz et al. (1994); Abdel –Latif (1995); Vespasiani et al. (1995); Abaza (1996); Perez –Alfocea et al. (1996); Wanas (1996); Yong et al. (1996) and Yurtsever and Sönmez (1996).** Obtained results about the effect of salinity on fruit length and diameter are in agreement with those reported on tomato fruits by **Al-Najum and Neimmah (1989); Rosario et al. (1990); Adams (1991); Caro et al. (1991); Davis et al. (1991); Ohta et al.**

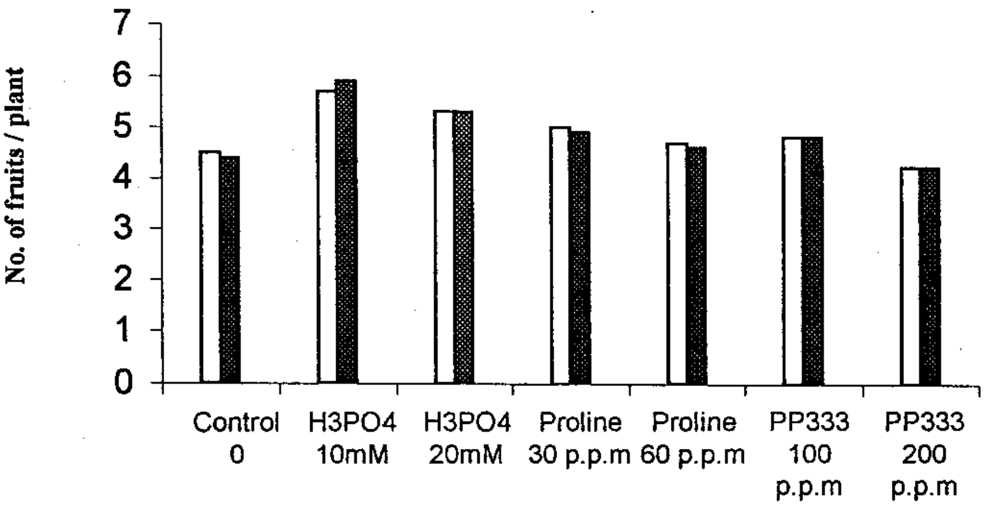
Fig. (6): *Effect of salinity levels (A) and chemical materials (B) on number of fruits / plant.*

(A)



Salinity levels

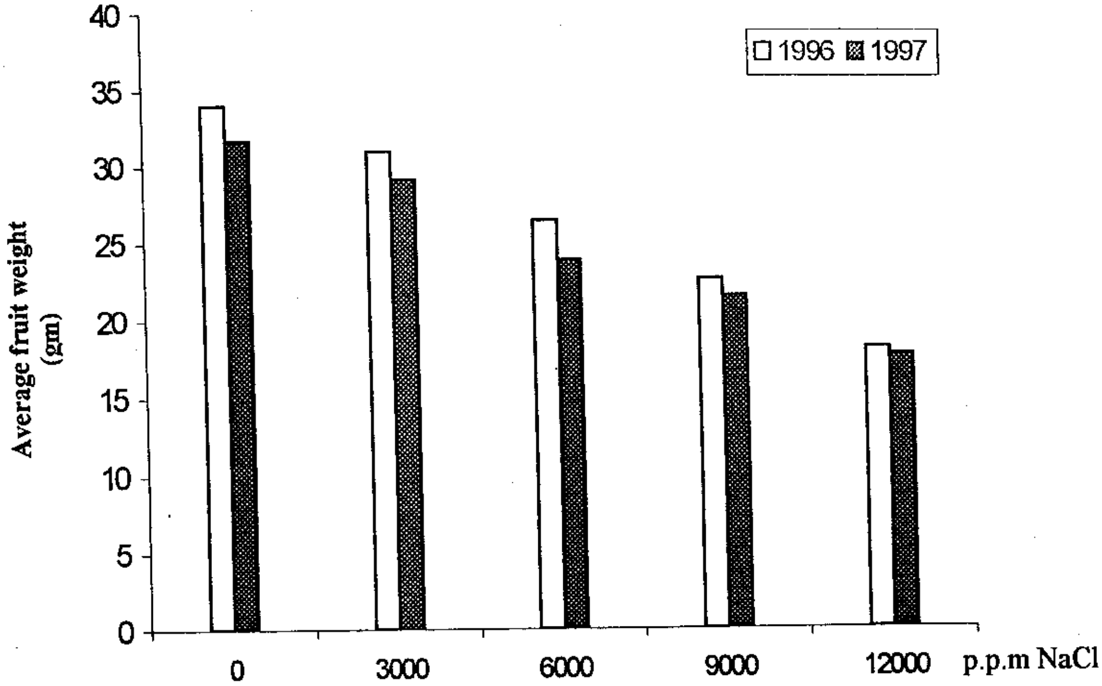
(B)



Chemical materials

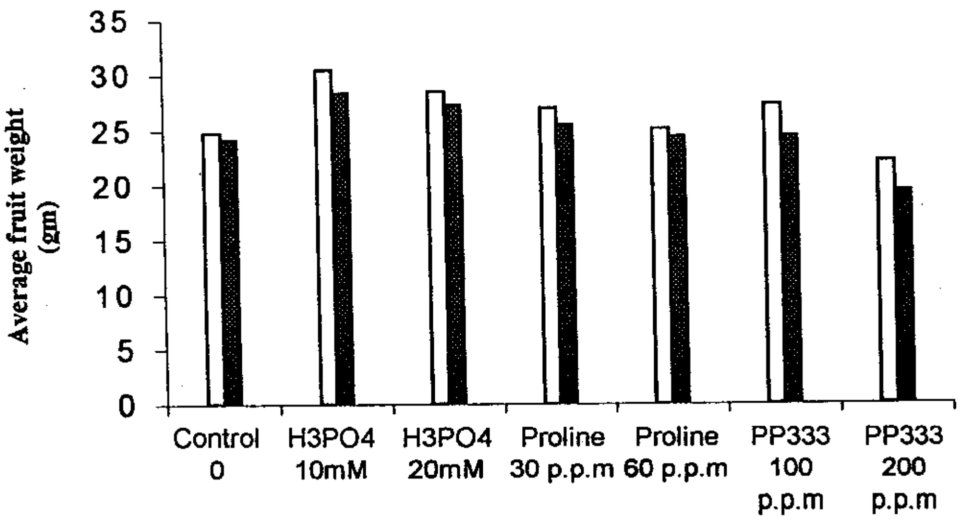
Fig. (7): *Effect of salinity levels (A) and chemical materials (B) on average fruit weight.*

(A)



Salinity levels

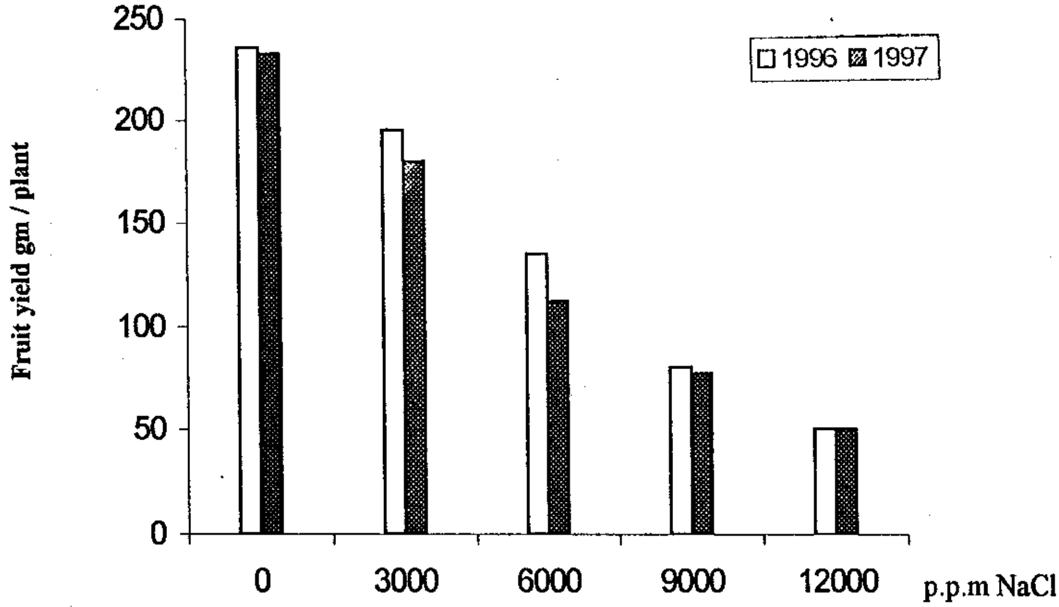
(B)



Chemical materials

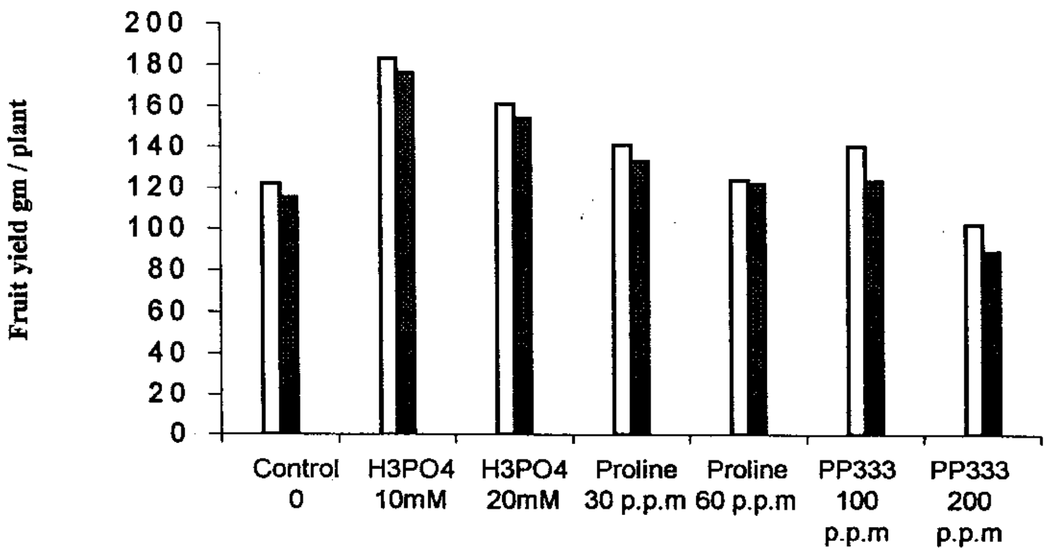
Fig. (8): *Effect of salinity levels (A) and chemical materials (B) on fruit yield / plant.*

(A)



Salinity levels

(B)



Chemical materials

Table (15): Effect of interaction between salinity and chemical materials on flowering and yield and its components of tomato plants during 1996 and 1997 seasons.

Seasons		1996							1997						
Salinity	Chemical materials	No.of clusters /plant	No.of flowers /plant	No.of fruits /plant	Average fruit weight (gm)	Fruit length (cm)	Fruit diameter (cm)	Plant yield (gm)	No.of clusters /plant	No.of flowers /plant	No.of fruits /plant	Average fruit weight (gm)	Fruit length (cm)	Fruit diameter (cm)	Plant yield (gm)
0 p.p.m	0	4.3	12.3	6.7	32.0	4.0	3.7	214	3.7	11.0	7.0	30.7	4.3	4.0	215
	Phosphoric acid 10mM	5.0	14.3	7.7	38.0	5.0	4.7	290	4.3	13.0	8.3	36.3	5.0	4.7	302
	Phosphoric acid 20mM	4.7	13.7	7.3	36.3	4.7	4.3	267	4.0	13.3	8.0	35.0	5.0	4.7	269
	Proline acid 30 p.p.m	4.3	12.7	7.0	33.7	4.3	4.0	234	3.7	11.0	7.3	32.0	4.7	4.7	234
	Proline acid 60 p.p.m	4.3	12.0	6.7	31.3	4.0	3.7	209	3.7	10.3	7.0	31.7	4.3	4.3	219
	PP_{333} 100 p.p.m	4.7	11.3	6.7	37.0	4.7	4.3	245	4.7	12.7	7.0	30.3	4.7	4.3	211
	PP_{333} 200 p.p.m	4.3	10.7	6.3	30.3	4.0	3.7	192	3.7	9.7	6.7	25.7	4.0	3.7	171
3000 p.p.m	0	3.7	10.3	6.0	28.7	3.7	3.3	172	3.3	10.0	5.7	28.0	4.0	3.7	158
	Phosphoric acid 10mM	4.3	13.7	7.0	35.3	4.7	4.3	247	4.0	12.0	7.0	33.7	4.7	4.3	233
	Phosphoric acid 20mM	4.0	13.0	6.7	33.3	4.3	4.3	221	3.7	12.0	6.3	32.7	4.7	4.3	206
	Proline acid 30 p.p.m	3.7	11.3	6.3	30.3	4.0	4.0	192	3.0	10.3	6.3	29.7	4.3	4.0	187
	Proline acid 60 p.p.m	3.3	10.7	6.0	28.7	3.7	3.3	170	3.3	9.7	6.3	28.3	4.0	4.0	179
	PP_{333} 100 p.p.m	4.3	10.3	6.3	33.0	4.3	4.0	208	4.3	10.0	6.0	28.7	4.3	4.0	170
	PP_{333} 200 p.p.m	3.7	9.7	5.7	27.0	3.7	3.3	153	3.3	8.7	5.3	23.0	3.7	3.3	123
6000 p.p.m	0	3.3	9.3	4.3	27.0	3.3	3.0	117	3.0	8.3	4.3	24.2	3.7	3.3	105
	Phosphoric acid 10mM	4.0	11.0	6.3	31.3	4.7	4.0	197	3.7	9.3	6.0	26.3	4.3	4.3	157
	Phosphoric acid 20mM	3.3	10.0	6.0	30.0	4.0	3.7	180	3.3	9.0	5.3	25.3	4.3	4.0	134
	Proline acid 30 p.p.m	3.0	10.0	5.3	25.3	3.7	3.7	134	3.0	8.0	4.7	24.7	4.0	3.7	115
	Proline acid 60 p.p.m	3.0	9.3	4.7	24.0	3.7	3.0	112	3.0	7.7	4.3	23.0	3.7	3.7	99
	PP_{333} 100 p.p.m	4.0	9.3	4.7	26.3	4.0	3.7	123	4.0	8.0	4.3	24.3	4.0	3.7	105
	PP_{333} 200 p.p.m	3.3	8.7	4.0	21.0	3.3	3.0	84	3.0	7.7	3.7	18.7	3.7	3.0	68
9000	0	2.3	7.7	3.3	22.7	3.0	2.7	75	2.7	6.7	3.0	22.7	3.3	3.3	68
	Phosphoric acid 10mM	3.3	8.7	4.3	25.3	4.3	4.0	109	3.0	7.7	4.7	24.0	4.3	4.0	112
	Phosphoric acid 20mM	3.0	8.0	3.3	23.7	4.0	3.7	78	2.7	7.0	3.7	23.0	4.0	3.7	84
	Proline acid 30 p.p.m	2.7	7.3	3.7	24.7	3.3	3.0	90	2.7	6.7	3.7	22.3	4.0	3.7	81
	Proline acid 60 p.p.m	2.7	6.3	3.7	22.0	3.3	3.0	80	2.7	6.7	3.3	21.0	4.0	3.3	70
	PP_{333} 100 p.p.m	4.0	7.0	3.3	21.0	4.0	3.7	70	3.7	6.3	3.7	20.7	3.7	3.3	76
	PP_{333} 200 p.p.m	3.0	6.0	3.0	18.7	3.0	2.7	56	2.7	6.0	3.0	16.3	3.7	3.0	49
12000 p.p.m	0	2.0	4.3	2.3	14.0	3.0	2.3	32	2.0	5.0	2.0	15.0	3.3	2.7	30
	Phosphoric acid 10mM	3.0	8.0	3.3	22.0	4.0	3.7	73	2.7	7.0	3.7	21.3	4.0	3.7	78
	Phosphoric acid 20mM	3.0	6.7	3.3	19.0	3.7	3.3	60	2.3	6.3	3.3	20.0	3.7	3.3	66
	Proline acid 30 p.p.m	2.3	5.7	2.7	20.7	3.3	3.0	55	2.3	5.7	2.7	18.7	3.7	3.3	50
	Proline acid 60 p.p.m	2.3	5.0	2.7	19.0	3.0	2.7	50	2.0	5.7	2.3	17.7	3.7	3.0	41
	PP_{333} 100 p.p.m	3.3	5.7	3.0	18.3	3.7	3.3	55	2.7	6.0	3.7	17.7	3.7	3.3	53
	PP_{333} 200 p.p.m	2.7	4.3	2.0	13.3	3.0	2.7	27	2.3	4.7	2.3	12.7	3.3	2.7	34
L.S.D. at 5 %		n.s	n.s	n.s	n.s	n.s	n.s	23	n.s	n.s	n.s	n.s	n.s	n.s	18

(1991); Soliman and Doss (1992); Alarcon et al. (1994); Vespasiani et al. (1995) and Wanas (1996).

4.2.Effect of chemical materials:

Data in Table (14) and Figures (6,7 and 8) show the effect of different chemical materials on plant yield and its components. It is evident from such data that there were significant increases in plant yield, number of fruits, average fruit weight and fruit length and diameter by phosphoric acid application (10 and 20 mM) in both seasons. Also the low level of proline (30 p.p.m) increased significantly fruit number, fruit diameter and plant yield in both seasons and average fruit weight in the first season. Whereas, the significant effect when paclobutrazol was used, was that effect of using low concentration (100 p.p.m) on plant yield during both seasons. The effect of other chemicals did not show similar trend in both seasons and in different cases they did not show significant differences when compared with the control. The higher level of paclobutrazol reduced significantly fruits weight and dimensions in both seasons. It is worthy to conclude that the highest values of yield and its components were observed on plants which were treated with phosphoric acid 10 mM followed by 20 mM phosphoric acid and 30 p.p.m proline acid, respectively. Whereas, the least values were recorded on tomato plants that treated with 200 p.p.m paclobutrzol in both seasons of study. In this regard, it is clear from obtained data that the increment of studied characters as a result of using 10mM phosphoric acid reached 130, 120, 151,124, and 130 % for number of fruits / plant, average fruit weight, plant yield, fruit length and fruit diameter, respectively, as average of both seasons in comparison with control. The results about the favourable effect of phosphoric acid on plant yield and physical fruit properties are in agreement with those reported on tomato by (**Jarmilo et al.,1978; Abdalla et al., 1979; Dimitrov and Rankov, 1979; Nunung, 1980; Satsijati and Soebijanto, 1980; Abed and Eid, 1987; El-Sawy, 1988; Al-Najum and Neimmah, 1989; Awad et al., 1990; Flett et al., 1990 and Abd –Alla et al. 1996**). Obtained results are also in confirmity with those of **Delbert** and **Hemphill (1982)** on carrot, cauliflower, cucumber, lettuce and onion; **Farag (1984)** on pepper and **Abd-El-Zaher (1989)** on eggplant. **Farrage (1970); Shafshak (1989); Selim (1990); Table et al. (1990 a & b) and Teneb et al. (1995)** working on different species of legumes. Similarly, **Manchanda et al. (1982)** and **Gibson (1988)** found the same conclusion on cereals and pasture species.

With regard to the effect of proline acid in theis respect, such results are in agreement with those reported by **Abdel –Latif (1995)** on tomato plants.

Regarding the effect of paclobutrazol on yield and its components and physical properties of fruits, such results are in agreement with those reported by **Elfving et al. (1987); Jones et al. (1988); Arora et al. (1989); Curry et al. (1989); Globerson et al. (1989; Prive et al. (1989); Elfving et al. (1990); El-Khoreiby et al. (1990) and Wanas (1996)** working on different species of vegetables.

As for the effect of interaction between salinity levels and chemicals used, data presented in Table (15) show that, it was only significant in case of plant yield, Meanwhile, differences did not reach the 5% level of significance in all physical fruit characters. This was true during both seasons of the experiment. The highest fruit yield (296gm/plant) was detected as phosphoric acid at 10mM was applied combined with control (tap water) irrigation. However, tomato plants supplemented with the highest level of salinity (12000 p.p.m) exhibited the least values, especially with application of 200 p.p.m paclobutrazol (31 gm / plant) as average of both seasons.

5.Fruit quality:

5.1. Vit. C, titratable acidity , T.S.S and sugars:

5.1.1. Effect of salinity:

Data presented in Table (16) show clearly that, there was a significant and gradual increase in fruits content of ascorbic acid (Vit.C.), titratable acidity and total soluble solids (T.S.S) as salinity level increased during both seasons. On the other hand, increasing salinity level resulted in a significant and progressive reduction in fruits content of reducing and total sugars, along with significant increase in fruits content of non-reducing sugars during both seasons of 1996 and 1997. Results regarding ascorbic acid (Vit .C.) are in harmony with those reported on tomato by **(Sarg, 1991 and Sarg et al. 1993).** On the contrary, **Ponomareva and Kubuzenko (1984)** found adverse results in this respect.

As for the favourable effect of salinity on fruits content of titratable acidity, results in this side are in agreement with those reported by **Mizrahi (1982); Grattan et al. (1987); Adams (1988) ; Davis et al. (1991); Sarg (1991); Sarg et al. (1993); Abaza (1996) and Satti et al. (1996)** on tomato plants.

Results on fruits content of total soluble solids (T.S.S) are in agreement with those reported on tomato plants by **Mizrahi (1982); Mizrahi et al. (1982); Lapushner et al. (1986); Adams (1987); Grattan et al. (1987): Mohamed (1987); Mizrahi et al. (1988); Sarg**

Table (16): Fruit quality of tomato plants as affected by irrigation with saline water and different chemical materials during 1996 and 1997 seasons.

Seasons	1996						1997					
Treatments / Salinity	Vit.C mg/100 gm F.W	Titratable acidity (%)	T.S.S. (%)	Reducing sugars (mg/ 100 gm D.W.)	Non-reducing sugars (mg/ 100 gm D.W.)	Total sugars (mg/ 100 gm D.W.)	Vit.C mg/100 gm F.W	Titratable acidity (%)	T.S.S. (%)	Reducing sugars (mg/ 100 gm D.W.)	Non-reducing sugars (mg/ 100 gm D.W.)	Total sugars (mg/ 100 gm D.W.)
0 p.p.m	22.7	0.52	6.6	4078	318	4396	23.1	0.52	6.2	4023	309	4332
3000 p.p.m	23.9	0.53	7.7	3871	352	4223	24.0	0.55	7.8	3900	347	4247
6000 p.p.m	24.4	0.55	8.7	3558	417	3975	24.9	0.57	8.9	3533	449	3982
9000 p.p.m	24.9	0.60	8.9	3291	466	3757	25.4	0.61	9.2	3242	465	3707
12000 p.p.m	25.8	0.65	9.3	2985	477	3462	26.0	0.64	9.6	2909	471	3381
L.S.D. at 5%	0.1	0.01	0.2	20	14	15	0.1	0.01	0.2	62	23	73
Chemical materials												
Control 0	24.5	0.57	7.7	3502	386	3888	24.8	0.58	8.0	3535	399	3934
Phosphoric acid 10m.M	25.0	0.57	8.5	3630	429	4059	25.1	0.58	8.4	3609	436	4045
Phosphoric acid 20m.M	24.9	0.57	8.3	3632	427	4059	24.9	0.58	8.4	3543	433	3976
Proline acid 30 p.p.m	23.3	0.56	8.3	3488	374	3861	23.9	0.57	8.3	3455	380	3835
Proline acid 60 p.p.m	23.4	0.57	8.2	3476	381	3857	24.0	0.57	3.3	3436	392	3828
PP_{333} 100 p.p.m	24.6	0.57	8.5	3594	424	4018	25.0	0.58	8.5	3543	410	3953
PP_{333} 200 p.p.m	24.7	0.57	8.4	3576	421	3997	25.1	0.58	8.5	3527	411	3938
L.S.D. at 5 %	0.1	n.s	0.2	15	77	13	0.1	n.s	0.2	77	21	73

(1991); **Sarg et al. (1993); Abaza (1996); Satti et al. (1996) and Yong et al. (1996).**

With respect to the effect of salinity on sugars content, such results are in agreement with those indicated by **(Rajasekaran and Shanmugavelu, 1983; Davis et al. 1991 and Sarg, 1991)** on tomato. However, contra results were reported by **Adams (1988); Sarg et al. (1993) and Vespasiani et al. (1995)** indicating an increase in tomato fruits sugars by increasing salinity levels.

5.1.2. Effect of chemical materials:

Data presented in Table (16) show the effect of different chemical materials on fruits content of ascorbic acid (Vit. C.), titratable acidity, total soluble solids as well as reducing, non-reducing and total sugars. Significant increase in most fruits content of ascorbic acid (Vit. C.), total soluble solids (T.S.S) reducing, non-reducing and total sugars, were obtained due to the application of either phosphoric acid, or paclobutrzaol in both seasons. Proline acid treatment had adverse significant effect on Vit.C., reducing and total sugars, beside the negative effect on non-reducing sugars and positive effect on T.S.S as compared to the control. On the other hand, titratable acidity of tomato fruits was not affected significantly as a result of spraying tomato plants with any of the chemical materials used during both seasons of this experiment . The results about the favourable effect of phosphoric acid on fruits content of T.S.S., Vit. C. and titratable acidity are in agreement with those reported by **Dunyamalev, (1977); Doikova (1978); Dimitrov and Rankov (1979); El-Sawah (1979); Kanesire et al. (1984); Abed and Eid (1987); El-Sawy (1988) and Satti et al. (1995)** on tomato, as well as **Abd-El-Zaher (1989)** found a similar findings on eggplants. On the contrary, results about the effect of phosphoric acid on fruits content of titratable acidity, results are in conflict with those reported by **(Abed and Eid, 1987 and El-Sawy, 1988)** on tomato.

With respect to the positive effect of paclobutrazol on fruits content of Vit.C., titratable acidity, T.S.S and sugar fractions, obtained results are in harmony with those reported by **Looney and MacKeller (1987)** on sweet cherry; **Nerson et al. (1989)** on Galia muskmelon; **El-Desouky and Abd-El-Dayem (1992 a & b)** on sesame and rapeseed; **Ismaeil (1995)** on broad bean and **Wanas (1996)** on tomato. On the contrary, **El-Bassiouny (1992)** working on strawberry found a converse results in most parameters, previously mentioned. Moreover, **Looney and MacKallr (1987)** found no differences due to the application of paclobutrazol in sugars content of sweet cherries compared to the control.

Concerning the effect of proline acid, results in this respect are in agreement with those reported by **Abdel- Latif (1995)** on tomato plants.

Regarding the interaction between salinity levels and different chemical materials, data illustrated in the Table (17) show that differences in this respect were only significant in case of Vit.C. and reducing sugars during both seasons, meanwhile significant effects in case of reducing and total sugars were only in the first season. It worth mentioning that increasing salinity levels was accompanied with increasing fruits content of Vit. C., and non-reducing sugars. In this connection, the highest values of fruits content of these constituents were observed on tomato fruits produced from plants supplement with

Table (17):Effect of interaction between salinity and chemical materials on fruit quality of tomato plants during 1996 and 1997 seasons.

Seasons		1996						1997					
Salinity	Chemical materials	Vit.C.mg/ 100 gm F.W	Titratable acidity (%)	T.S.S. %	Reducing sugars	Non-reducing sugar	Total sugars	Vit. C. mg/ 100 gm F.W	Titratable acidity (%)	T.S.S. %	Reducing sugars	Non-reducing sugars	Total sugars
0 p.p.m	0	22.5	0.52	6.1	4017	313	4330	23.3	0.52	6.0	4008	342	4350
	Phosphoric acid 10mM	23.6	0.52	6.9	4146	336	4482	23.5	0.52	6.1	4108	305	4413
	Phosphoric acid 20mM	23.4	0.51	6.8	4114	347	4461	23.4	0.52	6.2	4114	305	4419
	Proline acid 30 p.p.m	21.9	0.50	6.6	4030	395	4325	22.1	0.51	6.1	3931	305	4236
	Proline acid 60 p.p.m	21.9	0.52	6.5	4013	307	4320	22.2	0.51	6.2	3919	309	4228
	PP_{333} 100 p.p.m	23.0	0.53	6.9	4126	316	4442	23.5	0.53	6.4	4067	291	4358
	PP_{333} 200 p.p.m	23.0	0.52	6.8	4105	316	4421	23.6	0.52	6.5	4011	309	4320
3000 p.p.m	0	24.0	0.53	7.1	3822	334	4156	24.0	0.55	7.3	3914	336	4250
	Phosphoric acid 10mM	24.5	0.54	8.1	3945	367	4312	24.5	0.54	7.9	3991	319	4310
	Phosphoric acid 20mM	24.4	0.54	7.9	3960	340	4300	24.4	0.54	7.8	3988	328	4316
	Proline acid 30 p.p.m	23.0	0.53	7.8	3791	325	4116	23.2	0.55	7.9	3851	334	4185
	Proline acid 60 p.p.m	22.7	0.53	7.6	3795	330	4125	23.2	0.55	7.8	3807	376	4183
	PP_{333} 100 p.p.m	24.2	0.54	8.0	3915	383	4296	24.4	0.55	8.0	3868	383	4251
	PP_{333} 200 p.p.m	24.2	0.53	7.9	3875	386	4261	24.3	0.56	8.2	3880	355	4235
6000 p.p.m	0	25.0	0.56	8.0	3454	401	3855	25.1	0.57	8.6	3556	439	3995
	Phosphoric acid 10mM	24.9	0.56	9.0	3665	460	4125	25.0	0.56	9.0	3618	495	4113
	Phosphoric acid 20mM	24.8	0.56	8.8	3675	460	4135	25.0	0.56	9.1	3621	459	4018
	Proline acid 30 p.p.m	23.3	0.55	8.6	3447	356	3803	24.0	0.56	8.7	3451	410	3861
	Proline acid 60 p.p.m	23.5	0.55	3.6	3440	385	3825	24.4	0.57	8.8	3435	432	3867
	PP_{333} 100 p.p.m	24.7	0.55	9.0	3630	424	4054	25.3	0.57	8.9	3541	442	3983
	PP_{333} 200 p.p.m	24.6	0.55	9.0	3600	431	4031	25.5	0.57	9.1	3514	466	3980
9000 p.p.m	0	25.2	0.60	8.5	3228	433	3661	25.5	0.61	9.0	3240	454	3694
	Phosphoric acid 10Mm	25.4	0.59	9.1	3380	493	3873	25.8	0.62	9.3	3311	530	3841
	Phosphoric acid 20mM	25.3	0.59	9.0	3391	495	3886	25.5	0.62	9.2	3308	527	3835
	Proline acid 30 p.p.m	23.8	0.60	9.1	3230	421	3651	24.8	0.60	9.1	3141	450	3591
	Proline acid 60 p.p.m	24.0	0.60	8.9	3190	424	3614	24.9	0.60	9.2	3136	446	3582
	PP_{333} 100 p.p.m	25.0	0.60	9.0	3304	511	3815	25.6	0.62	9.4	3281	433	3714
	PP_{333} 200 p.p.m	25.4	0.59	9.2	3318	484	3802	25.8	0.62	9.4	3278	420	3698
12000 p.p.m	0	25.9	0.64	8.8	2990	451	3441	26.1	0.64	9.2	2961	423	3384
	Phosphoric acid 10mM	26.4	0.64	9.5	3014	491	3505	26.6	0.65	9.7	3018	533	3551
	Phosphoric acid 20mM	26.3	0.65	9.4	3022	491	3513	26.4	0.64	9.6	2686	544	3202
	Proline acid 30 p.p.m	24.8	0.65	9.3	2943	471	3414	25.3	0.64	9.7	2902	400	3302
	Proline acid 60 p.p.m	25.0	0.65	9.4	2945	460	3405	25.2	0.63	9.6	2884	397	3281
	PP_{333} 100 p.p.m	26.3	0.65	9.6	2998	487	3485	26.4	0.64	9.6	2958	501	3459
	PP_{333} 200 p.p.m	26.3	0.65	9.4	2983	488	3471	26.2	0.64	9.5	2956	505	3461
L.S.D. at 5 %		0.3	n.s	n.s	35	37	29	0.3	n.s	n.s	n.s	46	n.s

the highest level of salinity (12000 p.p.m), whereas plants that irrigated with tap water recorded the lowest values of these constituents in their fruits.

- Under such conditions, spaying tomato plant with phosphoric acid (10 and 20 mM) or paclobutrazol (100 and 200 p.p.m) exhibited a contribution effect in an increase fruits content of Vit. C. and non-reducing sugars. In this regard phosphoric acid (10 and 20 mM) recorded the highest values of fruits content of Vit. C. and non-reducing sugars (26.50 and 26.35 mg/ 100 gm F.W.) for 10 and 20 mM as average of both seasons, followed by paclobutrazol treatment (with 100 and 200 p.p.m) (26.35 and 26. 25 mg/ 100 gm D.W.) as average of both seasons.
- Proline acid treatment exhibited an adverse effect in this respect.
- The highest values of Vit.C. and non-reducing sugars were observed in tomato fruits that produced from plants irrigated with tap water and sprayed with paclobutrazol (100 p.p.m) and proline acid (30 p.p.m) (220 mg / 100 gm F.W. and 303 mg / 100 gm D.W) as average of both seasons for Vit. C. and non-reducing sugars, respectively.
- With respect to the effect on reducing and total sugars, the highest level of this constituents (4127 and 4447 mg / 100 gm D.W.) as average of both seasons were detected in fruits that produced from plants treated with phosphoric acid (10 mM) under irrigation with tap water, whereas, the least values of reducing ang total sugars (2914 and 3343 mg / 100 gm D.W.) as average of both season for reducing and total sugars, respectively were observed in tomato fruits that produced from plants received the higher concentration of proline acid (60 p.p.m) under irrigation with the highest level of salinity (12000 p.p.m NaCl). Tomato fruits that produced from

plants that treated with other treatments lie in between in this respect. On the other hand, differences between salinity levels and different chemicals materials did not reach the level of 5% of significant in case of titratable acidity and total soluble solids (T.S.S). This was true during both seasons of 1996 and 1997.

5.2.Mineral Composition of fruits:

5.2.1 Effect of salinity:

Data presented in Table (18) show that, increasing salinity level led to a significant and gradual decrease in the content of N,P,K and Ca. However, a significant and constant increase in Na content of tomato fruits could be detected in this respect during both studied seasons. Such results were found in the same direction in plant leaves (Table, 10) which may reflect the accumulation of these minerals in tomato fruits. Obtained results about the effect of salinity level on fruits mineral accumulation are in agreement with those reported on tomato plants **by (Adams and El-Gizawy, 1986; Adams , 1988 and Adams and Ho, 1989)** with Ca element , **and Faiz et al. (1994)** with N, P and K elements.

With respect to the effect of salinity level on Na accumulation in tomato fruits, obtained results are in agreement with those reported on tomato by **Mizrahi (1982); Mizrahi et al. (1982); Grattan et al. (1987); Adams (1987); Adams (1988); Mizrahi et al. (1988); Sarg et al., (1993) Faiz et al. (1994).**

5.2.2. Effect of chemical materials:

It is evident from data presented in Table (18) that, application of any kind of chemical materials that used in this study resulted in a significant and gradual increase in fruits content of N,P,K and Ca

Table (18): N,P,K,Ca and Na elements (mg/ 100 gm D.W.) of tomato fruits as affected by irrigation with saline water and spraying with different chemical materials during 1996 and 1997 seasons.

Seasons	1996					1997				
Treatments Salinity	N	P	K	Ca	Na	N	P	K	Ca	Na
0 p.p.m	3683	300	2917	1643	113	3674	319	2949	1637	101
3000 p.p.m	3576	274	2803	1548	178	3401	275	2843	1587	164
6000 P.P.m	3164	237	2713	1460	244	3183	250	2729	1529	232
9000 p.p.m	2744	212	2637	1387	289	2824	227	2621	1469	284
12000 p.p.m	2398	190	2529	1299	337	2486	206	2521	1380	332
L.S.D. at 5 %	38	4	25	16	4	32	4	40	19	4
Chemical materials										
Control 0	2918	216	2448	1428	260	2920	224	2414	1448	257
Phosphoric acid 10m.M	3200	250	2848	1512	206	3214	266	2933	1546	194
Phosphoric acid 20m.M	3204	252	2798	1484	221	3260	258	2746	1564	212
Proline acid 30 p.p.m	3214	249	2854	1446	231	3106	265	2914	1506	218
Proline acid 60 p.p.m	3204	242	2798	1432	242	3138	261	2936	1482	231
PP_{333} 100 p.p.m	3046	250	2684	1506	225	3108	260	2657	1564	212
PP_{333} 200 p.p.m	3006	240	2608	1464	242	3050	252	2528	1532	233
L.S.D. at 5%	27	6	28	23	5	25	7	40	24	4

during both seasons of this study. As average of both seasons, the highest values (3232, 258, 2890 and 1529 mg / 100 gm D.W. for N,P,K and Ca, respectively were detected in tomato fruits produced from plants that received phosphoric acid (20 mM) for N content and (10 mM) for P,K and Ca. Meanwhile, the least values in this respect were observed in fruits produced from untreated plants.

As for the effect of different chemical materials on Na content of tomato fruits, data show clearly that application of all used chemicals led to a significant reduction in comparison to control. This held true during both seasons of this work. The lowest values (200 mg /100 gm D.W.) as average of both seasons were recorded in tomato fruits produced from plant that spayed with phosphoric acid at 10 mM, whereas the highest value (259 mg) were detected in fruits from untreated plants. These results about the favourable effect of phosphoric acid on tomato fruits content of different elements are in agreement with those reported by **Selim (1990)** on pea and **Masaguer et al. (1991)** on tomato.

Concerning the effect of paclobutrazol on fruits content of different elements, results are in agreement with those mentioned by **(El-Desouky and Abd El-Dayem, 1992 a & b; Ismaeil, 1995 and Wanas, 1996)** on sesame, rapeseed, broad bean and tomato respectively. On the contrary, **El-Desouky (1992)** on tomato and **Ismaeil (1995)** on broad bean, found a converse results about the effect of paclobutrazol on total nitrogen and potassium, respectively, in tomato fruits and broad bean seeds.

With respect to the effect of interaction between salinity levels and different chemical materials on tomato fruits content of N,P,K,Ca and Na, it is evident from data (Table, 19) that difference were significant during both seasons of this study. It is worth mentioning that increasing salinity level resulted in a decrease in fruits content of N,P,K and Ca but fruits content of Na increased, in this respect the lowest values of N,P,K and Ca were recorded with the highest level of salinity (12000), whereas under these conditions Na content recorded the highest value.

-Spraying tomato plants with different chemicals overcome the deleterious effect, of salinity to some extent, on fruits content of these elements. Generally under spraying with used chemicals, tomato fruits maintained to more content of N,P,K and Ca as well as less content of Na in comparison with the untreated fruits (control).

-Phosphoric acid at 10 mM exhibited the best favourable effect on fruit content of K,Ca and Na (2705 , 1380, and 303 mg / 100 gm D.W) as average of both seasons under the highest level of salinity (12000 p.p.m NaCl), and proline acid at 30 p.p.m recorded the highest values of N and P contents (2595 and 210 mg / 100 gm D.W.). In this connection, tomato fruits that produced from plant that irrigated with 12000 p.p.m NaCl and without spraying with chemicals recorded the least values of N,P,K and Ca (2195, 172, 2175 and 1305 mg / 100 gm D.W.) for all mentioned elements, respectively, as average of both seasons. Meanwhile, it recorded the highest value of Na (378 mg). Tomato fruits that produced from plant treated with other treatments lie in between in this respect.

Table (19): Effect of interaction between salinity and chemical materials on N,P,K,Ca and Na elements (mg/100gm D.W.) of tomato fruits during 1996 and 1997 seasons.

Seasons		1996					1997				
Salinity	Chemical materials	N	P	K	Ca	Na	N	P	K	Ca	Na
0 p.p.m	0	3500	271	2620	1530	133	3570	292	2630	1600	120
	Phosphoric acid 10mM	3890	306	3070	1680	103	3810	335	3307	1640	87
	Phosphoric acid 20mM	3770	315	2970	1680	106	3830	347	2950	1670	96
	Proline acid 30 p.p.m	3640	302	3080	1630	113	3650	310	3100	1620	93
	Proline acid 60 p.p.m	3670	295	3030	1580	117	3580	315	3140	1610	108
	PP_{333} 100 p.p.m	3660	310	2880	1720	108	3670	314	2870	1680	95
	PP_{333} 200 p.p.m	3650	300	2770	1680	114	3610	318	2650	1640	106
3000 p.p.m	0	3400	225	2560	1500	200	3210	234	2550	1510	196
	Phosphoric acid 10mM	3690	291	2910	1640	160	3550	312	2970	1610	152
	Phosphoric acid 20mM	3680	295	2900	1580	172	3480	280	2840	1630	156
	Proline acid 30 p.p.m	3540	283	2920	1450	174	3380	282	3090	1580	158
	Proline acid 60 p.p.m	3580	271	2870	1440	184	3390	286	3050	1530	168
	PP_{333} 100 p.p.m	3560	285	2760	1660	178	3410	277	2800	1650	150
	PP_{333} 200 p.p.m	3580	270	2700	1570	182	3390	254	2600	1600	166
6000 p.p.m	0	3000	213	2470	1460	260	2980	227	2430	1440	271
	Phosphoric acid 10mM	3210	236	2830	1540	222	3280	245	2860	1560	205
	Phosphoric acid 20mM	3230	241	2810	1440	240	3310	241	2760	1570	228
	Proline acid 30 p.p.m	3250	251	2800	1480	243	3090	267	2950	1530	225
	Proline acid 60 p.p.m	3230	242	2700	1240	245	3180	269	2900	1500	235
	PP_{333} 100 p.p.m	3170	245	2680	1470	242	3270	258	2700	1580	217
	PP_{333} 200 p.p.m	3060	232	2630	1410	255	3170	241	2500	1520	245
9000 p.p.m	0	2510	201	2400	1350	324	2630	192	2300	1380	330
	Phosphoric acid 10mM	2770	215	2750	1360	235	2890	222	2800	1500	230
	Phosphoric acid 20mM	2810	210	2720	1420	267	3050	213	2620	1520	262
	Proline acid 30 p.p.m	3010	217	2780	1410	293	2850	241	2820	1460	287
	Proline acid 60 p.p.m	3000	216	2710	1380	307	2910	250	2840	1440	302
	PP_{333} 100 p.p.m	2560	216	2590	1400	282	2780	233	2490	1500	280
	PP_{333} 200 p.p.m	2550	211	2510	1390	312	2660	235	2480	1480	295
12000 p.p.m	0	2180	269	2190	1300	385	2210	175	2160	1310	370
	Phosphoric acid 10mM	2440	202	2680	1340	310	2540	217	2730	1420	295
	Phosphoric acid 20mM	2530	200	2590	1300	317	2630	210	2560	1430	317
	Proline acid 30 p.p.m	2630	193	2690	1260	332	2560	227	2610	1340	327
	Proline acid 60 p.p.m	2540	187	2610	1340	355	2630	185	2750	1330	340
	PP_{333} 100 p.p.m	2280	195	2510	1280	315	2410	216	2426	1410	320
	PP_{333} 200 p.p.m	2190	186	2430	1270	347	2420	210	2410	1420	355
L.S.D. at 5 %		60	14	63	53	10	58	17	91	n.s	11

6. Anatomical Studies:

6.1. Root anatomy:

6.1.1 Effect of salinity :

Data presented in Table (20) and Figures (9-11) show the effect of different levels of salinity in irrigation water on root anatomy features. Such data indicated that increasing salinity levels resulted in decrease the thickness of all studied features i.e. epidermis and exodermis, cortex, phloem, xylem and pith tissues, this reduction was proportional with increasing salinity. These results might be attributed to that role of salinity on inhibiting cell division and elongation which makes as a deleterious effects in this respect. Adverse results – to some extent – were reported by **Wanas (1996)** on tomato.

6.1.2 Effect of chemical materials:

Data presented in Table (20) and Figures (12-18) show clearly that spraying tomato plants with any kind of studied chemical led to an increase in most studied features compared with control. Phosphoric acid (at 10 and 20 mM) exhibited the most favourable effect in this respect followed by paclobutrazol (100 and 200 p.p.m). Proline acid treatment recorded the least values in this regard, but it still higher than control treatment. These results may be due to the role of phosphorus in cell division and the role of proline acid which act as osmo-regulator compound that plays an important role to depress the internal osmotic potential and so maintain a positive gradient for water uptake, this explain the mechanism by which the plant is able to withstand salt stress conditions. These results are in agreement with those reported on paclobutrazol and tomatoes by **Wanas (1996).**

Table (20): Anatomy of tomato plant roots as affected by irrigation with saline water and foliar spray with different chemical materials during 1997 season.

Treatments	*Thickness in microns for*				
	Epidermis and exodermis	Cortex	Phloem tissue	Xylem Tissue	Pith tissue
Salinity					
0 p.p.m	78.4	576.9	105.4	611.2	888.0
6000 p.p.m	71.5	536.7	82.5	500.1	774.4
12000 p.p.m	56.0	515.0	75.2	421.0	707.2
Chemical materials					
Control	63.5	516.3	77.9	425.6	644.3
H_3PO_4 10mM	74.1	582.9	103.5	641.1	863.5
$H3\ PO_4$ 20mM	69.6	553.1	106.7	481.6	899.7
Proline 30 p.p.m	68.3	534.9	74.1	616.5	804.8
Proline 60 p.p.m	68.8	498.1	72.0	579.2	658.1
PP_{333} 100 p.p.m	67.2	571.7	94.9	388.3	874.1
PP_{333} 200 p.p.m	68.8	542.9	84.8	443.2	785.5

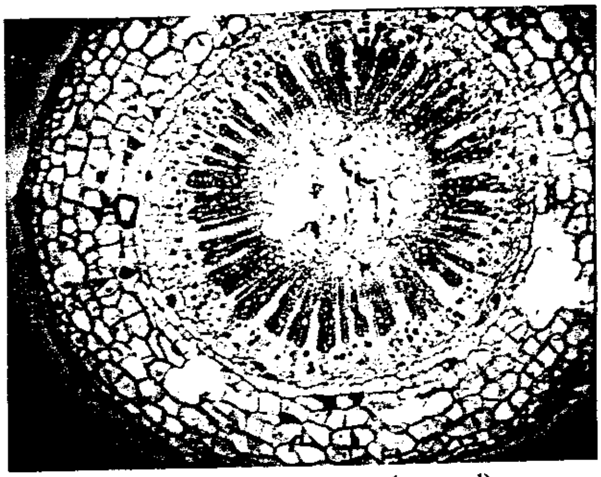


Fig. (9) : Tap water (control)

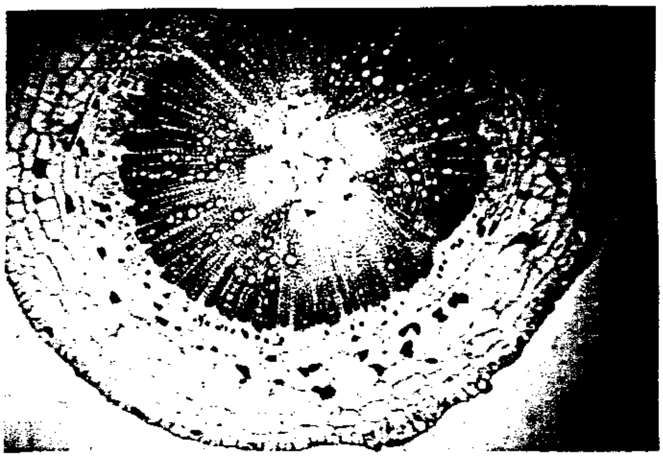


Fig. (10): 6000 p.p.m NaCl

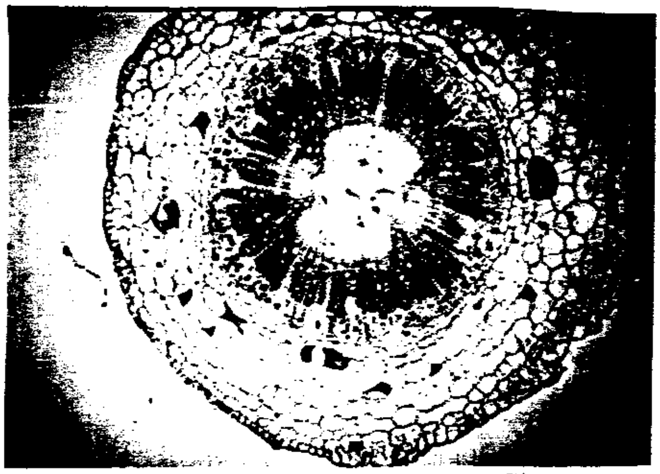


Fig. (11): 12000 p.p.m NaCl

Figures (9-11) :Effect of salinity levels on the anatomical structure of tomato plant root cv. UC97-3.

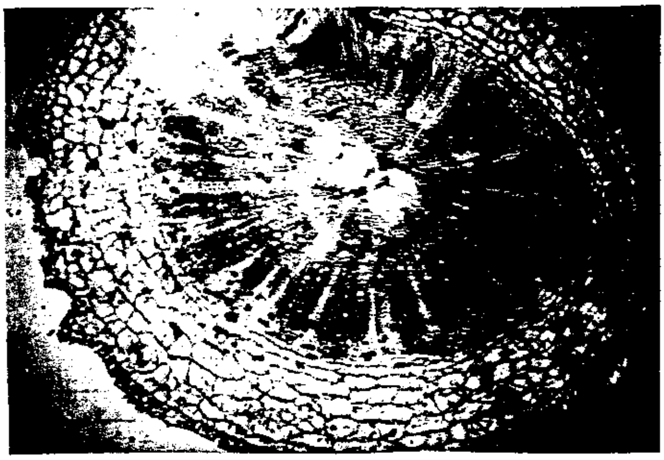


Fig. (12): Distilled water (control)

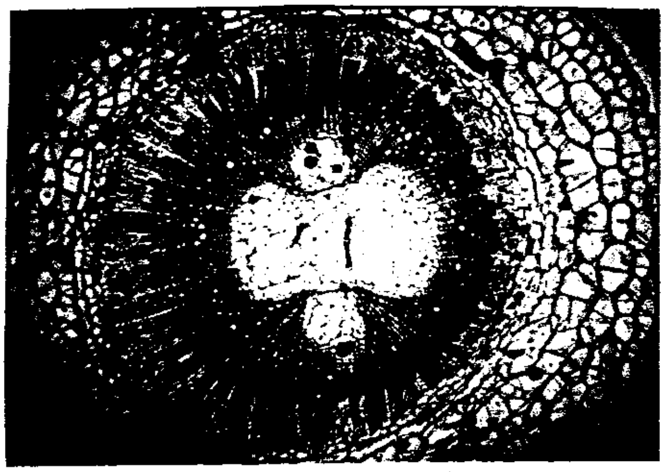


Fig. (13): H3PO4 (10mM)

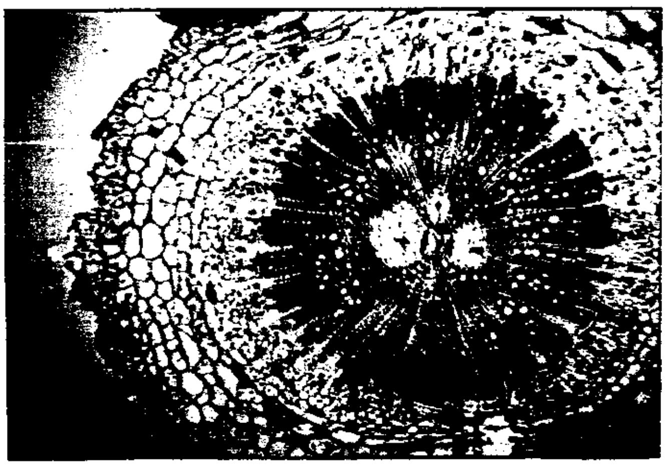


Fig. (14): H3PO4 (20mM)

Figures (12-18): Effect of different chemical materials on the anatomical structure of tomato plant root cv. UC97-3.

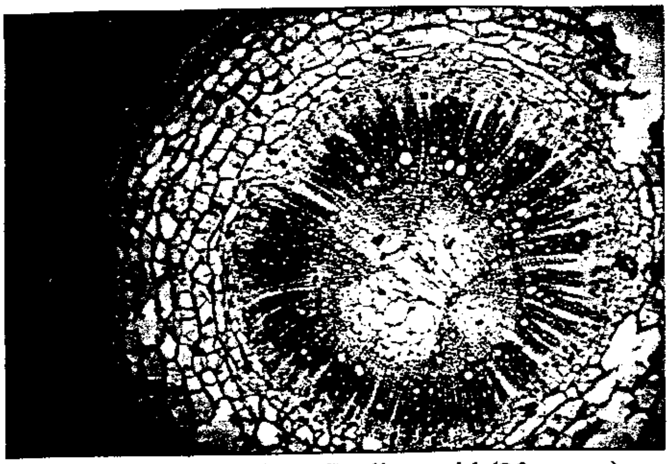


Fig. (15): Proline acid (30 p.p.m)

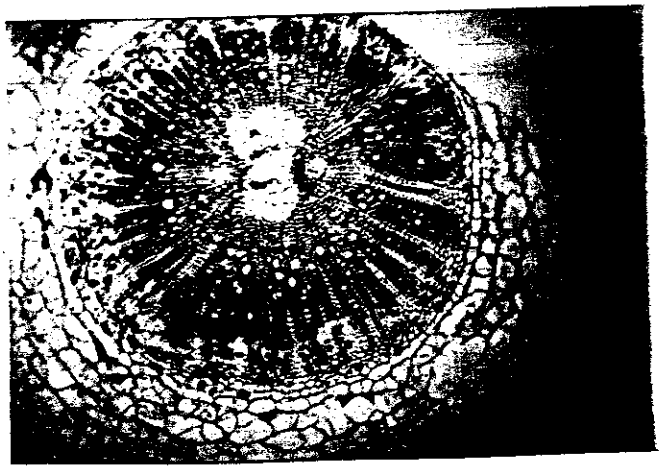


Fig. (16): Proline acid (60 p.p.m)

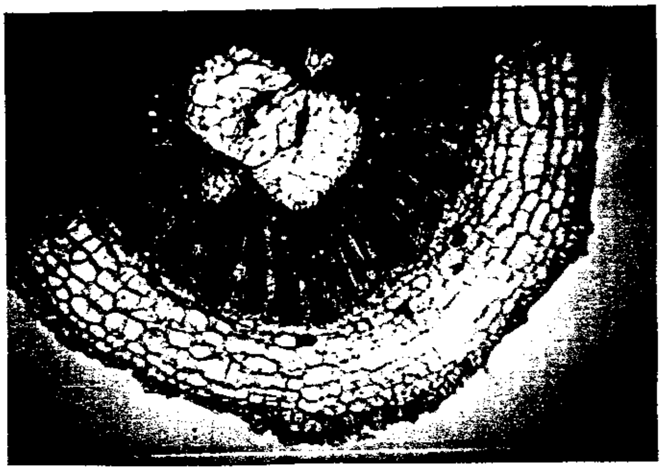


Fig.(17): PP_{333} (100 p.p.m)

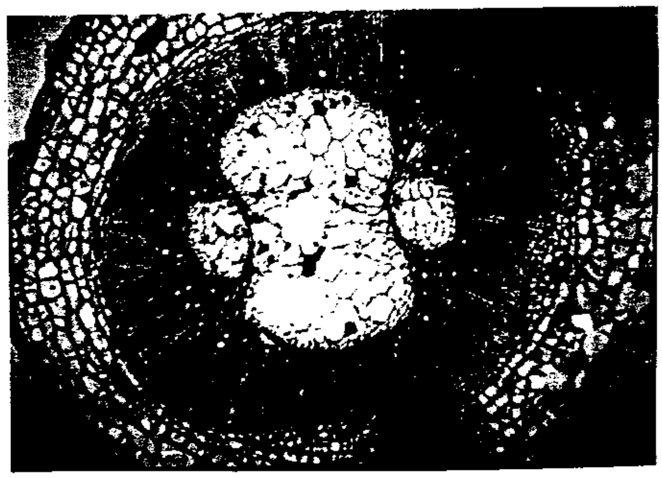


Fig. (18): PP_{333} (200 p.p.m)

Fig. (12-18):Cont.: Effect of different chemical materials on the anomical structure of tomato plant root cv. UC97-3.

6.2. Leaf anatomy:

6.2.1. Effect of salinity:

Data presented in Table (21) and Figures (19-21) show the effect of different levels of salinity on leaf anatomy of tomato plants. Such data indicate that the thickness of blade and measophyll (palisade and spongy tissues) as well as upper and lower epidermis and number of xylem vessels tended to decrease as a result of increasing salinity level. However, diameter and width of midrib exhibited slightly increase with increasing salinity level. These results may be attributed to that salinity suppressed cell enlargement and cell division. Obtained results are in agreement with those reported by **El-Lawendy (1985)** on different species of legumes; **Belda et al. (1996) and Wanas (1996)** on tomato plants. On the contrary, **Raafat et al. (1991)** and **Sarg (1991)** reported and adverse results to some extent in this respect.

6.2.2. Effect of chemical materials:

Data presented in Table (22) and Figures (22-28) show that spraying tomato plants with any of the tested chemicals led to an increase in measophyll tissue (contains of palisade and spongy tissues). Paclobutrazol (200 p.p.m) followed by proline acid (60 p.p.m) recorded the highest values in thickness of measophyll tissues and consequently blade thickness. The least values in this respect were observed with control treatment.

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Table (21):Anatomy of tomato plant leaves as affected by irrigation with saline water and foliar spray with different chemical materials during 1997 season.

	Thickness in microns for								
Treatments	Upper epidermis	Lower epidermis	Palisade tissue	Spongy tissue	Measophyll tissue	Blade	Width of Midrib	Diameter of midrib	Number of xylem vessels
Salinity									
0 p.p.m	25.1	17.1	91.2	129.8	221.0	263.2	785.6	699.8	45
6000 p.p.m	23.1	17.4	85.7	129.6	215.3	255.8	870.6	787.4	42
12000 p.p.m	20.3	15.1	80.4	107.4	187.8	223.2	826.3	694.2	39
Chemical materials									
Control	21.3	16.0	88.5	92.8	181.3	218.6	769.1	644.8	40
H_3PO4 10 mM	18.7	16.0	76.3	113.1	189.3	224.0	746.1	653.8	43
H_3 PO4 20 mM	18.1	15.5	73.6	117.9	191.5	225.1	826.1	799.5	44
Proline 30 p.p.m	29.3	19.2	95.5	120.5	216.0	264.5	852.3	721.1	43
Proline 60 p.p.m	26.1	18.1	93.7	126.4	220.2	264.4	1006.4	862.9	40
PP_{333} 100 p.p.m	21.9	14.4	77.3	130.7	208.0	244.3	852.3	756.3	43
PP_{333} 200 p.p.m	24.5	16.5	95.5	154.7	250.1	291.2	740.3	651.7	41

Fig. (19): Tap water (control)

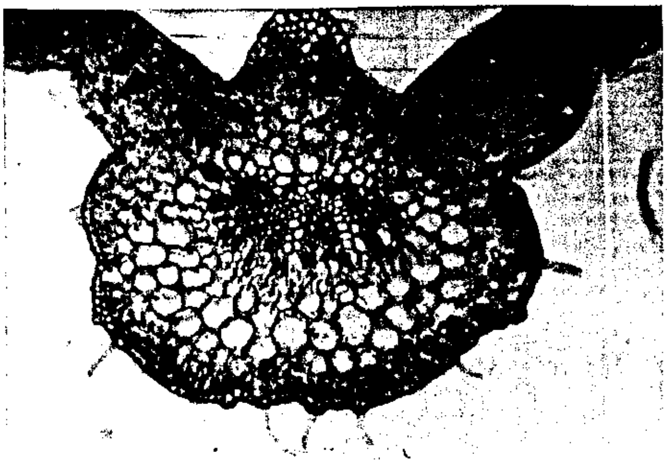


Fig. (20): 6000 p.p.m NaCl

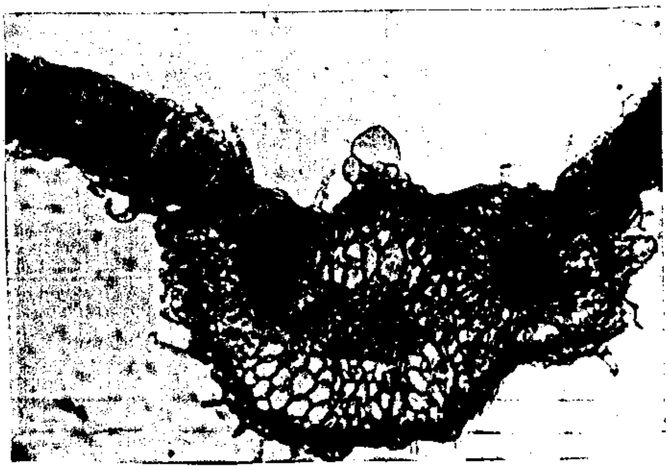


Fig.(21): 12000 p.p.m NaCl

Figures (19-21): Effect of salinity levels on the anatomical structure of tomato plant leaf cv. UC97-3.

Fig. (22): Distilled water (control)

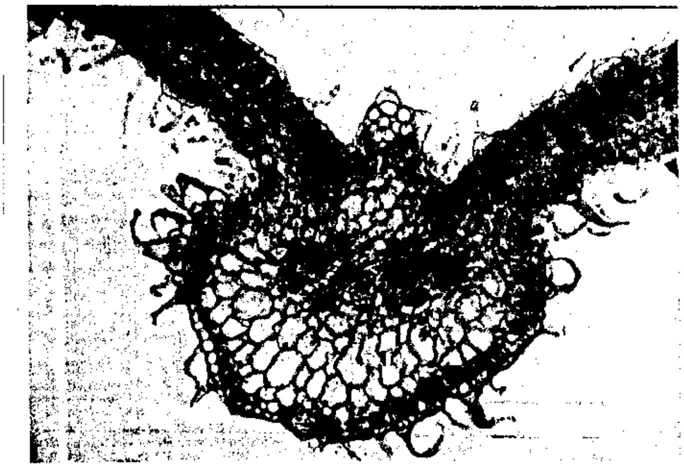


Fig. (23): H3 PO4 (10 mM)

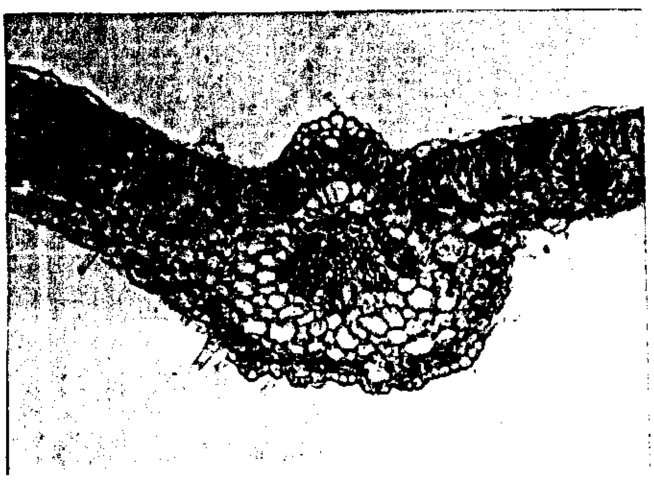


Fig. (24): H3PO4 (20 mM)

Figures (22-28): Effect of different chemical materials on the anatomical structure of tomato plant leaf cv. UC97-3.

Fig. (25): Proline acid (30 p.p.m)

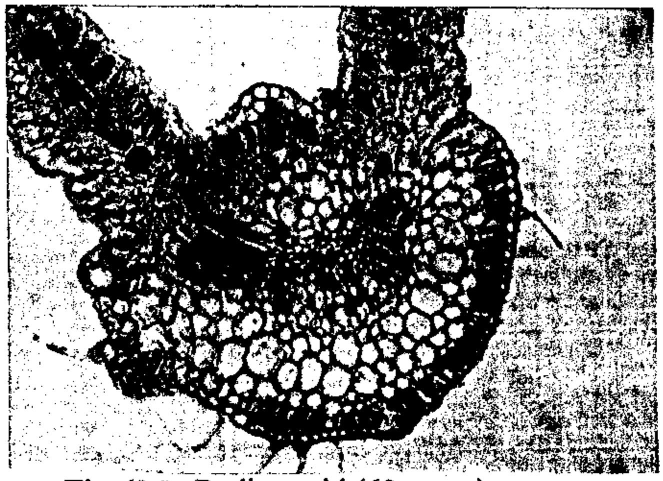


Fig. (26): Proline acid (60 p.p.m)

Fig. (27): PP_{333} (100p.p.m)

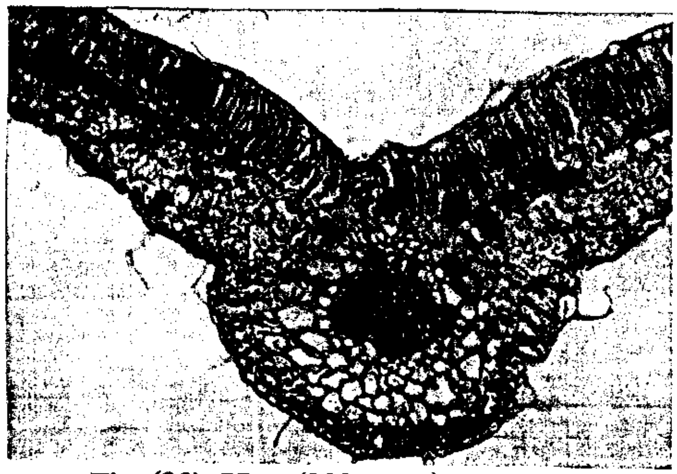


Fig. (28): PP_{333} (200 p.p.m)

Fig. (22-28) : Cont.:Effect of different chemical materials on the anatomical structure of tomato plant leaf cv. UC 97-3.

The second experiment : (Field experiment)

"Effect of irrigation frequencies with drainage water on vegetative growth, chemical composition, yield and quality of tomato plants cultivars"

1. Vegetative growth characteristics:

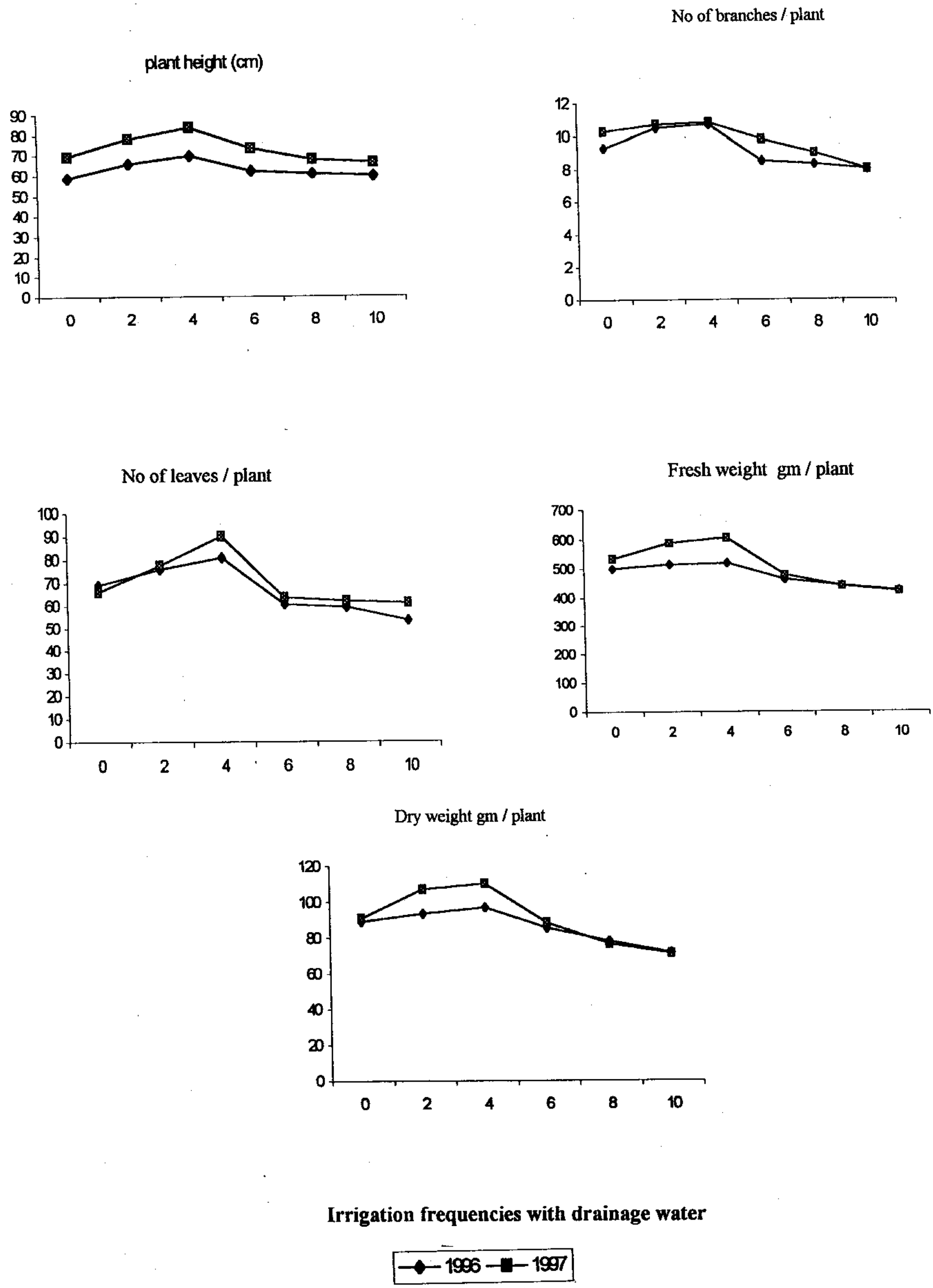
1.1.Effect of irrigation frequencies:

Data presented in Table (22) and Figure (29), show the effect of irrigation frequencies with drainage water on vegetative growth characteristics i.e. plant height, number of branches and leaves per plant as well as fresh and dry weight of plants of Edkawy and UC97-3 tomato cultivars. It is evident that irrigation with drainage water up to 4 times led to a significant increase in most mentioned parameters of vegetative growth during both seasons when compared with Nile water irrigation. The highest increments were obtained in case of using drainage water four times followed by tow times throughout plant growing seasons. These results are in agreement with those reported by **Abd El- Dayem (1982) and Abed et al. (1988)** on peas as well as by **Shafshak (1989)** on broad bean and **Arf and El-Dougdoug (1996)** on tomato. However, increasing drainage water frequencies up to six times or more led to a gradual decrease in all studied characters. This decrease might be attributed to the increase in salt a ccumulation in the soil as a result of increasing irrigation frequencies with drainage water that contained more concentration of salinity indices expressed as E.C. as well as the detrimental effect of Na^{+} and $SO4^{-}$ ion as indicated in Tables (3 and 4). These results are in agreement with those reported by **Vermooy and Nienhuis (1991) and Shennan et al. (1995)** on tomato and **London (1984), Kandil (1990) and Abo Soliman et al. (1992)** on wheat.

Table (22): Effect of irrigation frequencies of drainage water on plant vegetative growth characteristics of Edkawy and UC97-3 tomato cultivars during 1996 and 1997 seasons.

Seasons		1996					1997				
Drainage water frequencies	Varieties	Plant height (cm)	No.of branches / plant	No.of leaves / plant	Fresh weight gm/ plant	Dry weight gm/plant	Plant height (cm)	No.of branches / plant	No.of leaves / plant	Fresh weight (gm) plant	Dry weight gm/plant
0	Edkawy	77.7	10.5	90.7	692.5	115.4	78.2	11.0	83.7	688.2	104.8
	UC 97-3	39.5	8.2	47.7	306.7	62.6	60.0	9.7	48.7	379.5	76.8
2	Edkawy	83.0	11.5	96.2	704.7	118.9	89.0	11.7	97.2	737.5	129.9
	UC 97-3	48.2	9.5	55.7	324.7	67.9	67.2	9.7	58.2	437.7	83.6
4	Edkawy	86.7	12.2	101.7	706.5	123.5	110.0	12.0	118.2	762.7	132.9
	UC 97-3	52.5	9.2	60.5	332.7	69.9	57.2	9.7	62.2	442.2	86.6
6	Edkawy	81.7	9.2	75.7	651.5	111.6	89.2	10.2	80.2	591.5	102.0
	UC 97-3 .	42.5	7.7	45.7	273.5	59.0	57.5	9.5	47.0	363.7	73.9
8	Edkawy	81.2	9.0	75.5	610.7	101.6	83.2	9.7	77.7	580.5	101.3
	UC 97-3	40.2	7.7	43.2	269.7	53.9	52.5	8.2	46.5	299.2	51.0
10	Edkawy	80.5	9.0	65.5	582.5	94.2	80.7	8.7	77.5	567.5	95.6
	UC 97-3	38.5	7.0	41.2	263.7	48.9	51.5	7.2	44.5	275.2	46.4
L.S.D at 5 %		n.s	n.s	3.2	7.9	n.s	5.8	n.s	4.0	6.3	5.1
Drainage water frequencies											
0		58.6	9.3	69.2	499.6	89.0	69.1	10.3	66.2	533.8	90.8
2		65.6	10.5	76.0	514.7	93.4	78.1	10.7	77.7	587.6	106.7
4		69.6	10.7	81.1	519.6	96.7	83.6	10.8	90.2	604.4	109.9
6		62.1	8.5	60.7	462.5	85.3	73.3	9.8	63.6	477.6	88.0
8		60.7	8.3	59.3	440.2	77.7	67.8	9.0	62.1	439.8	76.1
10		59.5	8.0	53.3	423.1	71.5	66.1	8.0	61.0	421.3	71.0
L.S.D at 5 %		2.9	0.5	3.0	4.9	1.9	4.1	0.8	2.3	4.1	1.6
Varieties											
Edkawy		81.8	10.2	84.2	658.0	110.8	88.4	10.5	89.1	654.6	111.1
UC 97 –3		43.5	8.2	49.0	295.2	60.4	57.6	9.0	51.2	366.2	69.8
L.S.D at 5 %		2.1	0.3	1.3	3.2	1.8	2.3	0.4	1.6	2.6	2.1

Fig.(29): *Effect of irrigation frequencies of drainage water on vegetative growth characteristics of tomato plants.*

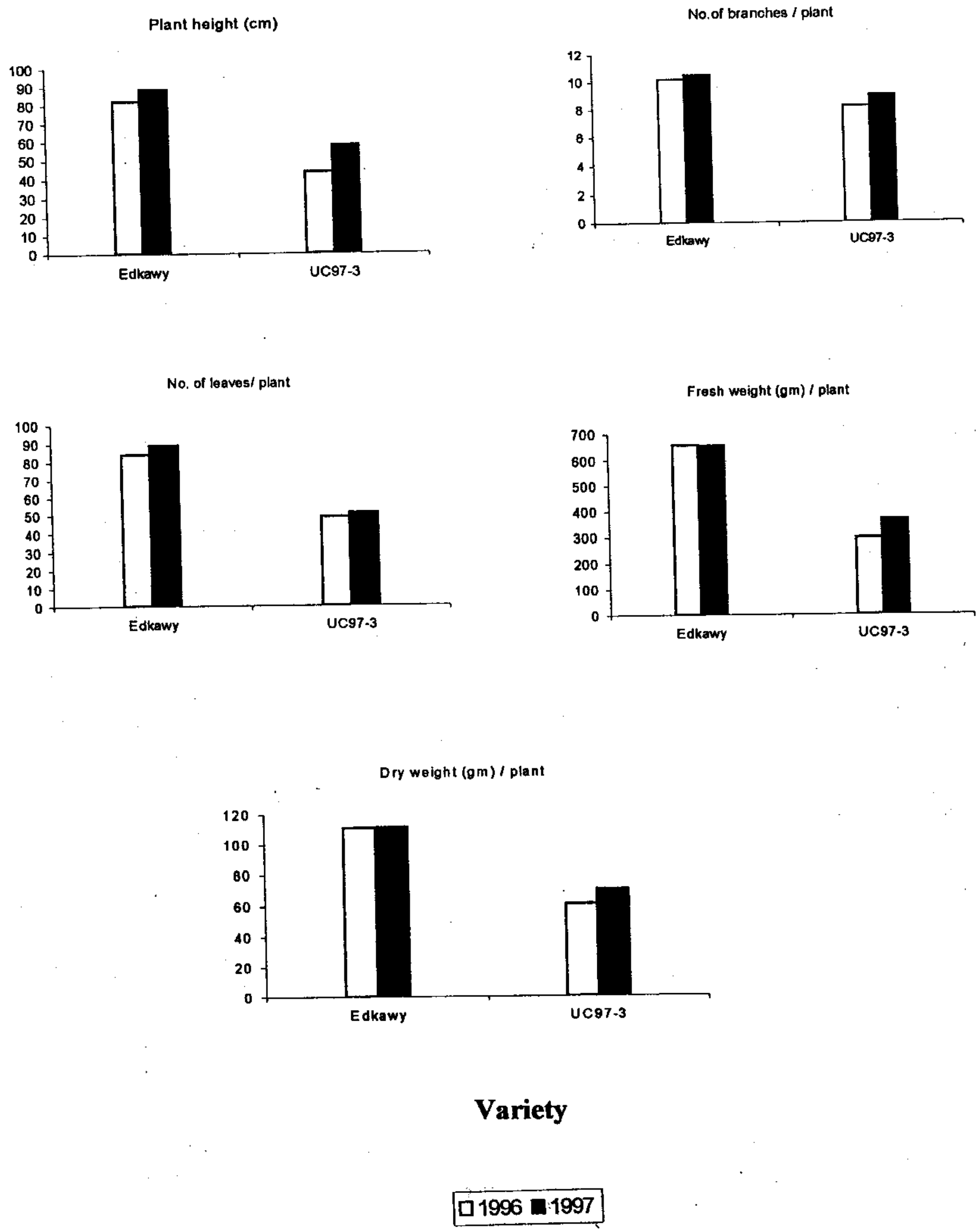


1.2.Effect of varieties:

Data presented in Table (22) and Figure (10) show clearly that differences between the studied cultivars were significant in all studied growth characteristics. In this regard, plant of cv.Edkawy showed the highest values in both seasons of this investigation compared with those of UC 97-3 one. Such differences between varieties in vegetative growth characteristics are mainly due to its genetical properties which may be considered as the main factor in this respect. These results are in agreement with those reported by **Mahmoud et al. (1986 a and b); Osman (1987) Sarg (1991); Mohamed and Hussein (1992), Soliman and Doss (1992); Rizk (1993); Abdel –Latif (1995); Abaza (1996) and Wanas (1996),** who worked on tomato cultivars, where indicated that the trends of changes under salinity stress depended on the studied cultivars.

Concerning the interaction between drainage water irrigation frequencies and studied cultivars, it is evident from data in Table (22) that differences were significant in number of leaves as well as fresh weight per plant during both seasons, whereas differences in plant height and dry weight per plant were only significant in the second season of this investigation. The highest values as average of both seasons (plant height 98.4 cm, number of leaves 110, fresh weight 734.6 gm / plant and dry weight 128.2 gm / plant)were detected on Edkawy plant cv. that irrigated with four times with drainage water. On the other side, the lowest values in this regard as average of both seasons (plant height 45 cm, number of leaves 42.9 leaves, fresh weight per plant 269,5 gm and dry weight per plant 47.7) were observed on plants of UC97-3 cv. that irrigated with ten times with drainage water. It is worth mentioning that increasing irrigation

Fig. (30): *Effect of tomato variety on vegetative growth characteristics.*



frequencies more than four times with drainage water resulted in significantly reduction in all studied characters in both seasons of this work.

2. Chemical composition of leaves:

2.1. Photosynthetic pigments:

2.1.1 Effect of irrigation frequencies:

Data presented in Table (23) and Figure (31) show that using drainage water up to four times for irrigation of tomato plants resulted in a significant and gradual increase in leaves content of chlorophyll a, b and consequently total chlorophyll (a + b) as well as leaves content of carotenoids compared to the control. Further increase to six times resulted in significant differences, but more that six times showed significant negative response in this respect. The increase in photosynthetic pigments of plant leaves occurred after four times irrigation with drainage water may be due to the increase in nitrogen and magnesium content of such leaves (Table 4). These results are in agreement with those reported by **Mininberg and Lezu (1973) and Shaheen (1984)** on broad bean and **Abed et al. (1988)** on pea. Similar finding was reported by **Aref and El-Dougdoug (1996)** on tomato plants. On the contrary, **Abdalla (1985)** found converse results in this respect on pea plants.

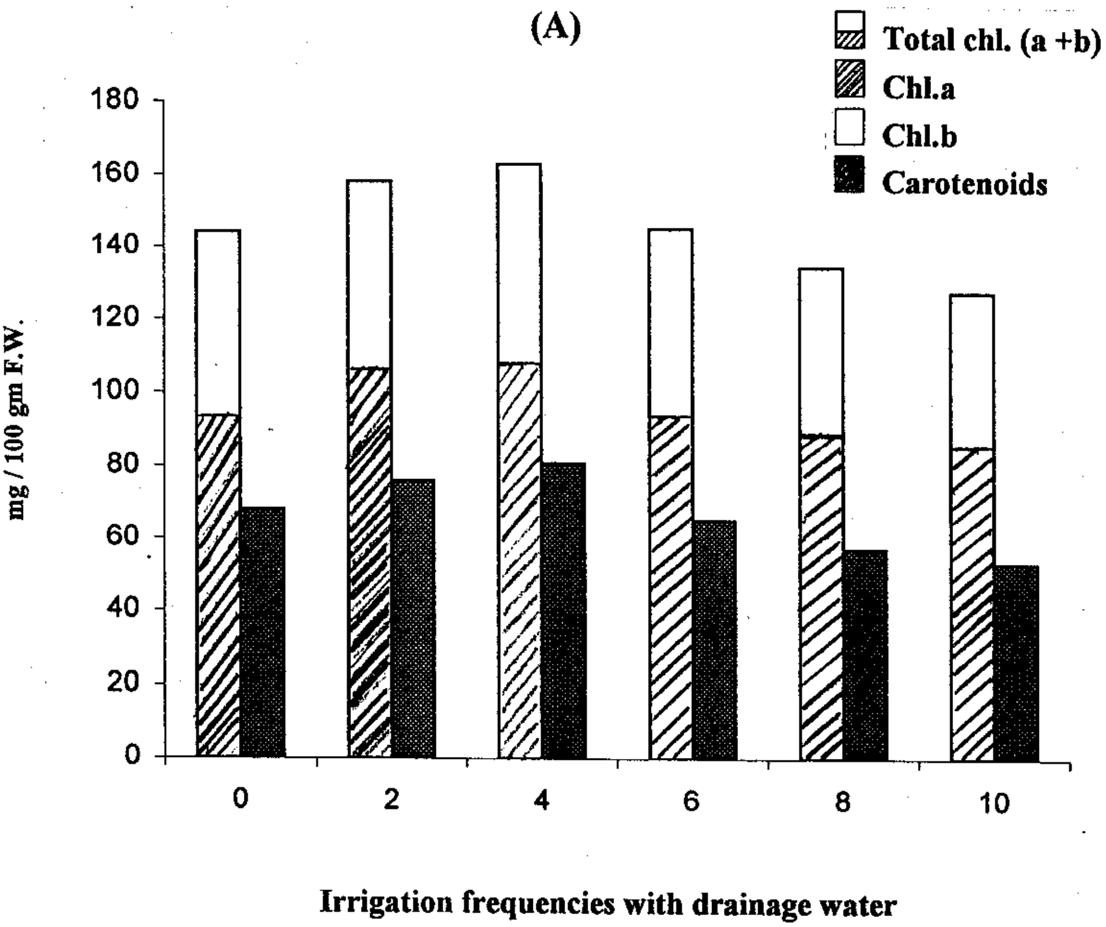
2.1.2. Effect of varieties:

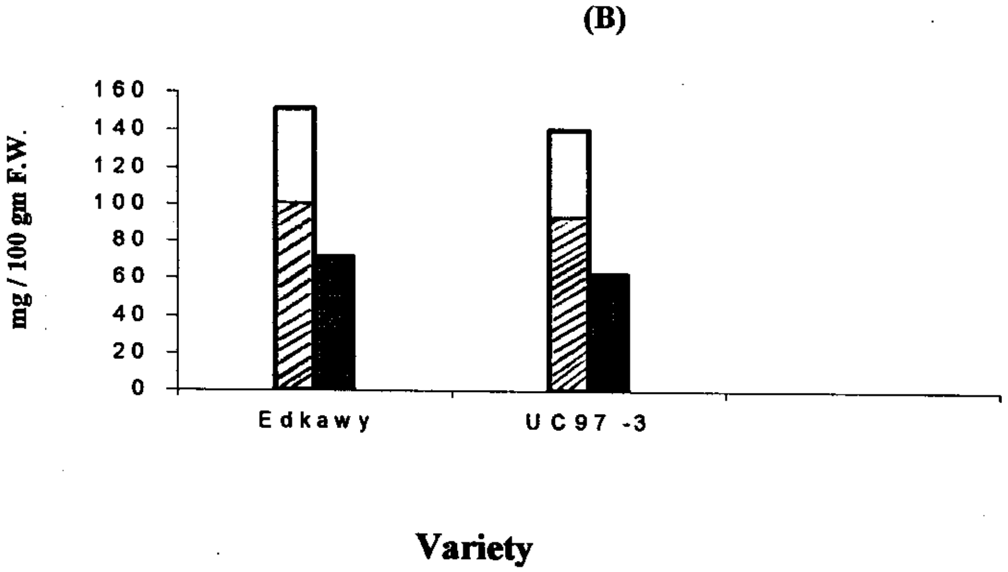
Concerning the effect of cultivars on leaves content of photosynthetic pigments presented in Table (23) and Fig.(31) show clearly that differences between the two cultivars under study were significant. Edkawy cv. recorded the highest values in all studied

Table (23): Effect of irrigation frequencies of drainage water on photosynthetic pigments (mg/100gm F.W.)of Edkawy and UC 97-3 tomato cultivars during 1996 and 1997 seasons.

Seasons		1996				1997			
Drainage water frequencies	Varieties	Chlorophyll (a)	Chlorophyll (b)	Total chlorophyll (a+b)	Corotenoids	Chlorophyll (a)	Chlorophyll (b)	Total chlorophyll (a+b)	Corotenoids
0	Edkawy	103	49	152	70	100	55	155	78
	UC 97-3	89	43	132	58	89	48	137	65
2	Edkawy	106	49	155	74	113	58	171	85
	UC 97-3	101	49	150	72	103	53	156	70
4	Edkawy	107	52	159	88	114	57	171	87
	UC 97-3	104	50	154	71	113	55	168	77
6	Edkawy	103	50	153	69	105	52	157	74
	UC 97-3	89	47	136	56	86	49	135	61
8	Edkawy	89	46	135	57	93	48	141	62
	UC 97-3	88	40	128	54	85	45	130	56
10	Edkawy	88	45	133	55	88	45	133	55
	UC 97-3	78	40	118	48	81	44	125	53
L.S.D at 5 %		n.s	n.s	7	5	5	n.s	6	7
Drainage water frequencies									
0		96	46	142	64	95	51	146	71
2		104	49	153	73	108	55	163	78
4		105	51	156	80	113	56	169	82
6		96	48	144	63	95	50	145	67
8		88	43	131	55	89	47	136	59
10		83	42	125	52	84	44	128	54
L.S.D at 5 %		4	3	5	3	5	2	6	4
Varieties									
Edkawy		99	48	147	69	102	52	154	73
UC 97 –3		92	45	137	60	93	49	142	64
L.S.D at 5 %		3	1	3	2	2	2	2	3

Fig.(31): *Effect of irrigation frequencies with drainage water (A) and tomato cultivers (B) on photosynthetic pigments of leaves. (as average of both seasons).*





pigments parameters compared to UC 97-3 in both seasons of 1996 and 1997.

With respect to the effect of interaction between drainage water irrigation frequencies and cultivars on leaves content of chlorophyll and carotenoids, data in Table (23) show that among studied treatments there were significant differences in leaves content of total chlorophyll and carotenoids during both seasons, whereas differences in leaves content of chlorophyll (a) were only significant in the second season. The highest values in this respect (110.55, 54.39, 164.94 and 87.38 mg/ 100gm F.W.) as average of both seasons for chlorophyll a,b, total and carotenoids were observed in the leaves of Edkawy cv. plants that irrigated with four times with drainage water. The least values in this respect were detected in plants of UC 97- 3 cv. that irrigated ten times with drainage water.

2.2.Mineral composition of leaves:

2.2.1. Effect of irrigation frequencies:

Data presented in Table (24) show clearly that using drainage water in irrigation up to four times resulted in a significant increase of N,P,K and Mg along with a significant decrease in Ca in tomato plant leaves during both season compared with irrigation with Nile water throughout the growing season (control). However, drainage water more than four times led to a significant reduction in all studied elements compared with that of Nile water (control).

With respect to the effect of irrigation frequencies with drainage water on tomato plant leaves content of Na and Cl elements, date presented in Table (24) show clearly that there was a significant and gradual increase in leaves content of these elements with increasing irrigation frequencies with drainage water, where the highest values in

Table (24): Effect of irrigation frequencies of drainage water on leaves content of N,P,K,Ca,Mg,Na and Cl (mg/100gm D.W) of Edkawy and UC 97-3 tomato cultivars during 1996 and 1997 seasons.

Seasons		1996							1997						
Drainage water frequencies	Varieties	N	P	K	Ca	Mg	Na	Cl	N	P	K	Ca	Mg	Na	Cl
0	Edkawy	3040	247	1987	1860	1340	109	181	2920	250	2118	1800	1365	105	182
	UC 97-3	2850	236	1895	1870	1280	106	167	2715	234	2044	1760	1315	97	162
2	Edkawy	3120	256	2042	1880	1380	124	191	3060	266	2124	1720	1370	123	194
	UC 97-3	3010	243	2005	1810	1330	110	184	2900	241	2070	1680	1330	115	183
4	Edkawy	3230	262	2087	1740	1430	126	206	3180	289	2160	1680	1500	135	202
	UC 97-3	3020	271	2135	1720	1380	114	191	3080	267	2150	1620	1460	123	191
6	Edkawy	2866	231	1890	1560	1290	408	498	2800	235	2056	1640	1290	420	486
	UC 97-3	2805	230	1848	1510	1210	360	487	2620	228	1910	1580	1250	384	474
8	Edkawy	2686	229	1794	1370	1070	423	538	2760	231	1812	1580	1160	438	529
	UC 97-3	2725	225	1734	1290	1040	396	526	2600	227	1790	1540	1140	420	521
10	Edkawy	2646	207	1634	1250	1070	456	594	2720	209	1764	1300	1140	462	581
	UC 97-3	2640	221	1672	1200	1030	444	580	2560	211	1748	1380	1120	432	572
L.S.D at 5 %		84	8	60	36	n.s	n.s	n.s	n.s	n.s	n.s	30	n.s	n.s	n.s
Drainage water frequencies															
0		2945	241	1941	1865	1310	107	174	2817	242	2081	1780	1340	101	172
2		3065	249	2023	1845	1355	117	187	2980	253	2097	1700	1350	119	188
4		3125	266	2111	1730	1405	120	198	3130	278	2155	1650	1480	129	197
6		2835	230	1869	1535	1250	384	492	2710	231	1983	1610	1270	402	480
8		2705	227	1764	1330	1055	409	532	2680	229	1802	1560	1150	429	525
10		2643	214	1653	1225	1050	450	587	2660	210	1756	1340	1130	447	576
L.S.D at 5 %		41	5	37	16	20	20	4	74	7	56	12	32	14	4
Varieties															
Edkawy		2931	238	1905	1610	1263	274	368	2906	246	2005	1620	1304	280	362
UC 97 –3		2841	237	1881	1566	1211	255	356	2752	234	1952	1593	1269	261	350
L.S.D at 5 %		34	n.s	24	14	13	11	2	22	7	31	12	14	16	3

this respect were observed in plants that irrigated with ten times with drainage water. Obtained results are true in both seasons of 1996 and 1997. These results about the irrigation frequencies with drainage water on leaves content of N,P,K, Ca and Mg are in agreement with those reported by **Dahiya and Singh (1976); Malik et al. (1977); Khadr (1979); Khadr et al. (1980); Abd- El-Dayem (1982); Abdalla (1985) and Abed et al. (1988)** on pea plants. Similar findings were observed by **D'arrigo et al. (1986) and Shafshak** on broad bean. In this respect, **Pasternak et al. (1986)** and **Pasternak et al. (1995)** found a similar findings with tomato plants, but they added that, there were no changes in leaves content of K and Ca as a result of using saline water in irrigation.

Results about the effect of irrigation frequencies with drainage water on leaves content of Na and Cl are in harmony with those reported by **Pasternak et al. (1986)** on tomato and **Abed et al., (1988)** on pea plants. In this regard, **Pasternak et al. (1995)** found a similar result on tomato with Na elements, but they indicated that irrigation with brackish water (ECi = 6.2 dS / m) had no effect on tomato leaves content of chloride.

Concerning the effect of irrigation frequencies on the relationship between Na^+ and other cations (K^+, Ca^{++} and Mg^{++}), data presented in Table (25) show clearly that significant increase in (Na^+: K^+, Na^+: Ca^{++} and Na^+: Mg^{++} ratios) could be detected as a result of using drainage water in tomato irrigation, this increase was proportional with increasing irrigation frequencies with drainage water. Obtained results are going in the same trend during both seasons of 1996 and 1997.

Table (25): Effect of irrigation frequencies of drainage water on ($Na^+:K^+$), ($Na^+:Ca^{++}$) and ($Na^+:Mg^{++}$) ratios and free proline of Edkawy and UC97-3 tomato cultivars during 1996 and 1997 seasons.

Seasons		1996				1997			
Drainage water frequencies	Varieties	$Na^+:K^+$	$Na^+:Ca^{++}$	$Na^+:Mg^{++}$	Free proline (mg/m F.W)	$Na^+:K^+$	$Na^+:Ca^{++}$	$Na^+:Mg^{++}$	Free proline (mg/m F.W)
0	Edkawy	0.055	0.059	0.081	0.755	0.050	0.058	0.077	0.770
	UC 97-3	0.056	0.057	0.083	0.682	0.047	0.055	0.074	0.672
2	Edkawy	0.061	0.066	0.090	0.786	0.058	0.072	0.090	0.796
	UC 97-3	0.055	0.061	0.083	0.695	0.056	0.068	0.086	0.704
4	Edkawy	0.060	0.072	0.088	0.835	0.063	0.080	0.090	0.812
	UC 97-3	0.053	0.066	0.083	0.766	0.057	0.076	0.084	0.757
6	Edkawy	0.216	0.262	0.316	0.864	0.204	0.256	0.326	0.843
	UC 97-3	0.195	0.239	0.297	0.800	0.201	0.243	0.307	0.794
8	Edkawy	0.236	0.309	0.396	0.918	0.242	0.277	0.378	0.871
	UC 97-3	0.228	0.307	0.381	0.874	0.235	0.273	0.368	0.809
10	Edkawy	0.279	0.365	0.426	1.020	0.262	0.355	0.405	1.001
	UC 97-3	0.265	0.370	0.431	0.968	0.247	0.313	0.386	0.886
L.S.D at 5 %		n.s	n.s	n.s	0.014	n.s	n.s	n.s	0.008
Drainage water frequencies									
0		0.055	0.058	0.082	0.718	0.049	0.057	0.075	0.721
2		0.058	0.063	0.086	0.741	0.057	0.070	0.088	0.750
4		0.057	0.069	0.085	0.800	0.060	0.078	0.087	0.784
6		0.205	0.250	0.307	0.832	0.203	0.250	0.316	0.818
8		0.232	0.308	0.388	0.896	0.238	0.275	0.373	0.840
10		0.272	0.367	0.429	0.994	0.255	0.334	0.396	0.943
L.S.D at 5 %		0.010	0.018	0.024	0.009	0.008	0.008	0.012	0.013
Varieties									
Edkawy		0.151	0.189	0.233	0.863	0.146	0.183	0.228	0.849
UC 97 –3		0.142	0.183	0.226	0.797	0.141	0.171	0.218	0.770
L.S.D at 5 %		0.006	n.s	n.s	0.006	n.s	0.010	n.s	0.003

2.2.2. Effect of varieties:

It is obvious from the data tabulated in Table (24) that Edkawy cultivar recorded the highest concentration of all studied elements, where the differences in both cultivars were significant in all studied elements during both seasons of this investigation with an unique exception in case of P content in the first season, where differences between the two cultivars did not reach 5% leavel of significance.

With respect to the effect of different cultivars on (Na^{+}: K^{+}), (Na^{+}: Ca^{++}) and (Na^{+}: Mg^{++}) ratios, data tabulated in Table (25) show that, although Edkawy cultivar reflected higher values compared with UC97-3 one, differences did not reach the 5% level of significance in most cases during both seasons.

With respect to the interaction between irrigation frequencies and cultivars, data presented Table (24) show that there were significant differences between irrigation frequencies and tomato cultivars with N,P,K concentrations during the first season only, whereas differences in the second season were insignificant. Moreover, differences were significant in case of Ca and insignificant in case of Mg, Na and Cl elements (Table, 24) as well as the ratios of Na^{+}: K^{+}, Na^{+}: Ca^{++} and Na^{+}: Mg^{++} (Table, 25) during both seasons.

2.3.Free proline accumulation:

2.3.1 Effect of irrigation frequencies:

Data dealing with the effect of irrigation frequencies with drainage water on tomato leaves content of free proline are presented in Table (25). Such data indicate that using drainage water in irrigation led to a significant increase in this respect. This increase in leaves content of free proline was proportional to the increase in irrigation frequencies with drainage water. The highest values in this respect were observed in plants irrigated ten times with drainage water compared with those irrigated ten times with Nile water, which recorded the least values in this respect. Obtained results are going in the same trend during both seasons of 1996 and 1997.

2.3.2. Effect of varieties:

Data presented in Table (25) show clearly that differences between Edkawy and UC 97-3 cultivars were significant regarding their leaves content of free proline. Plants of Edkawy cv. recorded the highest concentration in this respect during both seasons of this work.

With resect to the effect of the interaction between irrigation frequencies and tomato cultivars on leaves content of free proline, data presented in Table (25) show that differences were significant in both seasons. The highest values in this respect were recorded in Edkawy plants irrigated ten times with drainage water (1.010 mg / gm F.W) as average of both seasons, whereas tomato plants of UC 97-3 cultivars irrigated with Nile water recorded the least values in this respect. Tomato plants that treated with other treatment lie in between in this regard.

3. Flowering characteristics:

3.1. Effect of irrigation frequencies:

Data presented in Table (26) show that using drainage water in irrigation up to four times resulted in a significant increase in number of clusters per plant as expressed as flowering parameter during both seasons of this work. On the other hand, increasing irrigation frequencies with drainage water more than four times resulted in a gradual significant reduction in this respect.

3.2. Effect of varieties:

It is obvious from the data presented in Table (26) that differences between Edkawy and UC 97-3 cultivars were significant only during the second season, whereas no significant effects on number of clusters per plant could be detected during the first one of this work. It is obvious from such data that plants of UC 97- 3 cultivar recorded the highest number of clusters per plant compared with those of Edkawy during both seasons. These results are in agreement with those reported by **(Mohamed, 1987; Abaza, 1996 and Wanas, 1996).** They noticed that under irrigation with saline water, Edkawy cv. recorded the least reduction in number of clusters and flowers per plant in comparison with other studied cultivars.

Concerning the effect of the interaction between irrigation frequencies and studied varieties, data tabulated in Table (26) show clearly that differences were significant during both seasons. As average of both seasons, the highest number of clusters per plants (16.6) were observed in plants of UC97–3 cultivar irrigated four times with drainage water. On the other hand, least number of clusters (11.4) were observed when using either 8 or 10 irrigation with drainage water in UC 97- 3 cultivar.

4. Yield and its components:

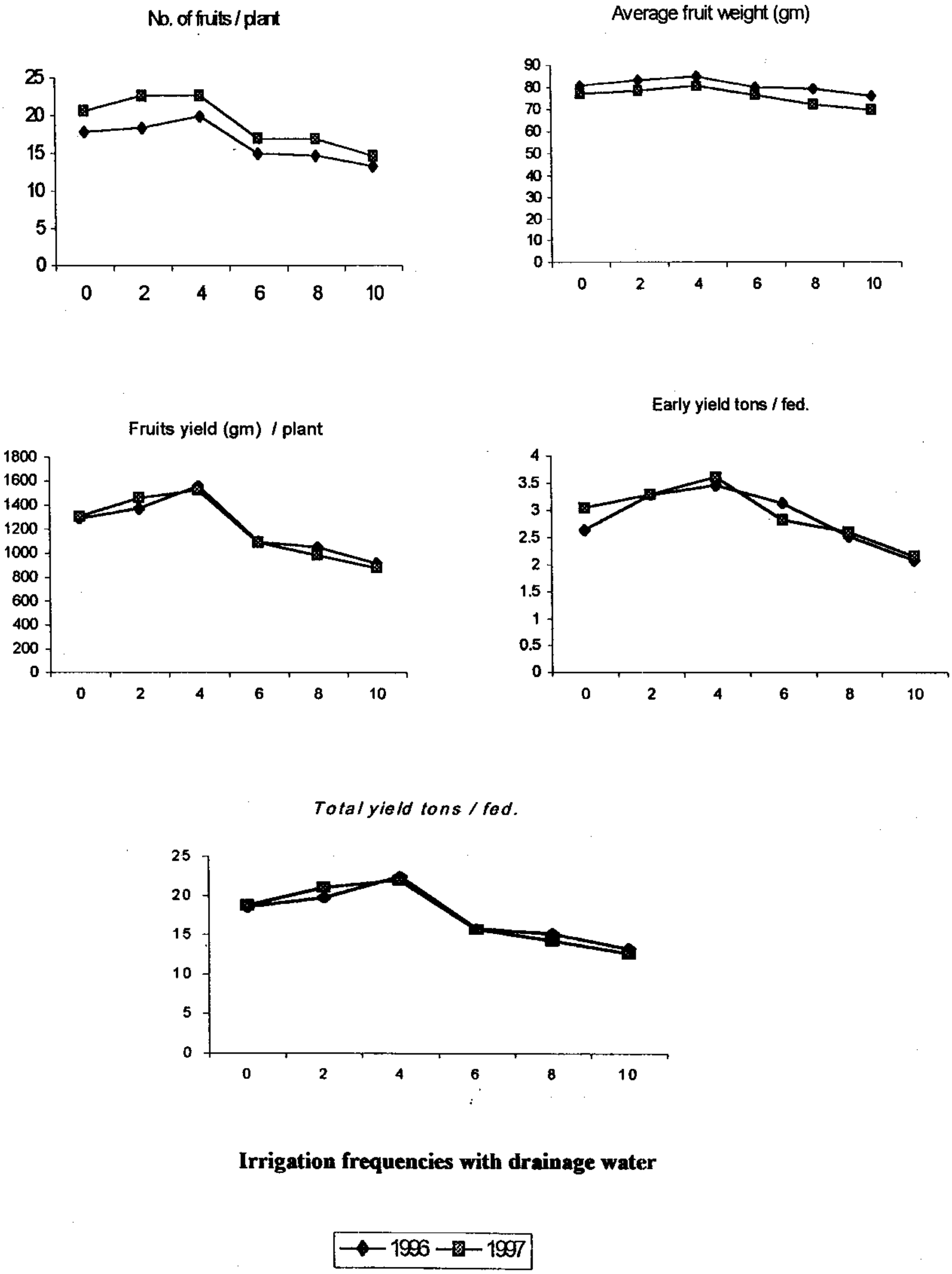
4.1. Effect of irrigation frequencies:

It is evident from data in Table (26) and Figure (32) that using drainage water in irrigation up to four times had a significant gradual improving effect on number of fruits per plant, average fruit weight, fruit length, fruit diameter, yield / plant as well as early and total yield /feddan in both seasons. Adverse effects were detected by increasing irrigation frequencies more than four times, whereby the worst results

Table (26): Effect of irrigation frequencies of drainage water on yield and its components of Edkawy and UC97-3 tomato cultivars during 1996 and 1997 seasons.

Seasons		1996								1997							
Drainage water frequencies	Varieties	Number of clusters/ plant	Number of fruits /plant	Average of fruit length (cm)	Average of fruit diameter (cm)	Average of fruit weight (gm)	Plant yield (gm)	Early yield tons/fed.	Total yield tons /fed.	Number of clusters/ plant	Number of fruits/ plant	Average of fruit length (cm)	Average of fruit diameter (cm)	Average of fruit weight (gm)	Plant yield (gm)	Early yield tons /fed.	Total Yield tons /fed.
0	Edkawy	12.0	11.6	4.7	6.6	106.0	1236	2.279	17.804	12.2	11.3	4.8	7.6	108.3	1224	2.761	17.639
	UC 97-3	16.2	24.0	4.7	5.0	55.7	1338	2.997	19.284	15.0	29.9	4.6	4.6	64.2	1382	3.318	19.919
2	Edkawy	14.0	12.4	4.8	6.3	110.3	1369	2.678	19.722	13.0	13.3	5.1	7.3	112.7	1508	2.880	21.731
	UC 97-3	15.0	24.4	4.5	5.5	56.1	1375	3.875	19.809	16.2	31.8	4.5	5.2	44.3	1409	3.685	20.300
4	Edkawy	14.2	14.8	4.9	7.7	112.0	1663	2.712	23.960	13.2	13.9	5.1	7.9	114.9	1606	2.921	23.138
	UC 97-3	16.0	25.0	4.5	5.0	57.9	1449	4.202	20.881	17.2	31.2	4.6	5.5	46.3	1446	4.284	20.839
6	Edkawy	12.0	10.9	4.8	6.8	105.4	1157	2.806	16.671	12.0	10.3	4.8	7.2	107.5	1110	2.719	16.001
	UC 97-3	13.2	19.0	4.6	4.9	54.6	1037	3.441	14.940	14.2	23.7	4.5	4.6	45.1	1074	2.916	15.482
8	Edkawy	12.7	10.2	4.8	6.8	104.5	1066	2.280	15.358	12.0	10.0	4.5	7.1	106.3	1069	2.197	15.411
	UC 97-3	8.7	19.3	4.4	4.7	53.6	1039	2.767	14.979	14.0	23.8	4.3	4.6	37.8	903	3.001	13.012
10	Edkawy	12.0	9.6	4.5	6.2	101.7	979	1.799	14.104	11.2	9.9	4.5	6.7	98.7	981	1.841	14.140
	UC 97-3	9.2	17.0	4.4	4.5	50.4	858	2.361	12.367	13.7	19.2	4.2	4.4	40.7	773	2.483	11.140
L.S.D at 5 %		1.2	1.9	n.s	0.3	n.s	106	0.200	1.540	0.9	2.1	n.s	n.s	3.8	94	0.120	1.350
Drainage water frequencies																	
0		14.1	17.8	4.7	5.8	80.8	1287	2.638	18.544	13.6	20.6	4.7	6.1	77.2	1303	3.040	18.779
2		14.5	18.4	4.7	5.9	83.2	1372	3.276	19.769	14.6	22.6	4.8	6.2	78.5	1459	3.283	21.015
4		15.1	19.9	4.7	6.0	84.9	1556	3.457	22.420	15.2	22.6	4.9	6.7	80.6	1526	3.603	21.989
6		12.6	15.0	4.7	5.8	80.0	1097	3.124	15.805	13.1	17.0	4.7	5.9	76.3	1092	2.817	15.741
8		10.7	14.7	4.6	5.7	79.0	1052	2.523	15.168	13.0	16.9	4.4	5.8	72.1	986	2.599	14.212
10		10.6	13.3	4.5	5.4	76.0	918	2.080	13.236	12.5	14.6	4.3	5.5	69.7	877	2.162	12.640
L.S.D at 5 %		0.6	1.1	n.s	0.3	2.0	71.0	0.080	1.020	0.7	1.3	0.2	0.3	2.2	57	0.130	0.830
Varieties																	
Edkawy		12.8	11.6	4.8	6.6	106.6	1245	2.426	17.936	12.2	11.4	4.8	7.3	108.1	1250	2.553	18.010
UC 97 – 3		13.0	21.4	4.5	4.9	54.7	1183	3.274	17.045	15.0	26.6	4.4	4.8	43.4	1164	3.281	16.782
L.S.D. at 5%		n.s	0.7	0.1	0.1	1.1	43	0.080	0.630	0.4	0.9	0.2	0.2	1.5	38	0.050	0.550

Fig. (32):*Effect of irrigation frequencies of drainage water on yield and its components of tomato plants.*



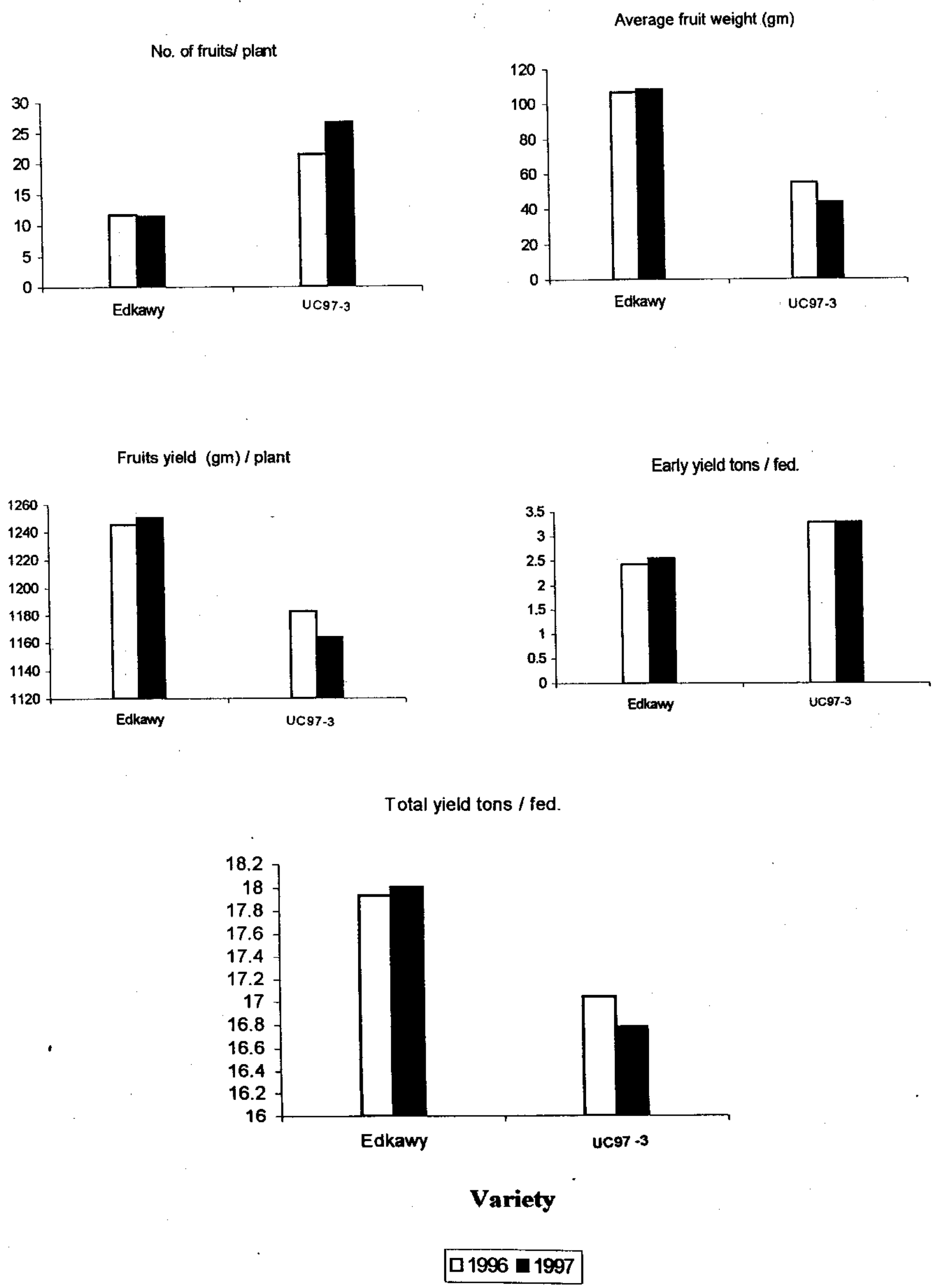
were obtained with plants received ten irrigations by using drainage water only. These results are in agreement with those reported by **(Grattan et al. 1987, Al-Najum and Neimmah, 1989; Drews, 1991; Mitchell et al.,1991; Grattan et al., 1994; Shaheen et al.,1995 and Aref and El-Dougdoug, 1996)** worked on tomato and **Abed et al.(1988)** on pea, **Shafshak (1989)** on broad bean as well as **Abo Soliman et al. (1992)** on wheat plants. However, many studies on tomato, indicated that using drainage water with high E.C. values reduced fruits yield **(Pasternak et al., 1986 and 1995; Mitchell et al.,1991; Grattan et al., 1994 and Katkat et al., 1996).**

4.2.Effect of varieties:

Data on the effect of different cultivars on number of fruits per plant, fruit length, fruit diameter, average fruit weight, yield per plant, early and total yield of tomato plants are tabulated in Table (26) and Figure (13). Such data show clearly that differences in this respect between the two cultivars were significant during both seasons of this work. UC97-3 cultivar recorded the highest values with number of fruits per plant and early yield during both seasons, while Edkawy cultivars recorded the highest values of fruit length and diameter, average fruit weight, plant yield as well as total yield. These results are in agreement with those reported by **(Ruch and Epstein, 1981; Mahmoud et al., 1986 b; Sarg, 1991; Soliman and Doss , 1992; Sarg et al., 1993 ; Abdel-Latif, 1995; Vespasiani et al.,1995; Abaza, 1996 and Wanas, 1996)** on tomato plants.

With respect to the interaction between irrigation frequencies and studied cultivars (Table, 26), such data exhibited a significant with most studied characters in this respect, the exception was with

Fig. (33): *Effect of tomato variety on yield and its components.*



case of fruit length which differences were insignificant during both seasons. Edkawy cv. recorded the highest values (113.5 gm , 1635 gm, 23.549 tons and 7.8 cm) for average fruit weight, plant yield, total yield and fruit diameter, respectively, whereas, UC97-3 exhibited the highest values for number of fruits per plant and early yield/ feddan (14.4 fruits and 4.243 tons) respectively. On the other hand, least values of number of fruits per plant (9.8) and early yield (1.82 tons / fed.) as average of both seasons were observed on plants of Edkawy cv. that irrigated ten times with drainage water, whereas ,the least values of average fruit weight (40.7 gm), plant yield (816 gm), total yield/ feddan (11.734 tons) and fruit diameter (4.5 cm) as average of both seasons were detected on plant of UC97-3 one that irrigated 8-10 irrigations with drainage water.

5.Fruit quality:

5.1. Vit. C., titratable acidity, T.S.S. and sugars:

5.1.1. Effect of irrigation frequencies:

Data presented in Table (27) illustrated the effect of irrigation with drainage water on fruits content of Vit.C., titratable acidity, T.S.S and sugars. These effects were significant during both seasons. Such data indicate that using drainage water in irrigation up to four times lead to the highest values of Vit.C., titratable acidity, reducing, non-reducing and total sugars, whereas the highest values of T.S.S were detected when ten irrigations with drainage water were used. On the other hand using drainage water in irrigation for ten times resulted in the least values for Vit.C., titratable acidity and sugar content, whereas the least value of T.S.S. as average of both seasons was detected when ten irrigations with Nile water were used. These results may be attributed to the increase or decrease in photosynthetic

Table (27): Effect of irrigation frequencies of drainage water on fruit quality of Edkawy and UC97-3 tomato cultivars during 1996 and 1997 seasons.

Seasons		1996						1997					
Drainage water frequencies	Varieties	Vit.C mg/100 mg F.W	Titratable acidity (%)	T.S.S (%)	Reducing sugars (mg / 100 gm D.W)	Non-reducing sugars (mg / 100 gm D.W)	Total sugars (mg / 100 gm D.W)	Vit. C mg/100 mg F.W	Titratable acidity (%)	T.S.S (%)	Reducing sugars (mg / 100 gm D.W)	Non-reducing sugars (mg / 100 gm D.W)	Total sugars (mg / 100 gm D.W)
0	Edkawy	20.1	0.51	4.3	3911	438	4350	22.2	0.48	4.2	3931	432	4363
	UC 97-3	19.9	0.50	4.2	3836	480	4316	21.4	0.56	4.2	3852	488	4340
2	Edkawy	21.9	0.52	5.1	4023	563	4586	25.4	0.50	5.0	4102	508	4610
	UC 97-3	21.7	0.54	4.8	3961	582	4543	21.2	0.56	4.7	3986	568	4554
4	Edkawy	23.2	0.57	5.5	4086	542	4628	26.4	0.58	5.6	4183	510	4693
	UC 97-3	21.9	0.56	5.1	3980	596	4576	24.0	0.60	5.3	4063	553	4617
6	Edkawy	20.3	0.48	5.6	3796	473	4240	22.4	0.49	5.6	3873	398	4271
	UC 97-3	19.8	0.52	5.3	3690	517	4208	19.1	0.55	5.4	3801	413	4214
8	Edkawy	20.5	0.46	5.7	3675	446	4121	19.1	0.46	5.8	3721	391	4112
	UC 97-3	18.0	0.47	5.7	3625	478	4103	18.3	0.54	5.6	3649	382	4032
10	Edkawy	18.6	0.46	6.2	3478	393	3871	17.5	0.46	6.0	3591	321	3913
	UC 97-3	17.2	0.46	5.8	3409	440	4849	17.3	0.51	5.7	3480	376	3856
L.S.D at 5 %		n.s	n.s	n.s	n.s	n.s	n.s	1.4	n.s	n.s	n.s	n.s	n.s
Drainage water frequencies													
0		20.0	0.50	4.2	3873	459	4333	21.8	0.52	4.2	3891	460	4351
2		21.8	0.53	4.9	3992	572	4565	23.3	0.53	4.8	4044	538	4582
4		22.5	0.56	5.3	4033	569	4602	25.2	0.59	5.4	4123	531	4654
6		20.0	0.50	5.4	3730	495	4224	20.8	0.52	5.5	3837	405	4242
8		19.2	0.47	5.7	3650	462	4112	18.7	0.50	5.7	3685	386	4071
10		17.9	0.46	6.0	3444	417	3860	17.4	0.48	5.8	3536	349	3885
L.S.D at 5 %		0.9	0.02	0.1	21	25	10	1.2	0.02	0.1	32	24	16
5Varieties													
Edkawy		20.7	0.50	5.4	3824	476	4299	22.2	0.50	5.3	3900	426	4326
UC 97–3		19.7	0.50	5.1	3750	515	4266	20.2	0.55	5.1	3805	463	4268
L.S.D at 5 %		0.6	n.s	0.1	11	14	7	0.6	0.01	0.1	18	22	11

pigments (Table,23) since sugars is the main products of photosynthetic assimilation. Obtained results are in agreement with those reported by **Pasternak et al. (1986); Al-Najum and Neimmah (1989) and Mitchell et al. (1991)** on tomato, **Farrage (1978)** on broad bean and **Abed et al. (1988)** on pea plants. However, **Mitchell et al. (1991)** added that there was no effect on hexose concentration when saline water was used in irrigation.

5.1.2. Effect of varieties:

Data in Table (27) show the effect of different cultivars on fruit content of Vit.C., titratable acidity, T.S.S and sugar content (reducing, non-reducing and total sugars). It is obvious from such data that, differences between studied cultivars were significant in all studied parameters in this respect during both season of this work, with the unique exception of the titratable acidity during the first season which was insignificant. In this regard, Edkawy cv. recorded the highest values of fruits content of Vit.C., total soluble solids, reducing and total sugars, whereas UC 97-3 one, recorded the highest values of titratable acidity and non-reducing sugars as average of both seasons.

The interaction between irrigation frequencies and studied cultivars (Table, 27) show clearly that the only significant in this respect was found with Vit.C. parameter during the second season only. The highest content of Vit.C. was observed with. Edkawy cv. that irrigated with four times with drainage water, whereas the least value in this regard was detected when irrigated UC97-3 cv. with ten irrigations with drainage water.

5.2.Mineral composition of fruits:

5.2.1. Effect of irrigation frequencies:

Data presented in Table (28) show the effect of irrigation frequencies with drainage water on fruit content of N,P,K, Ca and Na elements. It is obvious from such data that using drainage water in irrigation of tomato plants led to a significant reduction in fruit content of N,P and Ca elements during both seasons of this work. This reduction in fruit content in such elements was proportional with increasing irrigation frequencies with drainage water. Fruits content of K tended to increase by increasing irrigation frequencies up to four times then began to decrease in both seasons, but fruit content of Na tended to increase significantly by increasing irrigation frequencies of drainage water up to ten times. Obtained results are going in the same trend during the two seasons of 1996 and 1997. These results are in agreement with those reported by **(Abed et al., 1988 and Shafshak, 1989)** on pea and broad bean plants, respectively.

5.2.2.Effect of varieties:

Data illustrated in Table (28) show the effect of different tomato cultivars on fruit content of N,P,K, Ca and Na elements. It is evident from such data, that differences between the studied cultivars were significant with all studied elements during both seasons of this work, with the exception of P and Ca elements during the second season, where no significant could be detected in this respect. Edkawy cv. exhibited the highest values of fruit content of N,P,K and Na elements during both seasons, whereas UC 97-3 recorded the highest values of Ca element in tomato fruit content during both seasons of this work.

Concerning the effect of interaction between irrigation frequencies with drainage water and studied cultivars, data presented

Table (28): Effect of irrigation frequencies of drainage water on fruits content of N,P,K,Ca and Na (mg/100 gm D.W) of Edkawy and UC97 –3 tomato cultivars during 1996 and 1997 seasons.

Seasons		1996					1997				
Drainage water frequencies	Varieties	N	P	K	Ca	Na	N	P	K	Ca	Na
0	Edkawy	3370	408	2660	1520	63	3310	397	2629	1590	63
	UC 97-3	3150	390	2455	1560	58	3140	385	2581	1630	60
2	Edkawy	3215	382	2821	1450	69	3280	380	2659	1580	67
	UC 97-3	3057	377	2641	1490	63	3150	391	2619	1590	67
4	Edkawy	3060	375	3004	1445	71	3180	354	2692	1575	80
	UC 97-3	2950	369	2677	1465	64	3120	361	2627	1585	72
6	Edkawy	2970	367	2430	1440	111	3060	345	2660	1505	124
	UC 97-3	2850	342	2379	1460	100	3090	336	2430	1495	115
8	Edkawy	2880	358	2347	1430	127	2920	337	2452	1490	127
	UC 97-3	2730	345	2331	1440	113	2780	325	2293	1450	124
10	Edkawy	2760	350	2330	1410	135	2690	320	2210	1430	130
	UC 97-3	2640	326	2218	1380	128	2610	312	2058	1440	126
L.S.D at 5 %		45	n.s	55	21	n.s	n.s	10	57	22	n.s
Drainage water frequencies											
0		3260	399	2557	1540	60	3225	391	2605	1610	61
2		3145	379	2731	1470	66	3215	385	2639	1585	67
4		3005	372	2840	1455	67	3150	357	2659	1580	76
6		2910	354	2404	1450	105	3075	340	2545	1500	120
8		2805	351	2339	1435	120	2850	331	2372	1470	126
10		2700	338	2274	1395	131	2650	316	2134	1435	128
L.S.D at 5%		34	9	62	22	7	67	10	37	13	4
Varieties											
Edkawy		3042	373	2598	1449	96	3073	355	2550	1528	98
UC 97 – 3		2899	358	2450	1465	87	2981	351	2434	1531	94
L.S.D at 5%		18	5	22	8	2	43	n.s	23	n.s	3

in Table (28) show that differences were significant in fruit content of K and Ca elements during both seasons as well as N and P during first and second season, respectively. the highest values of N,P and K elements were observed in plant of Edkawy cv. that treated with Nile water only (for N and P) and four times with drainage water (for K), whereas the highest value of Ca content was found in plants of UC97-3 that treated with ten irrigations with Nile water. On the other hand, the least values of the previous elements (as average of both seasons) were observed in plants of UC 97-3 cv. that treated with ten irrigations with drainage water. In this connection, no significant could be detected on fruits content of Na element during both seasons of this work.

6.Anatomical studies:

6.1. Leaf anatomy:

6.1.1 Effect of irrigation frequencies:

Data presented in Table (29) and Figures (34–39) show the effect of irrigation frequencies with drainage water on anatomy features of tomato leaves i.e upper and lower epidermis, measophyll tissue (contains of palisade and spongy tissues) as well as number of xylem vessels and diameter and width of midrib. Such data indicated that increasing irrigation frequencies with drainage water up to ten times was accompanied with gradual decrease all studied parameter. The highest decrement was found with the highest used irrigations with drainage water in comparison with using Nile water only during season, The exceptions - in this case - were in case of diameter and width of midrib that improved with increasing irrigation frequencies with drainage water. These results might be due to the role of salinity on inhibiting sell division and elongation that grown under saline conditions.

6.2.2 Effect of varieties:

Table (29) and Figures (34-39) show clearly the effect of different studied cultivars on anatomy features of tomato plants. Such data indicate the best favourable effect of Edkawy cv. on all studied characters such as upper and lower epidermis, measophyll tissue (contains of palisade and spongy tissues) as well as number of xylem vessels and diameter and width of leaf midrib compared to UC97 – 3 one. These results may be attributed to the genetical properties which may be considered as the main factor in this respect. Obtained results are in harmony with those reported by **Sarg (1991) and Wanas (1996)** on tomato, they noticed that under saline conditions, Edkawy cv. was less affected in its anatomical properties than UC97-3.

Table (29):Anatomy of tomato plant leaves as affected by different irrigation frequencies with drainage water within Edkawy and UC97-3 cultivars.

	Thickness in microns for								
Treatments	Upper epidermis	Lower epidermis	Palisade tissue	Spongy tissue	Measophyll tissue	Blade	Diameter of midrib	Width of Midrib	Number of xylem vessels
Irrigation water frequencies									
0	24.0	20.0	128.0	181.6	309.6	353.6	888.8	823.2	47
4	24.0	19.2	112.0	177.6	289.6	332.8	1352.8	1368.0	46
10	19.2	16.0	93.6	125.6	219.2	254.4	1112.0	1092.0	45
Varieties									
Edkawy	23.5	20.8	122.1	184.5	306.7	350.9	1120.5	1132.8	47
UC97 – 3	21.3	16.0	100.3	138.7	238.9	276.3	1115.2	1056.0	46

Fig. (34): Nile water only (control)

Fig. (35): Nile water only (control)

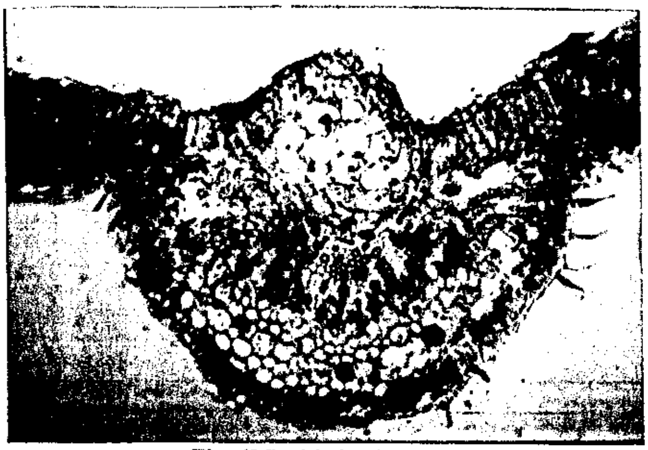


Fig. (36): 4 irrigations of drainage water

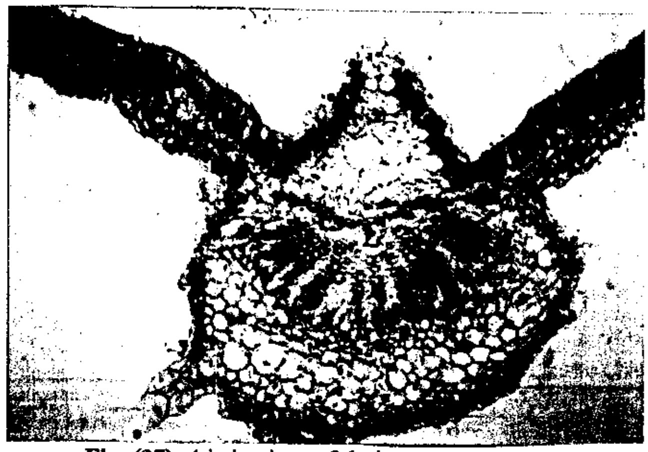


Fig. (37): 4 irrigations of drainage water

Fig. (38): 10 irrigations of drainage water

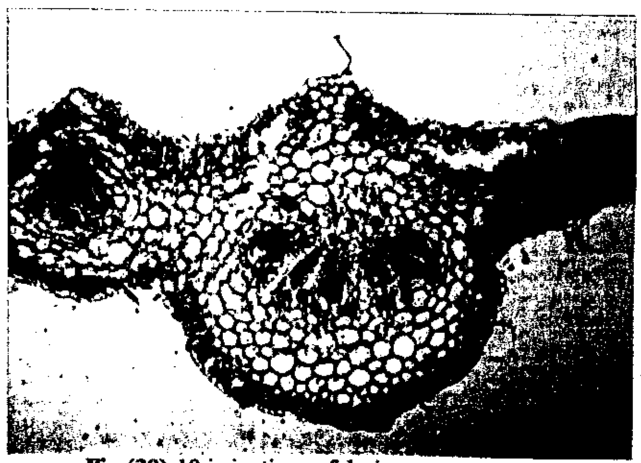


Fig.(39): 10 irrigations of drainage water

[Edkawy] **[UC97-3]**

Figures (34 –39): Effect of irrigation frequencies of drainage water on the leaf anatomical structure of Edkawy and UC97-3 tomato cultivars.