4. RESULTS AND DISCUSSIONS

Introductory résumé :

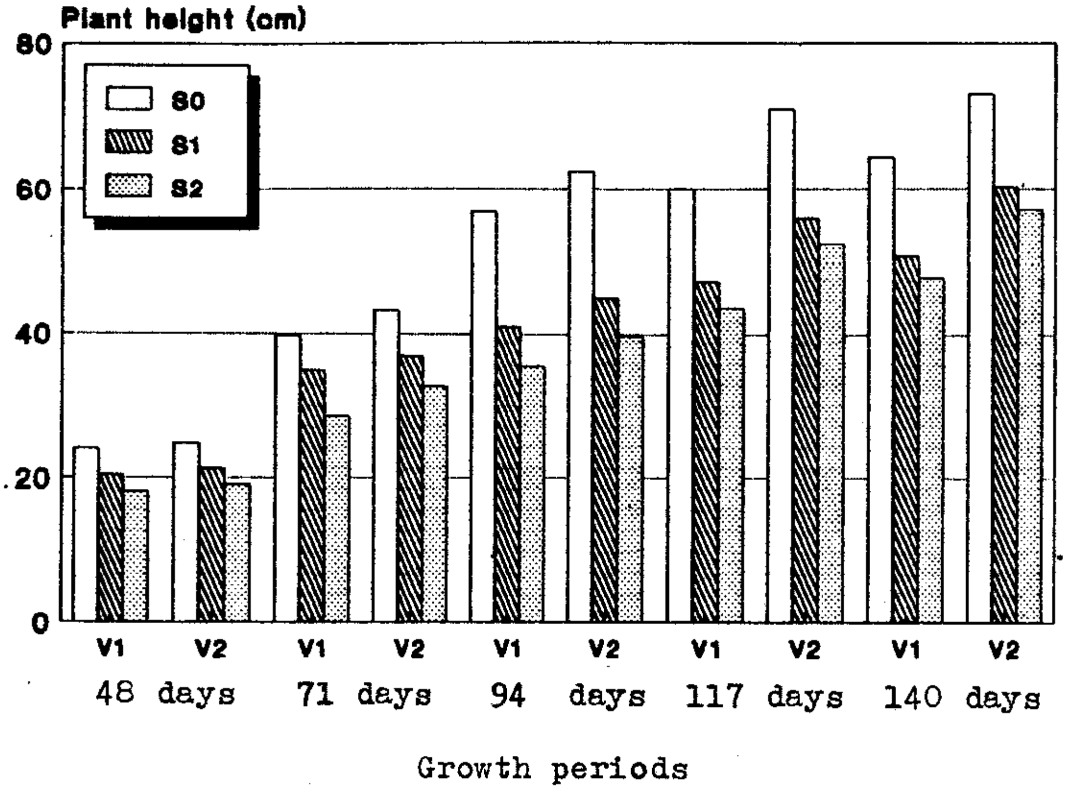
Cotton plant growth characters, chemical components and yield respond, but perhaps differently, to irrigation with saline waters. Effect of irrigation with diluted sea water (d.s.w.)(10000, 15000, or 30000 ppm (S_1, S_2 and S_3)) supplied at specific intervals on the previous plant characters compared to that of tap water (S_0) of 250 ppm salinity, was estimated. Different periods of applications to cotton plants were 20-48, 49-71, 72-94, 95-117 and 118-140 days from planting namely; P_1, P_2, P_3, P_4, and P_5 respectively. The used varieties were Giza 45 (V_1) and Giza 81 (V_2) (first season) and Giza 81 (second season). Noting that, no measured data were recorded at the high salinity level ; S_3P_1 treatment in the second season and plant died before the end of first growth period. This means that Giza 81 subjected to irrigation with 30000 ppm diluted sea water (0.66 seawater) through the growth period from 20-48 days after planting failed to grow till the end of this growth period. The same variety showed a certain plant response when subjected to irrigation with 10000 ppm and 15000 ppm. Shavrygin and Sattarov (1964) reported that cotton plants grew well at salt concentration of 7-8 gm per liter of soil solution. At higher concentration, plants grew badly or died.

4.1. Effect of salinity on cotton plant growth characters :

Being recorded plant growth characters provides a very clear notation about the inner reactions of plant biological and chemical components that is also affected with the outer environment in which plants survive . The recorded plant growth parameters were plant height, leaf number and leaf area . All these parameters were adversely affected with diluted sea water but to a certain extent differing with salinity level . Meiri and Shalhevet (1973) attributed such salinity effects to the following reasons, which are almost similar to these mentioned by Thorne and Peterson (1954); (a) reduction the content of water available to plant leading to disturbe water balance in the plant cells and that reduce turgor pressure and lower growth rate . (b) disturbance in the hormones mechanisms and their effect on the balance between the changes of root and shoot hormones. (c) damage of plant cells and cytoplasmic organells, due to the accumulation of excessively high levels of ions in the plant leaves, which causes the death of the cells . Also, the salinity changes the structure of chloroplasts and the mitocondria in the leaves, such changes may interfere with the normal metabolism and growth behaviour . (d) interference with normal metabolism by increasing plant respiration and reducing photosynthesis rate in leading to a reduction of photosynthetic products available to plant growth .

4.1.1. Effect of salinity on height of cotton plants :

The recorded data of cotton plant heights (cm) are shown in tables(4 and 7), illustrated in figs(4 and 7) and tabulated in appendix (1). Mean values of plant heights of the two cotton varieties due to salinity treatments showed



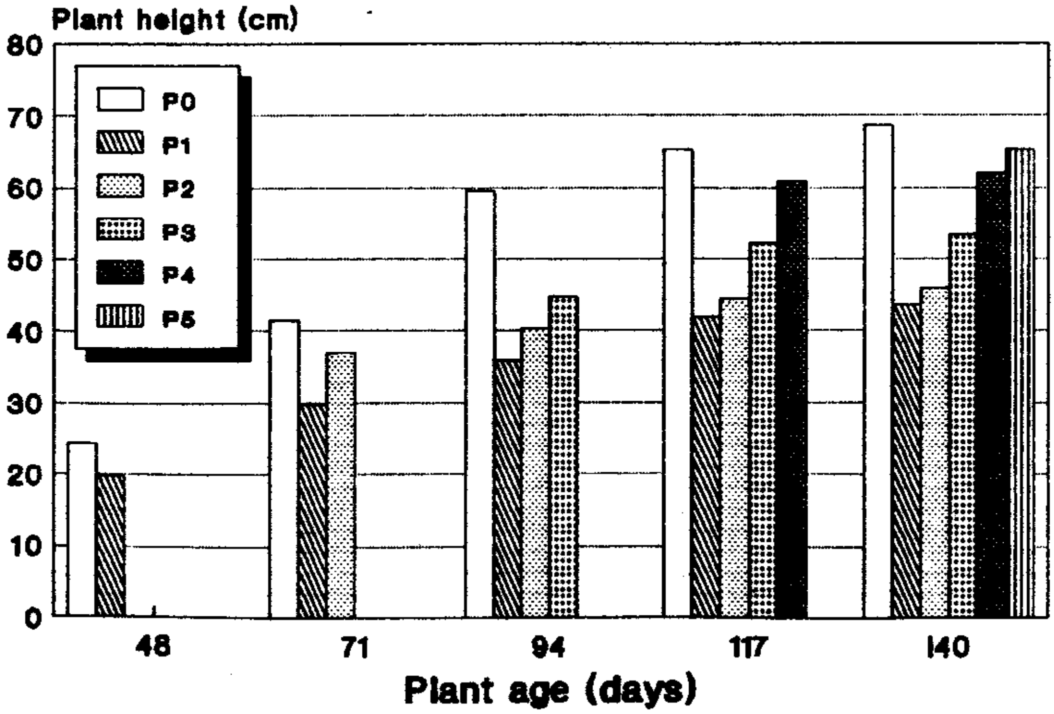


Fig (2): Effect of salinity, levels and growth periods on plant height (cm) at different plant ages (days) of two varieties of cotton .

Table (4): Effect of salinity levels and growth periods on plant height (cm) at different plant ages (days) of two varieties of cotton.

Type of treatments		Giza 45 Plant ages (days)					Giza 81 Plant ages (days)				
		48	71	94	117	140	48	71	94	117	140
control		24.0	39.8	56.9	60.0	64.3	24.9	43.3	62.4	70.8	73.0
10000 ppm	P_1	20.3	31.8	36.9	38.5	39.8	21.2	33.3	42.2	48.0	49.7
	P_2	24.1	38.0	42.0	43.3	44.8	24.6	40.7	44.8	48.8	50.5
	P_3	24.2	40.5	44.0	50.0	50.7	24.5	43.6	48.5	59.0	60.8
	P_4	24.1	40.2	56.5	57.7	58.5	24.5	43.6	62.5	67.7	69.7
	P_5	24.5	40.2	56.9	60.0	60.5	24.7	43.5	62.0	70.2	70.6
15000 ppm	P_1	18.1	24.9	30.7	37.7	39.3	19.2	28.5	34.4	43.7	45.7
	P_2	24.5	32.4	34.9	37.3	38.8	24.5	37.1	39.3	48.0	49.8
	P_3	23.9	39.5	41.2	44.2	45.7	25.0	43.4	45.6	55.5	56.8
	P_4	23.5	39.1	55.0	55.8	57.0	24.6	43.0	61.2	62.0	63.3
	P_5	23.8	39.8	56.3	59.4	59.8	25.2	44.0	62.6	70.0	70.5

L.S.D.	5 %	1 %
V	0.48	0.63
S	0.59	0.77
P	0.76	1.00
V x P	N.S.	N.S.
V x S	N.S.	N.S.
P x S	1.31	1.73

highly significant effect on both cotton varieties but height of Giza 45 (V_1) plants were lower than Giza 81 (V_2) . All the tested salinity levels plant height comparing with control , by 21 and 18 % for V_1 and V_2 under S_1, and by 25 and 22 % for V_1 and V_2 under S_2 level, i.e. the higher the level of salinity was,the lower the plant height in both cotton varieties . These results agreeswith those of El-Hifny et al (1975) .who reported similar trend with six tested cotton varieties under salinity levels used .

Concerning the effect of salinity level on plant height, the mean values revealed that S_1, S_2 and S_3 decreased plant height by 22, 26 and 41 % , as percentage of control in every growth season . Similar findings were reported by Hoffman et al (1971), El-Hifny (1975) and Lotfy et al (1987) . They concluded that plant height of cotton tested varieties were inhibited at different salinity levels . Also, Longenecker (1973), Thomas (1980), El-Saidi et al (1983) and Babu et al (1987) came to the same conclusion .

The recorded data showed that the significant depressive effect due to saline water irrigation was progressed with increasing salinity . The accumulation decreasing occurred with saline water irrigation were 36, 33, 22, 9, 5 % as percentage of control measured at G_3 for the five growth periods P_1, P_2, P_3, P_4 and P_5 respectively . Itai et al (1968) and Amer (1989) attributed such effect to the hormones responsible for increasing plant height . These hormones are most sensitive to salinity stress at the first growth stage in some barley varieties and at the second stage in another .

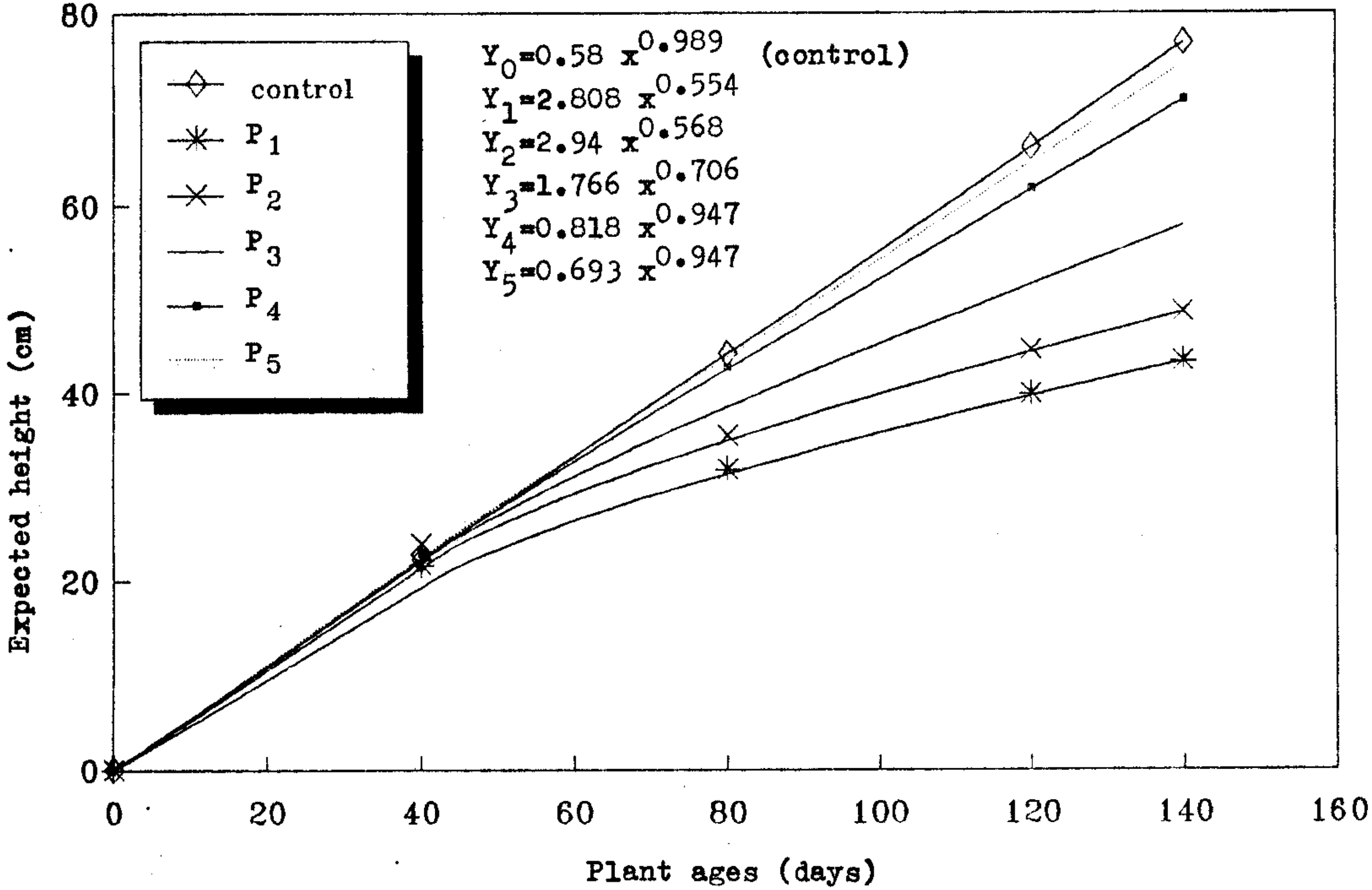


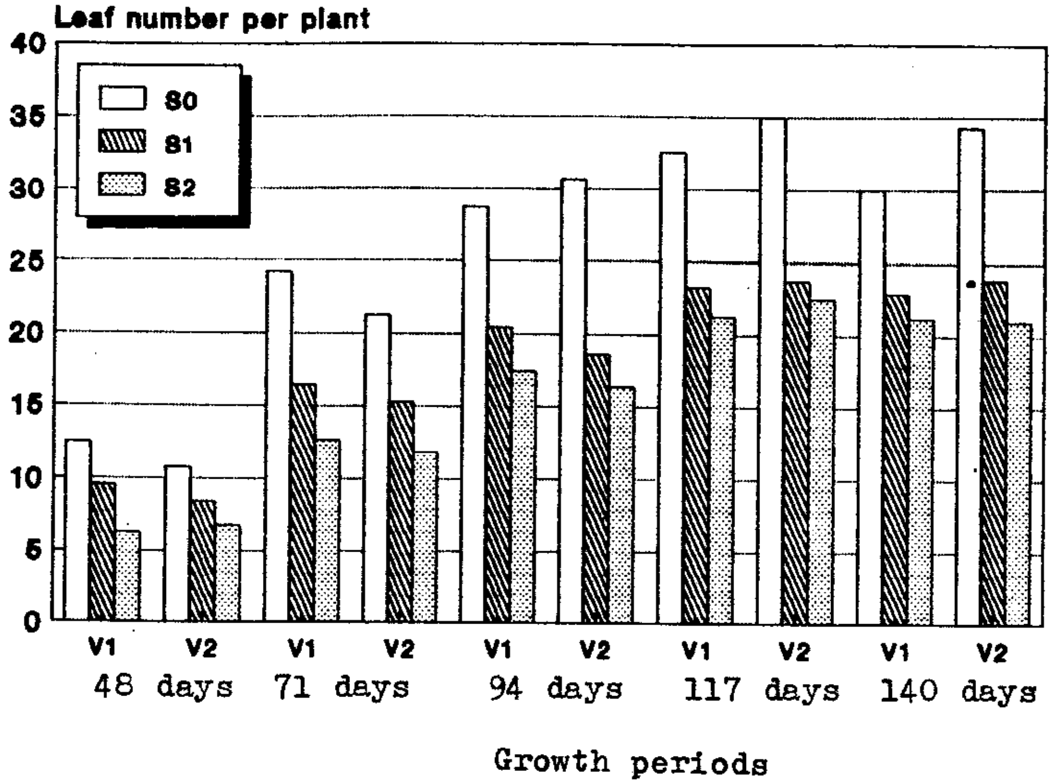
Fig (3) : Fit regression power equation of plant height at ages and growth periods (days) .

Depressions of plant heights at different plant ages (after 48, 71, 94, 117 and 140 days from planting) were 19, 11, 25, 7, 5 % as percentage of control treatment . Concerning accumulative decreasing of plant height at tested growth period of P_1 that measured at G_3 was higher than other growth period the simultaneous decrease at growth period P_3 was higher than the others . The curve fitted to the data in fig (3) was calculated from statistical significant power regression equation of cotton plant height with r values; 0.88** , 0.89**, 0.91**, 0.94** , 0.95** and 0.96** for the five growth periods respectively . Plant height of both cotton varieties under first growth period was more affected than any other period subjected to salinity level . Taha (1980) stated similar results to those mentioned above .

4.1.2. Effect of salinity on cotton plant leaves observations :

4.1.2.1. Effect of salinity on cotton leaf number per plant :

The recorded data for cotton leaf number per plant in the first and second growth seasons areeshown in tables (5,7) and illustrated in figs(4,5).Values of leaf number per plant under tested salinity levels and growth periods of both cotton varieties areeadversely highly significant, but somewhat differently affected for each variety . The obtained ddecreasing under salinity levels were 28 and 42 % for V_1 and V_2 under S_1, while they were 34 and 36 % for V_1 and V_2 under S_2 respectively , as percentage of control, at 117 day from planting . Although cotton plant was subjected to abscission in the last growth periods(117-140 days from planting), almost the main trend of leaf



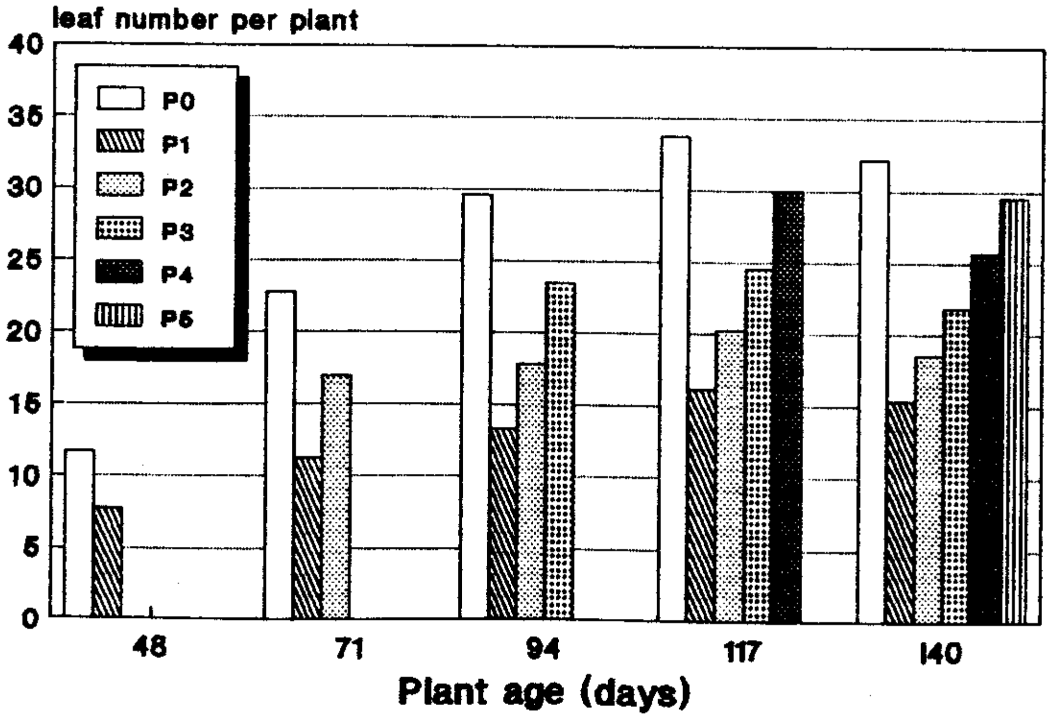


Fig (4):Effect of salinity levels and growth periods on leaf number per plant at different plant ages(days) of two varieties of cotton .

Table (5) : Effect of salinity levels and growth periods on leaf number per plant at different plant age (days) of two varieties of cotton .

Type of treatments		Giza 45 Plant ages (days)					Giza 81 Plant ages (days)				
		48	71	94	117	140	48	71	94	117	140
Control		12.5	24.3	28.7	32.5	30.0	10.8	21.3	30.6	35.0	34.3
10000 (ppm)	P_1	9.6	13.1	16.3	18.2	18.0	8.4	13.0	14.7	19.3	18.2
	P_2	12.6	19.9	20.5	21.2	20.1	10.9	17.7	18.7	19.9	17.8
	P_3	12.8	24.1	24.6	25.0	22.3	10.8	21.0	22.4	24.5	23.5
	P_4	12.3	24.7	28.4	28.9	24.8	10.9	21.4	29.9	31.2	28.3
	P_5	12.5	24.3	28.9	32.0	29.5	10.8	21.5	29.8	34.6	30.1
15000 (ppm)	P_1	6.4	9.4	11.0	12.3	11.1	6.8	9.3	11.3	14.7	14.1
	P_2	12.2	15.9	16.4	18.0	17.2	10.6	14.4	16.0	22.0	19.2
	P_3	12.4	24.3	25.1	26.1	22.5	11.1	21.0	21.8	22.7	19.1
	P_4	12.3	24.5	28.5	28.9	25.5	10.7	21.1	30.1	30.9	24.2
	P_5	12.4	24.5	28.9	32.5	29.90	11.0	21.2	30.0	35.1	28.6

L.S.D.	5 %	1 %
V	0.29	0.38
S	0.35	0.46
P	0.45	0.60
V x P	0.64	0.85
V x P	0.50	0.65
P x S	0.79	1.04

number per plant still as that of pre-last growth period (94-117 days from planting) . This finding is supported by that of El-Hifny et al (1975) .

On the other hand, salinity levels of irrigation water significantly decreased the leaf number per plant at each growth period to cotton variety . This depressing effect was increased with higher salinity level where the reduction values were 28 , 34 and 44 % as percentage of control under S_1, S_2 and S_3 respectively . These results agree with the findings reported by Ashley et al (1974) and Lotfy et al (1987) . Also, Selem et al (1989) mentioned that salinity of irrigation water (2.91 mmhos/cm) .reduced cotton leaf number/plant with 27 % compared with fresh irrigation water .

Concerning leaf number per plant of Giza 45 and Giza 81 under S_1 and S_2 (first season) or Giza 81 under S_1, S_2 and S_3 (second season), a highly significant difference among growth periods was found . The decreasing of leaf number per plant accumulated untill 117 days from planting with the first four growth periods respectively were 52, 40, 27 and 11 % as percentage of control, while with the different plant ages (48, 71, 94 and 117 days) were 33 , 26 , 21 and 11 % . This means that salinity decreased the leaf number per plant at the growth interval of 20-48 days from planting more than the other periods, or other ages .

Considering the effect of salinity levels through growth period S_1 reduced the leaf number/plant at the end of every growth period comparing with simultanous control by 23, 18, 12 and 11 % for the first four growth period , otherwise reductions due to S_2 were 43, 34, 21 and 11 % respectively . Power equation

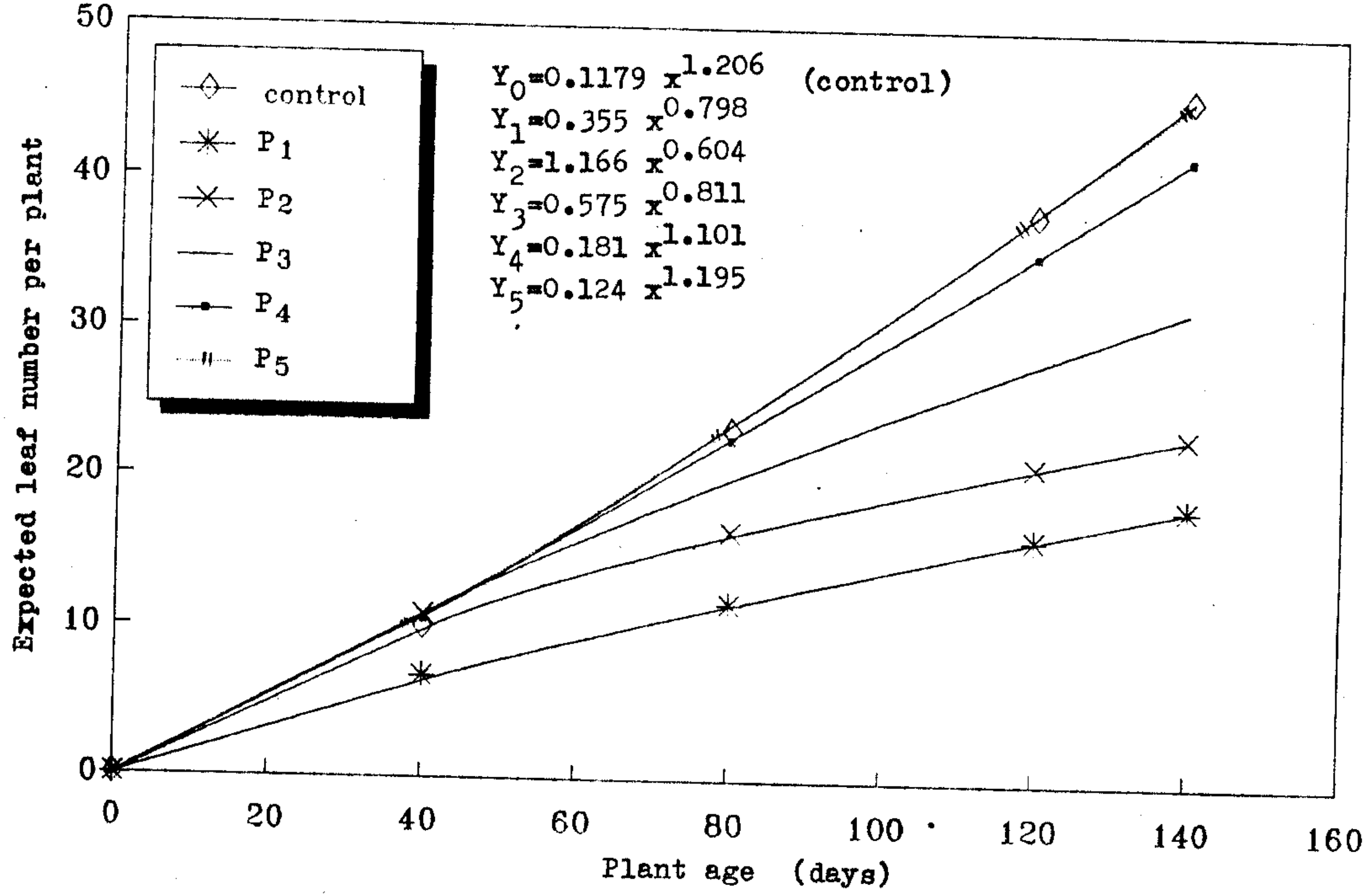


Fig (5) : Fit regression power equation of leaf number per plant at ages and growth periods (days) .

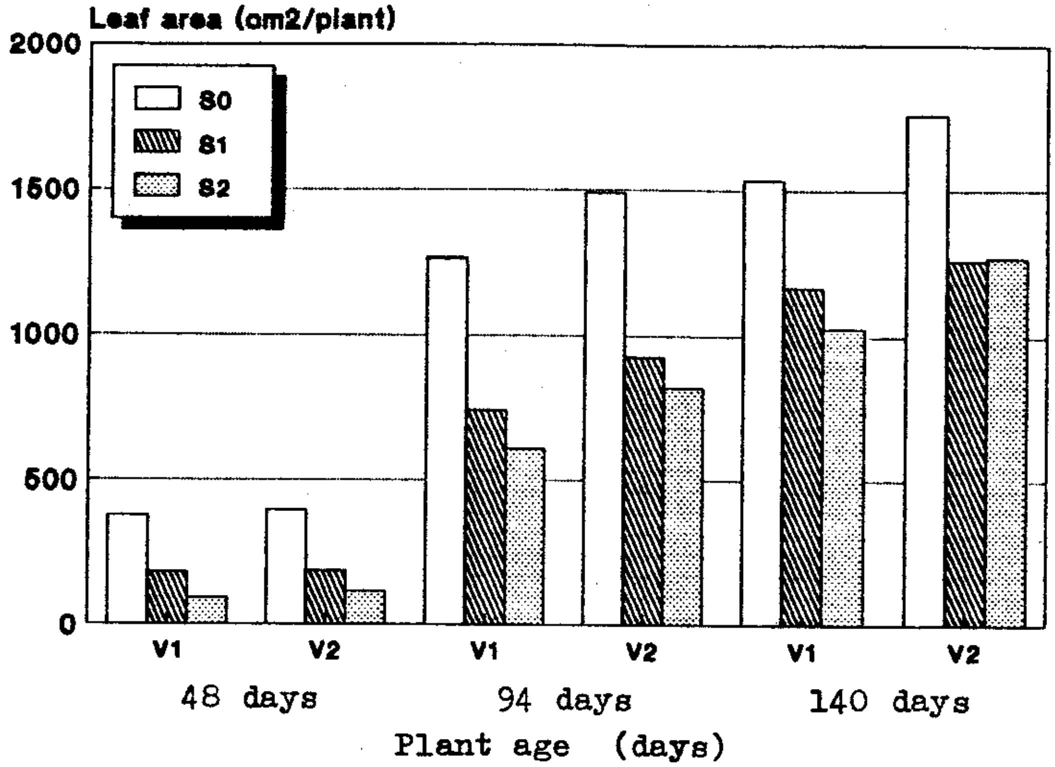
($Y = a x^b$) calculated for leaf number per plant of cotton varieties treated with P_1, P_2, P_3, P_4, P_5, and P_0 was fit with highly significant r in all cases (fig 5) .

4.1.2.2. Effect of salinity on cotton leaf area (cm^2/plant) :

Recorded data are shown in tables(6 and 7) and illustrated in figs (6, 7) . Mean values of plant leaf area (cm^2) significantly varied from 1098 cm^2/plant for Giza 45 and 1273 cm^2 for Giza 81 . The corresponding reductions in leaf area (cm^2/plant)were 28.4 and 27.6 %, respectively for V_1 and V_2 . A pronounced effect of salinity on leaf area was evident with both varieties and between them, but at similar degree with the two varieties .

With respect to salinity levels, leaf area (cm^2/plant) of two cotton varieties were significantly affected in different extents parallel with salinity concentrations used, in the other way, S_1, S_2 and S_3 decreased leaf area (cm^2/ plant) by 26, 30 and 44 % as percentage of control . Lockhart (1965) attributed such effect to reduction of leaf cell expansion rates by inducing reductions in wall extensibility as well as by reducing turgor . Also, Termaat et al (1985) concluded that salt, rather than causing a reduction in turgor, induced a "message" which was transmitted from the root to the leaf and regulated leaf growth rate, possibly by an effect on cell wall propeties . The obtained results of salinity effect agree with findings reported by Hoffman et al (1971) and Ashley et al (1974) .

The values of plant leaf area were significantly depressed under different periods of tested varieties and salinity levels . The accumulation reductions that took place under the



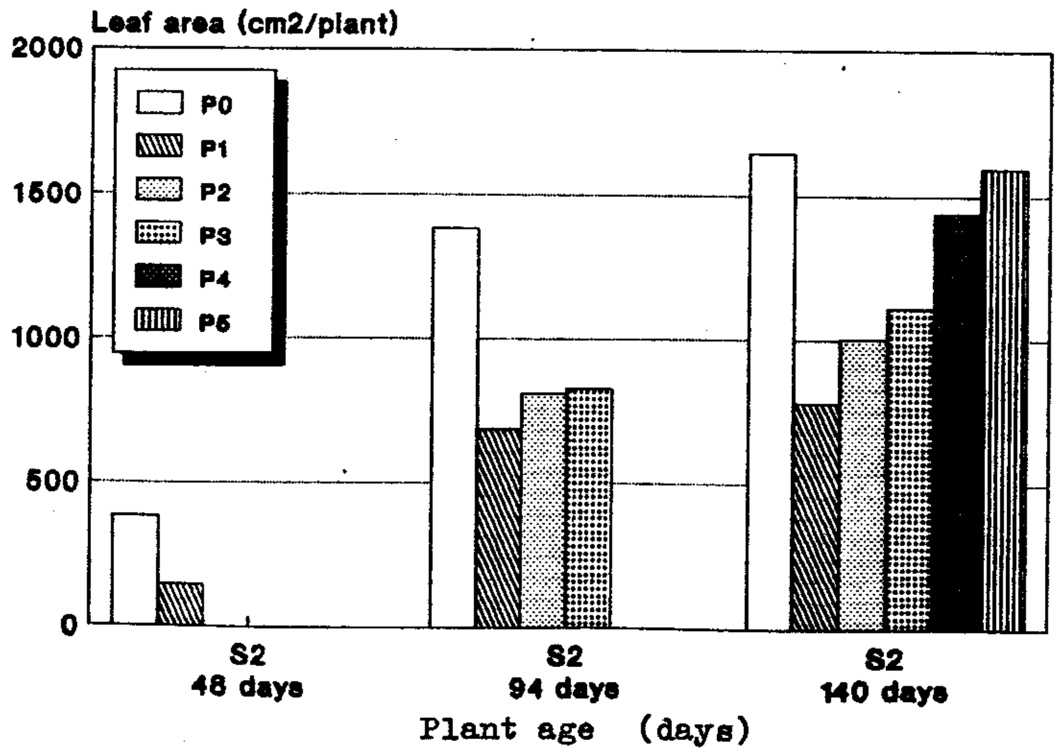


Fig (6) :Effect of salinity levels and growth periods on leaf area (cm^2/plant) at different plant ages(days) of two varieties of cotton .

Table (6) : Effect of salinity levels and growth periods on leaf area (cm²/plant) at different plant ages (days) of two varieties of cotton .

Type of treatments		Giza 45 Plant age (days)			Giza 81 Plant age (days)		
		48	94	140	48	94	140
Control		375	1269	1533	398	1492	1759
10000 (ppm)	P_1	183	674	780	188	862	942
	P_2	380	790	983	400	988	1058
	P_3	379	766	1197	397	936	1050
	P_4	376	1264	1378	396	1500	1577
	P_5	374	1267	1501	396	1495	1719
15000 (ppm)	P_1	94	444	550	118	774	855
	P_2	379	643	787	397	822	1186
	P_3	374	748	1045	396	872	1153
	P_4	377	1270	1295	396	1493	1506
	P_5	374	1267	1468	401	1494	1684

L.S.D.	5 %	1 %
V	16.42	21.66
S	20.11	26.53
P	25.97	34.25
V x P	36.72	48.44
V x S	28.45	37.52
P x S	44.98	59.32

Table (7) : Effect of salinity levels and growth periods on plant height, leaf number and leaf area (cm^2/plant) (second season) .

Type of treatment		Height (cm)	Plant leaf number	Leaf area cm^2/plant
Control		65.50	29.20	1162
10000 (ppm)	P_1	47.50	14.80	895
	P_2	39.67	16.50	920
	P_3	45.00	19.30	930
	P_4	54.67	22.50	1022
	P_5	59.00	25.80	1107
15000 (ppm)	P_1	35.67	11.30	710
	P_2	37.83	14.20	782
	P_3	47.33	18.20	809
	P_4	54.33	21.70	940
	P_5	58.50	24.20	992
30000 (ppm)	P_1	0.0	0.0	00
	P_2	37.15	13.90	650
	P_3	46.17	16.10	796
	P_4	55.15	19.90	863
	P_5	58.17	22.30	920

L.S.D.	5%	1%	5%	1%	5%	1%
S	2.03	2.72	0.21	0.28	47.62	63.71
P	2.27	3.04	0.23	0.31	53.24	71.23
S x P	4.53	6.08	0.40	0.54	106.48	142.47

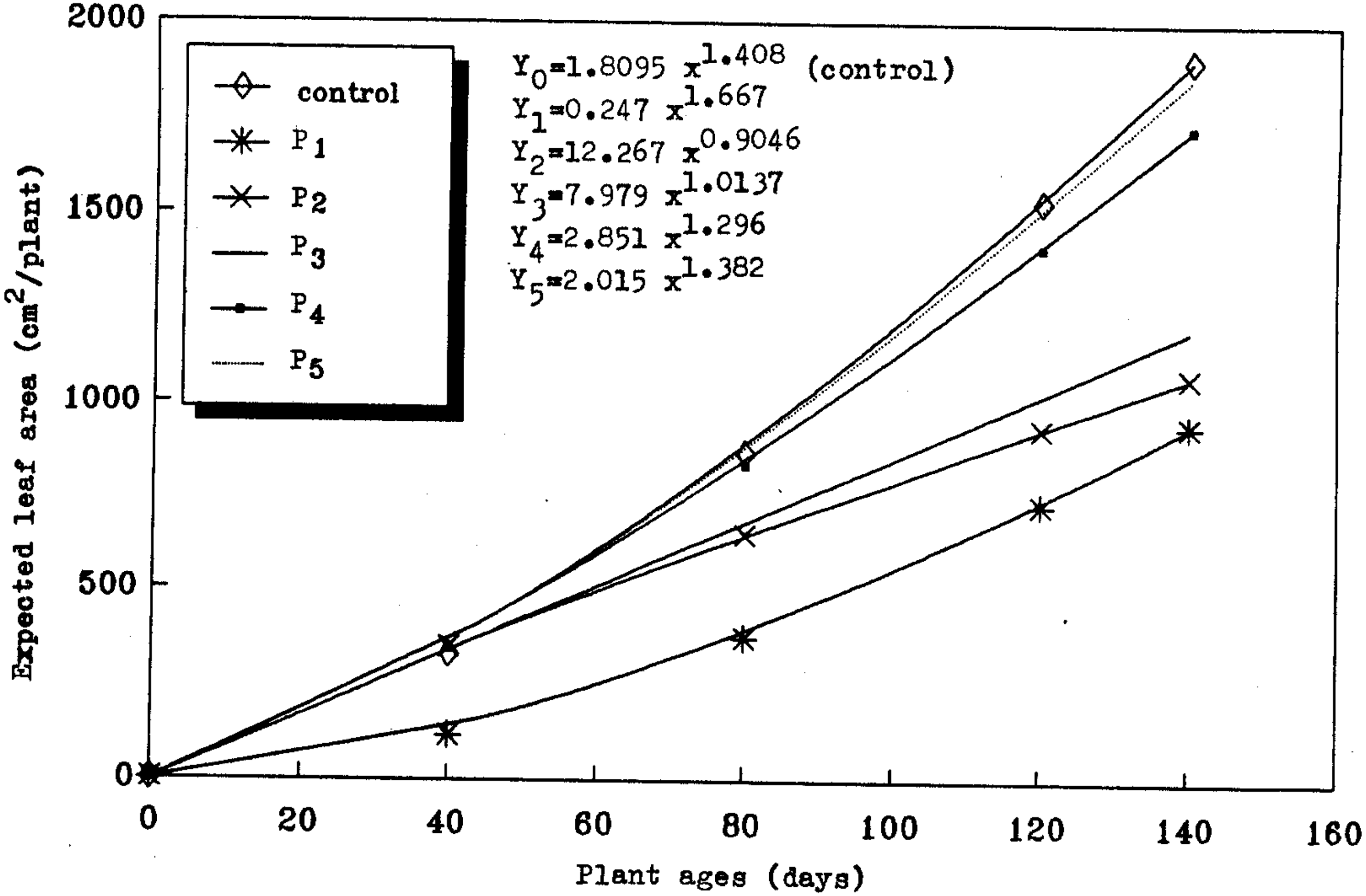


Fig (7) : Fit regression power equation of leaf area cm^2/plant at ages and growth periods (days) .

five time of sea water applications (P_1-P_5) were 53, 39, 33, 13 and 3% compared with the control, respectively. While the decreasing at tested different plant ages were 63, 39 and 3% compared with the control. The main trend of leaf area/plant at the time of sea water applications revealed that cotton plant were affected with salinity level at P_1 and was more serious than the other time of sea water applications, whereas the reduction percent reached to 83 % . The curve fitted to the data in fig (7) was calculated from statistically significant power regression equation of cotton leaf area treated through the five P's and P_0 with r values not less than 0.91** reveals that leaf area/plant of both cotton varieties are the most adversely affected through the 1 st time of application (P_1) when subjected to saline water irrigation . This is interpreted according to Hoffman et al (1971) who stated that at all relative humidities, the leaf area of the saline treatments approached a steady state, whereas the nonsaline plants continued expanding until harvesting and claimed that older plant presumably had time to make morphological changes to compensate for the saline root medium .

4.2. Effect of salinity on chemical components of cotton plants :

Chemical analysis of cotton plants has been undertaken to reveal the contents of nutrients in plant tissues under the experimental conditions (saline water irrigation at different time of application) and effect of tested treatments on chemical components of these plants .

Plant samples were taken for analysis three times in the first growth season namely; G_1 , G_2 and G_3 (after 48, 94 and 140 days from planting) while they were taken one time in the second growth season namely; after the fifth time of application , i.e. after

140 days from planting . Values of concentration and content of nitrogen, phosphorus, potassium and sodium in shoots of cotton plants grown in two successive seasons(1987, 1988) are shown in tables (8-13) and illustrated in figs (8-11) .

4.2.1. Effect of salinity on plant nitrogen :

Values of nitrogen content were shown in tables (8,I2 and 13) and illustrated in fig (8) . A general increasing trend of N content with developed growth was evident, though values of N concentration showed a contradictive trend . No significant difference was found between nitrogen concentration values in the two tested cotton varieties . The relative nitrogen absorped by Giza 45 was more than Giza 81 under the two salinity levels; at G_1 and G_2 . At G_1 , the relative nitroge content under S_1 and S_2 for Giza 45 were 81 % and 41 % respectively, for G_2, they were 71 % and 63 % . For Giza 81 the corresponding were 77 %, 16 % at G_1 and 62 %, 54 % at G_2 . For G_3, the relative nitrogen content in Giza 81 was more than Giza 45 . The relative nitrogen content under the two salinity levels by Giza 45 were 77 % and 60 % . For Giza 81, they were 78 % and 72 %, respectively . These results indicated that nitrogen content of Giza 81 was relatively higher in the initial periods than the later ones , when compared with Giza 45, the depressive effect of salinity levels behaved quite differently . This agreed with the results reported by Lotfy et al (1987) who mentioned that increasing salinity levels gradually decreased the nutrients uptake by cotton seedlings of Ashmonui than Giza 4 cultivar . Also, El-Aggory at al (1986) reported that 14 cotton varieties varied in the nutrient contents of the different plant portions .

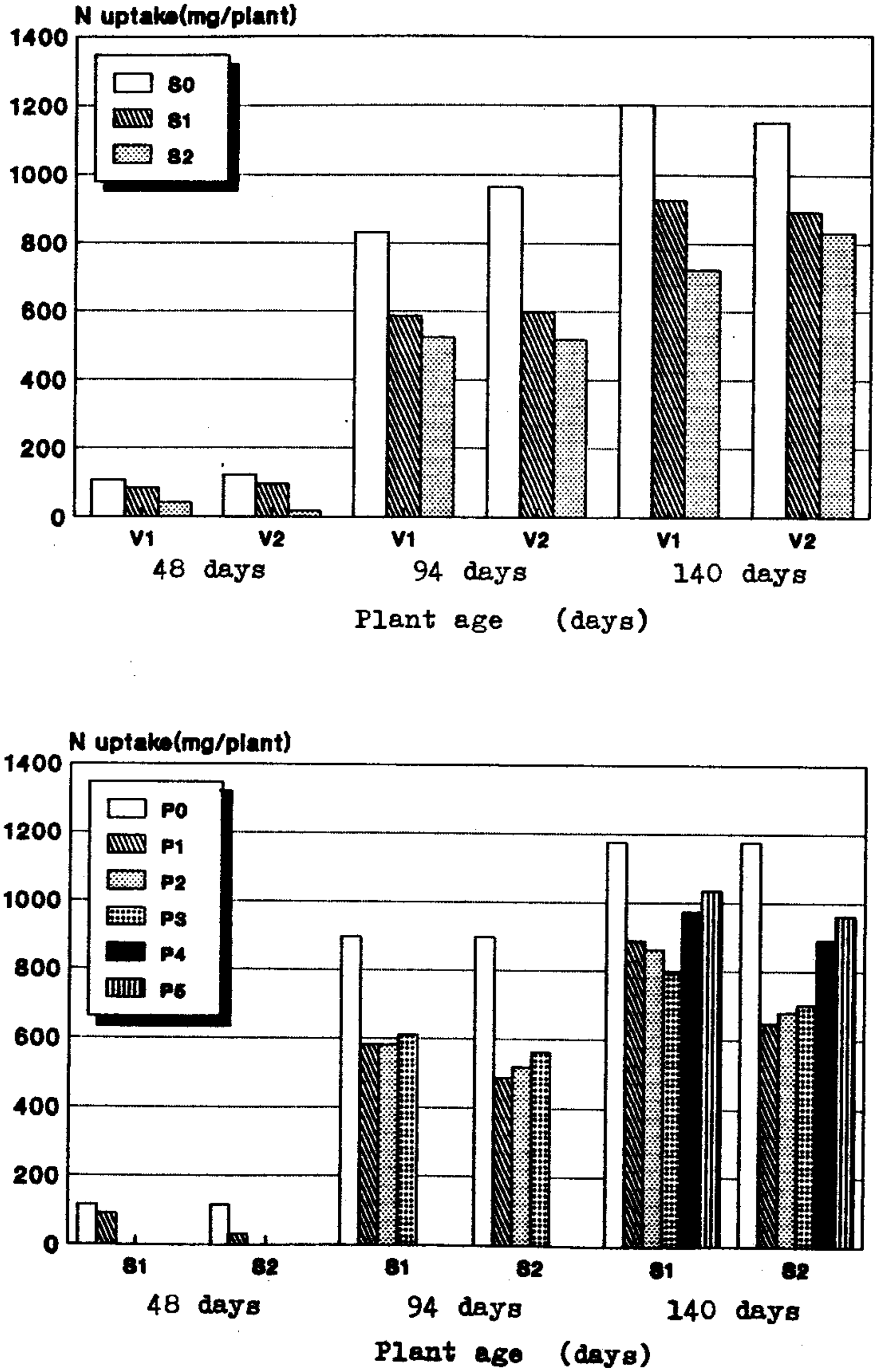


Fig (8) : Effect of salinity levels and growth periods on nitrogen content at different plant ages (days) of two varieties of cotton,(first season) .

Table (8) : Effect of salinity levels and growth periods on nitrogen content and concentration at different ages (days) of two varieties of cotton (first season) .

Type of treatments		Giza 45						Giza 81					
		Plant ages (days)						Plant ages (days)					
		48		94		140		48		94		140	
		%	mg/plant	%	mg/plant	%	mg/plant	%	mg/plant	%	mg/plant	%	mg/plant
Control		3.40	108	1.66	833	1.27	1200	3.68	127	1.60	965	1.15	1150
10000 (ppm)	P_1	3.54	87	1.49	574	1.21	926	3.98	96	1.44	596	1.14	855
	P_2	3.41	108	1.42	569	1.20	861	3.67	124	1.35	601	1.14	865
	P_3	3.40	108	1.48	621	1.21	830	3.66	124	1.39	601	1.15	759
	P_4	3.42	109	1.64	842	1.21	963	3.67	124	1.60	959	1.15	983
	P_5	3.41	108	1.64	842	1.23	1055	3.68	125	1.60	959	1.15	1012
15000 (ppm)	P_1	2.90	44	1.51	493	1.21	570	1.75	20	1.38	484	1.12	728
	P_2	3.42	108	1.38	507	1.18	609	3.69	125	1.29	529	1.14	753
	P_3	3.41	109	1.45	581	1.20	661	3.68	125	1.32	542	1.13	745
	P_4	3.42	109	1.65	854	1.20	837	3.66	124	1.57	948	1.13	947
	P_5	3.40	108	1.66	839	1.23	937	3.67	125	1.56	960	1.15	989

L.S.D. (uptake)	5 %	1 %		5 %	1 %		5 %	1 %
V	12.48	16.40	V x S	21.61	28.41	V x G	21.61	28.41
S	15.28	20.09	V x P	N.S.	N.S.	S x G	26.47	34.79
P	19.73	25.93	S x P	34.17	44.91	P x G	34.17	44.91
G	15.28	20.09						

Nitrogen concentration in the two varieties of cotton plants under S_1 was more than the control at G_1 . These results agreed with those reported by Selem et al (1989) who found an increase in N concentration of cotton plants irrigated with drainage water (2.91 mmhos/cm). Also, they are conincided with the findings of Khalil et al (1967) by using salinity levels; 5, 7 and 9 mmhos/cm on cotton plant, and Abo El-Defan (1990) with salinity levels of 8.5 and 15.8 mmhos/cm for tomato plant . Concerning nitrogen concentration under S_2 at G_1 and the two salinity levels at G_2 and G_3 were less than the control. This is in agreement with the results obtained by Taha (1980) who pointed out that increasing soil salinity (0.2, 0.4 and 0.8 %) was accompanied by decreasing N concentration . As mentioned before, nitrogen concentration decreased with advancing cotton plant age . Bassett and Mackenzie (1983) outlined that N concentration in cotton normally declines quite rapidly as the season progresses .

The relative nitrogen uptake by both varieties gradually decreased with more growth development by 79 %, 66 % and 51 % under S_1 and 27 %, 58 % and 44 % under S_2 at G_1 , G_2 and G_3 respectively . The descending relative nitrogen content with developing growth under S_1 were attributed to exhaust considerable N amounts of nitrogen for bud initiation and formation of squares, flowers and bolls . This result is in parallel of that decided by Halevy et al (1987) who concluded that the demand for N by the ripening bolls is high at ages 95 and 110 days after planting, since the quantity of N absorbed by the roots does not satisfy to meet the plant needs, in spite of the high rates of nitrogen application . So, some N is translocated from the older leaves to the bolls .

As for relative nitrogen uptake by cotton plants under S_2, the same trend caused by S_1 except at G_1 was the least one and could be attributed to the depressive effect of high salinity level on nitrogen uptake at this age. This was supported by Lotfy et al (1987).

Nitrogen content at G_1, cotton plants exposed to irrigation with diluted sea water through growth periods between 21-48 days, S_1 and S_2 caused a decreasing in N content equal to 21 and 73 % of control, respectively.

Nitrogen content at G_2, which irrigated with diluted sea water through three growth periods, 21-48, 49-71 and 72-94 highly significant differences were found. Relative N uptake under S_1 was 35, 35 and 32 % through three successive growth periods, but with S_2 they was 46, 42 and 37 % respectively. Inspite of the wide variations between decreasing caused by S_1 and S_2 measured at G_1, only narrow ones occurred between the corresponding values at P_3 at G_2, i.e., the ability of cotton plants to absorb nitrogen till G_1 under S_2 was more than that of S_1, but to a lesser extent for P_3 at G_2. Cotton plant treated at P_1 and P_2 took up more nitrogen when measured after 46 and 23 days of irrigation with tap water after salinity treatments and the results revealed that relative nitrogen content under S_1 at G_2 was less than that at G_1, while under S_2 was more. This may be attributed to increasing nitrogen concentration under S_1 and decreasing under S_2 at G_1, while at G_2 the decreasing of nitrogen concentration under the two salinity levels caused the above discussed results. Shannon (1985) mentioned that physiological mechanisms that prevent damage at low salt concentrations are not the same ones acting as those contributing to tolerance at extremely high concentrations.

Nitrogen content at G_3 which cotton plant exposed to irrigation with diluted sea water through growth periods 20-48, 49-71, 72-94 , 95-117 , and 118-140 days after planting in the two growth seasons, more or less , the main trend was observed in the two growth season, while the absolute values were different, depending upon dry weight of cotton plant under different climatic condition in the two seasons . The ascending ordere of the relative nitrogen uptake by cotton plants under S_1 were $P_3 < P_2 < P_1 < P_4 < P_5$. Slight effect of S_1 at P_5 was found in nitrogen content since cotton plants were irrigated with saline water after 117 days from planting. Also, P_4 come before P_5 in depressive effect . Cotton plants at these periods of growth take up nitrogen slighly more or less amount compared with the preceeded periods . Murphy (1936) found that cotton plants take up 16 % of their nitrogen demand from first open boll till maturity . Concerning P_3 , N uptake was inhibited by water salinity because of the depress that occurred in dry weights . Bhivare and Nimbalkar (1984) stated that under saline conditions N content in frensh bean was adversely affected . So, the effect of salinity at this certain growth period that meet the high rates of N uptake under normal conditions may interpret why cotton plant under this salinity growth period can not recover enough nitrogen . Marani and Aharonov (1964) found that the highest rates of nitrogen absorption occurred during the first two weeks of the flowering stage and about 69 percent of N uptake was absorbed during the period from flowering initiation to boll formations . As for P_1 and P_2, they were irrigated with tap water for 92 and 69 days after the periods of saline water irrigation . Under normal conditions took up a considerable amount of nitrogen . Murphy (1936) pointed out that cotton plants take upt 34 % of their nitrogen demand from seed sprouts till first square .

Also, Yagodin (1984) mentioned that cotton plants uptake 3-5 % of nitrogen required from the beginning of growth till budding, while it was 25-30 % from budding to flowering and 65-70 % of nitrogen uptake from flowering to rippening . Thereby , cotton plants treated at P_1 and P_2 may recover N after the end of saline water irrigation particularly if the level of salinity (S_1) is not too high . Taking into mind that nutrients uptake is an indication of dry weight . Therefore, Ashley et al (1974) pointed out that there was a tendency for plants to be recovered from the adverse effects in early season that vegetative development became equalized during the latter part of the season .

Finaly, N uptake of both varieties was gradually depressed by increasing salinity level . However, N uptake by Giza 45 was less than Giza 81 at G_1 and G_2, but was more affected at G_3 . The effect of salinity treatments at P may reveal that cotton plants up to the age 48 days were less tolerance, but this growth period was more regressive after salinity period has ended . P_2 went in the same trend of P_1 . P_3 was more tolerance and less regressive, while salinity levels in P_4 and P_5 were less effective .

4.2.2. Effect of salinity on plant phosphorus :

Values of phosphorus content and concentration are shown in tables(9,12 and 13) and illustrated in fig (9) . While P content was highly significant affected at all experimental treatments, P concentration was not so . Results reveal that less P uptake was observed at V_2S_2 but more at V_2S_1 than others at G_1, while P uptake values by Giza 81 at G_2 and G_3 under S_1 and S_2 were more than that by Giza 45 . The differences bewteen P uptake due to variety effect

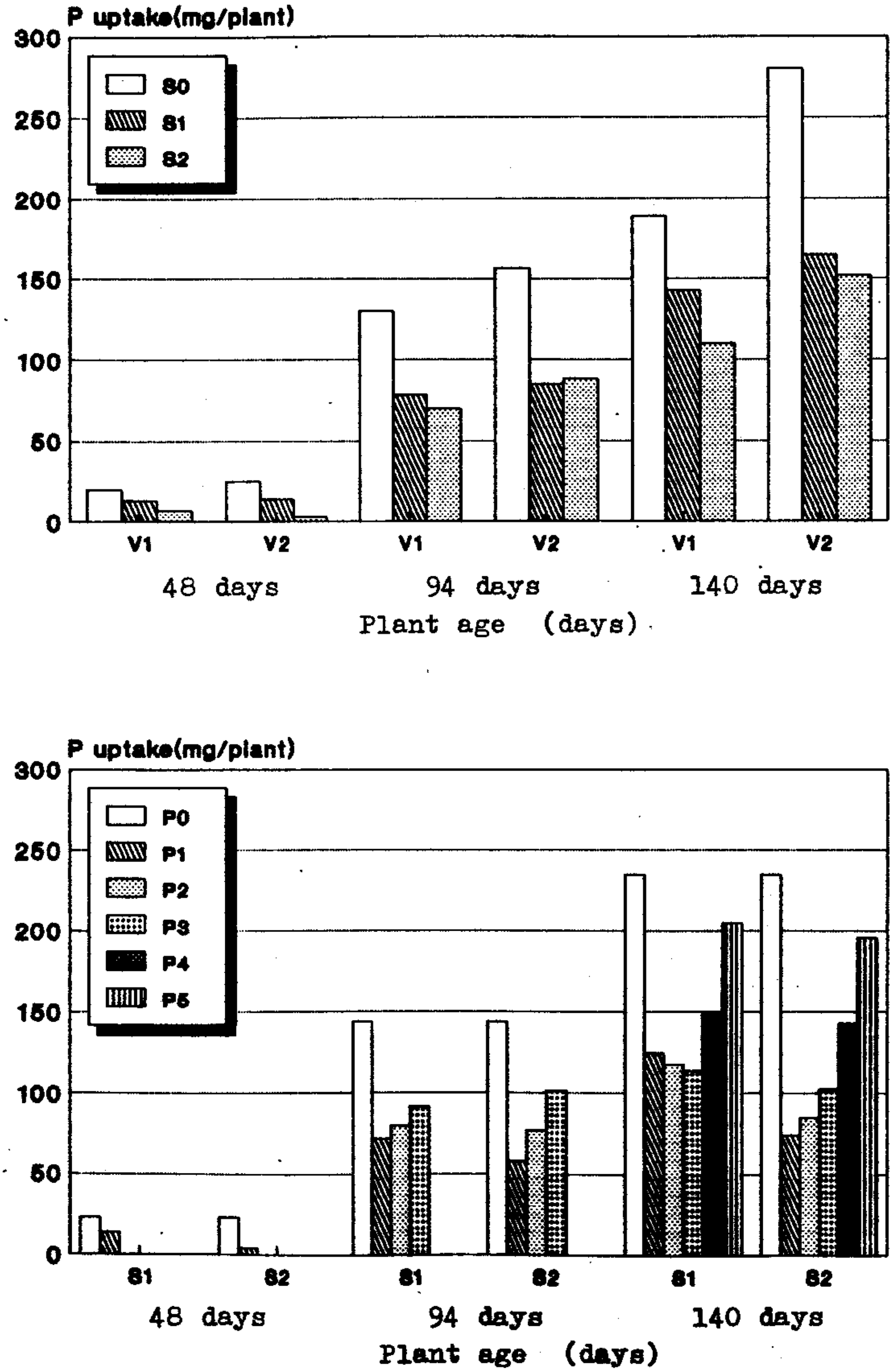


Fig (9) : Effect of salinity levels and growth periods on phosphorus content at different plant ages (days) of two varieties of cotton,(first season) .

Table (9) : Effect of salinity levels and growth periods on phosphorus content and concentration at different ages (days) of two varieties of cotton (first season) .

Type of treatments		Giza 45 plant ages (days) 48 %	48 mg/plant	94 %	94 mg/plant	140 %	140 mg/plant	Giza 81 plant ages (days) 48 %	48 mg/plant	94 %	94 mg/plant	148 %	148 mg/plant
Control		0.62	20	0.26	130	0.20	189	0.75	25	0.26	157	0.28	280
10000 (ppm)	P_1	0.54	13	0.17	65	0.16	123	0.57	14	0.19	79	0.17	127
	P_2	0.61	19	0.20	80	0.16	115	0.75	25	0.18	80	0.16	121
	P_3	0.61	20	0.21	88	0.15	103	0.74	25	0.22	95	0.19	125
	P_4	0.62	20	0.27	139	0.15	119	0.74	25	0.27	162	0.21	179
	P_5	0.60	19	0.27	139	0.21	180	0.75	26	0.26	157	0.26	229
15000 (ppm)	P_1	0.45	7	0.16	52	0.12	57	0.27	3	0.18	63	0.14	91
	P_2	0.61	19	0.15	55	0.11	57	0.75	25	0.24	98	0.17	112
	P_3	0.60	19	0.25	100	0.16	88	0.74	25	0.25	103	0.18	118
	P_4	0.61	20	0.27	140	0.17	118	0.76	26	0.27	163	0.20	168
	P_5	0.60	19	0.28	142	0.22	168	0.75	26	0.27	166	0.26	224

L.S.D.(uptake)	5 %	1 %		5 %	11%		5 %	1 %
V	5.02	6.59	V x S	8.69	11.42	V x G	8.69	11.42
S	6.14	8.07	V x P	N.S	N.S	S x G	10.64	13.98
P	7.93	10.42	S x P	13.74	18.05	P x G	13.74	18.05
G	6.14	8.07						

agree with those reported by Abd-Elnaim and Ahmed (1968) who mentioned that P total content of the vegetative organs per Ashmouni plant was almost twice as much as the Karnak. A study on Egyptian 14 cotton verieties, El-Aggory et al (1986) reported similar findings . In general, the relative P uptake by Giza 45 was more than Giza 81 at any age or salinity level .

Phosphorus uptake and concentration in the tested varieties under all salinity levels were less than control at any plant age (first and second season). Also, S_2 had decreased the relative P uptake more than S_1 did . Comparable results were found by Hassan et al (1970) who mentioned that a significant negative relationship between salinity and uptake of P . Also, Taha (1980) and Pal et al (1984) supported these findings .

Phosphorus content at G_1 by cotton plants at 48 days after planting subjecting to irrigation with diluted sea water (S_1 and S_2) through the period between 21-48 days after planting, were depressed by 39 and 78 % of control, respectively . Remison et al (1988) mentioned similar effect of salinity on coconut seedlings.

Phosphorus content at G_2 by cotton plants at 94 days after planting,under irrigation with diluted sea water through three growth periods, P_1 , P_2 , P_3, highly significant differences were found between growth periods .
The relative P content values under S_1 were 50, 56 and 64 % through the three successive growth periods , while under under S_2 they were 40, 53 and 71 % respectively. There was a wide difference between depressions under S_1 and S_2 through P_1 measured at G_1 , but it was narrow at P_1 measured at G_2 , as well as P_2

and P_3 . So the ability of cotton plant to absorb P at G_1 under S_2 was more than S_1 , but it was more or less, the same at G_2 . The relative P content value measured at G_2 for P_1, P_2, and P_3 revealed that tap water irrigation through P_1 and P_2 at 46 and 23 days after growth periods , cotton plant recovered the absorption of phosphorus . Adding to that from G_2 the demand of cotton plant to phosphorus increased . Halevy et al (1987) stated that phosphorus uptake increased from boll formation to boll opening . Values of P uptake measured immediately after end of P_3, which was simultaneousness with age of high phosphorus demand was decreased .

Phosphorus content at G_3 by cotton plants at 140 days with diluted sea water through the five times of sea water applications P_1 - P_5 , the obtained values could be ascendingly ordered of relative P content as follows; $P_4 < P_3 < P_2 < P_1 < P_5$. Since cotton plants received saline water after 117 days from planting, P content decreased at P_5 less than other growth periods . This may be caused by little effect of salinity on cotton plant at this age as well as the less demand of phosphorus at this late age . Murphy (1936) reported that the amount of phosphorus uptake by cotton plant from the first open boll to maturity was 5 % of total phosphorus uptake along plant life . As for P_4 , P_3 and P_2, phosphorus uptake values were inhibited by saline irrigation water at these growth periods. The plant age versus these growth periods represent the important period for taken up phosphorus . Younts and Musgrae (1958) observed that in pot experiment the phosphorus uptake was depressed by high Cl^- additions . Remison et al (1988) stated that an antagonistic effects occurred between

Ca and P . Regarding the finding of Murphy (1936) which reported the amount of phosphorus content from first square to first open boll was 58 % of total P uptake, as well as the finding of Elbisary (1961) who reported that seed contains little more than half the P percent in the aerial parts of plant, they could throw light on P absorbed by cotton plants at P_2 , P_3 and P_4. With respect to P_1, which was irrigated with tap water for 69 days after growth period . So, cotton plants were recovered and P content, whereas cotton age after G_1 is the time to uptake the majority of phosphorus,(on the basis of findings of Murphy (1936), Yagodin (1984) and Halevy et al (1987)) .

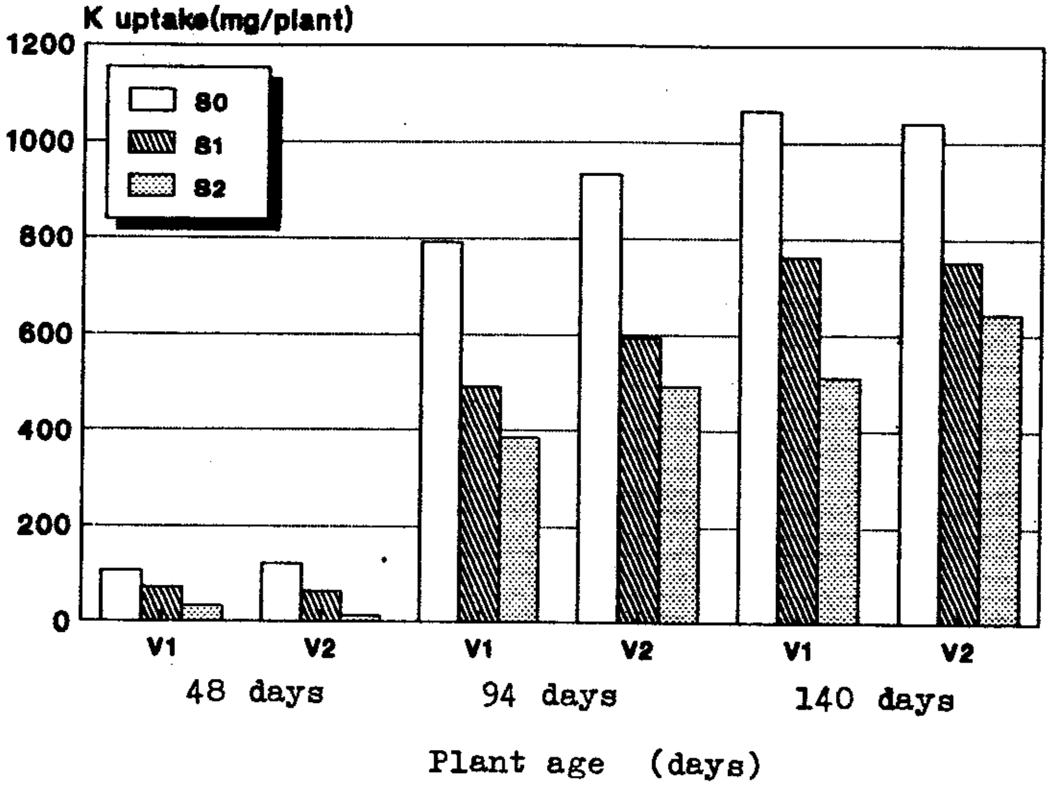
The ascending order of relative phosphorus absorbed by cotton plants under S_2 and S_3 in the two growth seasons were, $P_1 < P_2 < P_3 < P_4 < P_5$. The most depressive effect was at P_1 and the least was at P_5 . Regarding high salinity level at P_1, highly damage to plant was obvious, so that they could not recover enough phosphorus uptake after this growth period, but the severity of damage was minimized from P_1 to P_2 and so on, up to P_5 where the least effect and almost normal P content was observed at this age . This may be attributed to the highly salinity levels (15000 and 30000 ppm) which decreased phosphorus content at any growth period .

With respect to cotton varieties, phosphorus content under salinity conditions show that phosphorus uptake by Giza 45 was less than that taken by Giza 81 at all growth age . The relative values of phosphorus uptake by Giza 45 was more than those of Giza 81 . The decreasing of phosphorus uptake by the two varieties under S_2 and S_3 were more serious than S_1 . Phosphorus content measured at G_1 decreased under S_2 more than S_1, and the decreasing under the two salinity levels were more than that at age 94 or 140 days . So, cotton plant has a considerable sensitive for phosphorus under salinity levels at first period than others . But phosphorus content measured at 94 and 140 days concerned cotton plant P, without cotton boll or seed phosphorus . Therefore the phosphorus content at these ages included stems and leaves .

4.2.3. Effect of salinity on plant potassium :

The obtained resulted for potassium content and concentration at the two season are shown in tables(10,12 and 13) and illustrated in fig (10) . The results revealed that K content values tend to increase with growth development while K concentrations tend to decrease . The mean values of potassium took up by cotton varieties measured at G_1, G_3 showed that Giza 81 absorbed less K than Giza 45 . Also, the relative content values followed the same trend at G_1 while the relative potassium taken up by Giza 81 was more than Giza 45 at G_2 and G_3 . Statistical analysis of K content showed highly significant differences between the two tested varieties .

It is also seen from fig (10), the two tested varieties of cotton plants absorbed potassium under S_1 more than under S_2 . The relative decrease values in K content under S_1 and S_2 were 43 and 79 , 37 and 49 , 28 and 45 measured at G_1 , G_2 and G_3 respectivily . The results showed that the decreases in relative K content was more serious at cotton age G_1, than at G_2 and G_3 under both salinity levels . The differences through K content values under S_1, S_2 and S_3 were highly significant. Similar results were obtained by Remison et al (1988) and Selem et al (1989). Potassium concentration at any plant age decreased with increasing salinity level .



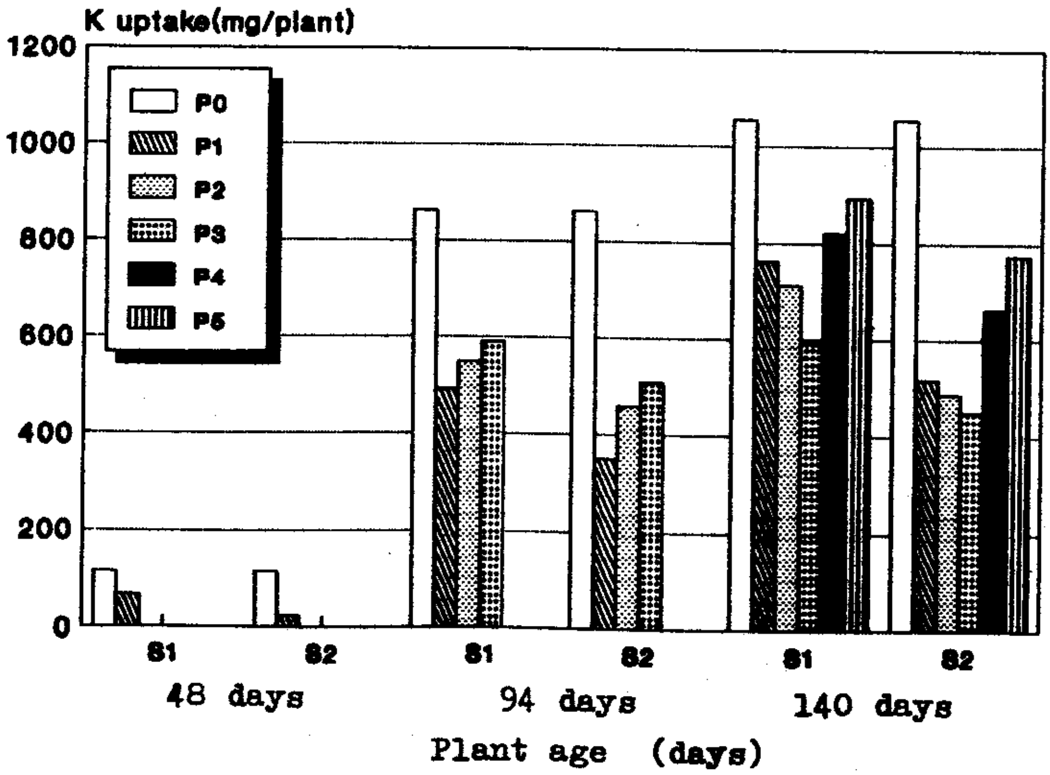


Fig (10) : Effect of salinity levels and growth periods on potassium content at different plant ages (days) of two varieties of cotton,(first season).

Table (10) : Effect of salinity levels and growth periods on potassium content and concentration at different ages (days) of two varieties of cotton (first season) .

Type of treatments		Giza 45 plant ages(days) 48 %	48 mg/plant	94 %	94 mg/plant	140 %	140 mg/plant	Giza 81 plant ages(days) 48 %	48 mg/plant	94 %	94 mg/plant	140 %	140 mg/plant
Control		3.37	107	1.58	793	1.13	1068	3.59	122	1.55	935	1.04	1040
10000 (ppm)	P_1	2.90	72	1.13	435	1.01	772	2.64	64	1.32	546	1.01	757
	P_2	3.39	107	1.21	485	0.96	689	3.59	121	1.38	615	0.97	736
	P_3	3.38	108	1.32	554	0.92	631	3.61	122	1.45	627	0.85	561
	P_4	3.37	107	1.52	811	1.00	796	3.60	121	1.56	935	0.99	846
	P_5	3.36	107	1.57	806	1.08	926	3.61	122	1.55	929	0.98	863
15000 (ppm)	P_1	2.26	34	0.96	313	0.90	424	1.18	14	1.11	389	0.94	611
	P_2	3.36	107	1.08	397	0.84	433	3.57	121	1.28	524	0.82	542
	P_3	3.37	108	1.12	449	0.77	386	3.58	121	1.39	571	0.79	521
	P_4	3.35	107	1.58	818	0.96	612	3.58	122	1.57	948	0.85	712
	P_5	3.35	106	1.57	794	0.94	716	3.60	122	1.56	960	0.97	834

L.S.D. (uptak)	5 %	1 %		5 %	1 %		5 %	1 %
V	22.71	29.85	V x S	39.33	51.69	V x G	39.33	51.69
S	27.81	36.55	V x P	N.S.	N.S.	S x G	48.17	63.31
P	35.91	47.19	S x P	62.19	81.74	P x G	62.19	81.74
G	27.81	36.55						

Potassium content at G_1 was highly decreased under S_2 compared with the control and S_1 as well .

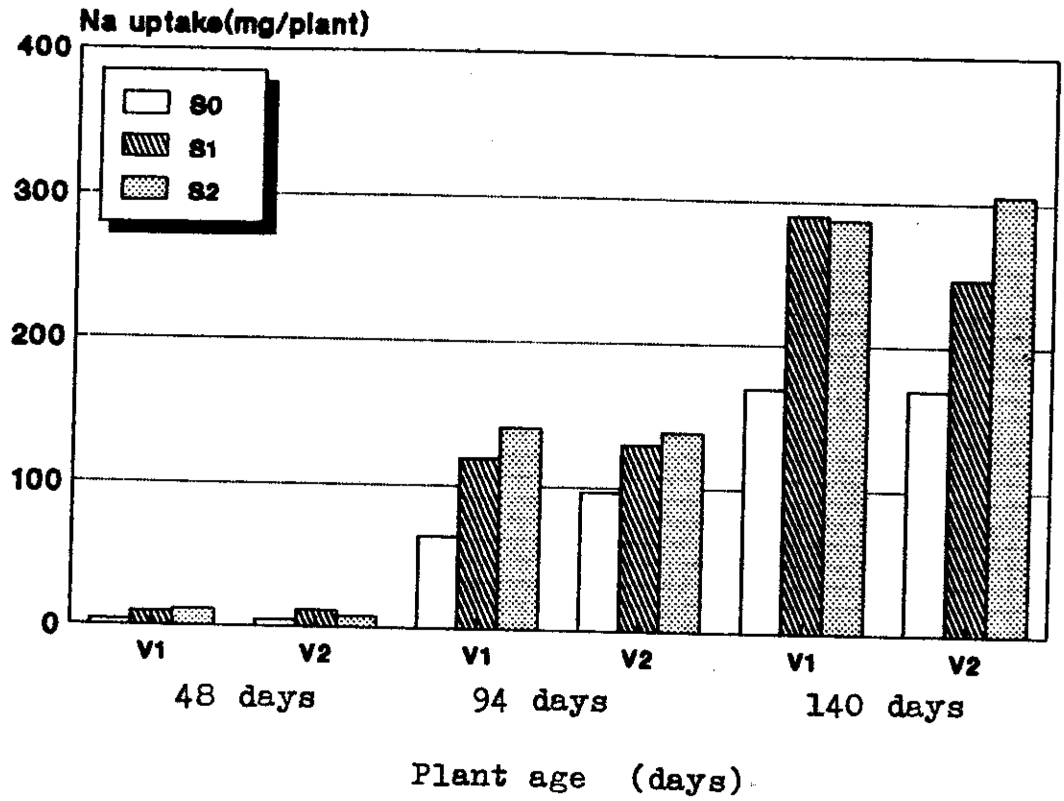
Potassium content at G_2 was higher under S_1 than S_2, also the relative K content values followed the same trend . Potassium content by cotton plants subjected to irrigation with either salinity level (S_1 or S_2) through P_1 interval as measured at G_2 was less than those at P_2 and P_3 . The relative decrease values occurred were ; 49, 59 and 64 % under the three successive growth periods, respectively . This agrees with the findings of Rao et al (1981) who reported that early seedling growth was most sensitive to salinity .

Potassium content at G_3 irrigated with diluted sea water for the five growth periods followed the main trend of potassium content under S_1 and was higher than that under S_2 at any growth period . The ascending order of relative K content under S_1 were $P_3 < P_2 < P_1 < P_4 < P_5$ with the corresponding decreases as follows ; 43 , 32 , 27 , 22 , 15 %, whereas K content under P_3 was the most decreased whereas the least decreased was noticed under P_5 . Cotton plant subjected to irrigation with saline water at growth periods P_1 and P_2 , took up during these periods less K amounts than the control due to sodium antagonistic effect . Plants irrigated with tap water after salinity-treatment period utilized more potassium as a result of reduced salinity stress, as well as the more suitability of tap water irrigation periods to the highly cotton plant demand of K content during such growth periods as reported by Yagodin (1984). He stated that cotton take 78-80 % of their total potassium needs through the period from flowering to ripening . The ascending order of potassium content by cotton plants under S_2 and S_3 in the two growth seasons were the same as S_1 . This may be due to the high salinity or sodium concentration of both levels in ambient conditions . Decrease caused in K content due to saline water irrigations agreed with those reported by Ashraf and McNeilly (1987) .

Finaly, the relative potassium content values by Giza 45 at G_1 decreased less than Giza 81, but more at G_2 and G_3 . The decrease in potassium content by plants of both varieties, under S_3 and S_2 , was more than that at S_1 . Adverse effect of salinity treatments, at P_1 on potassium content was more serious up to G_1 , while a regressive trend was obvious after ending of salinity treatment at this growth period , as well as P_2 which behaved the same way . The decrease in potassium content under P_3 was more under the three salinity levels, while salinity levels in P_4 and P_5 were less effective .

4.2.4. Effect of salinity on plant sodium :

The results of sodium content and concentration of cotton plant grown for two successive seasons are shown in tables(11, 12 and 13) and illustrated in fig (11) . Mean values of sodium content increased while sodium concentration decrease with growth development . No significant differences were found between varieties . The results of sodium uptake under S_2 were higher than those under S_1 . This accumulation could be logically attributed to the highly sodium concentration in the diluted sea water. Many workers supported this finding such as Iyengar (1978) and Bhivare and Nimbalkar (1984) .



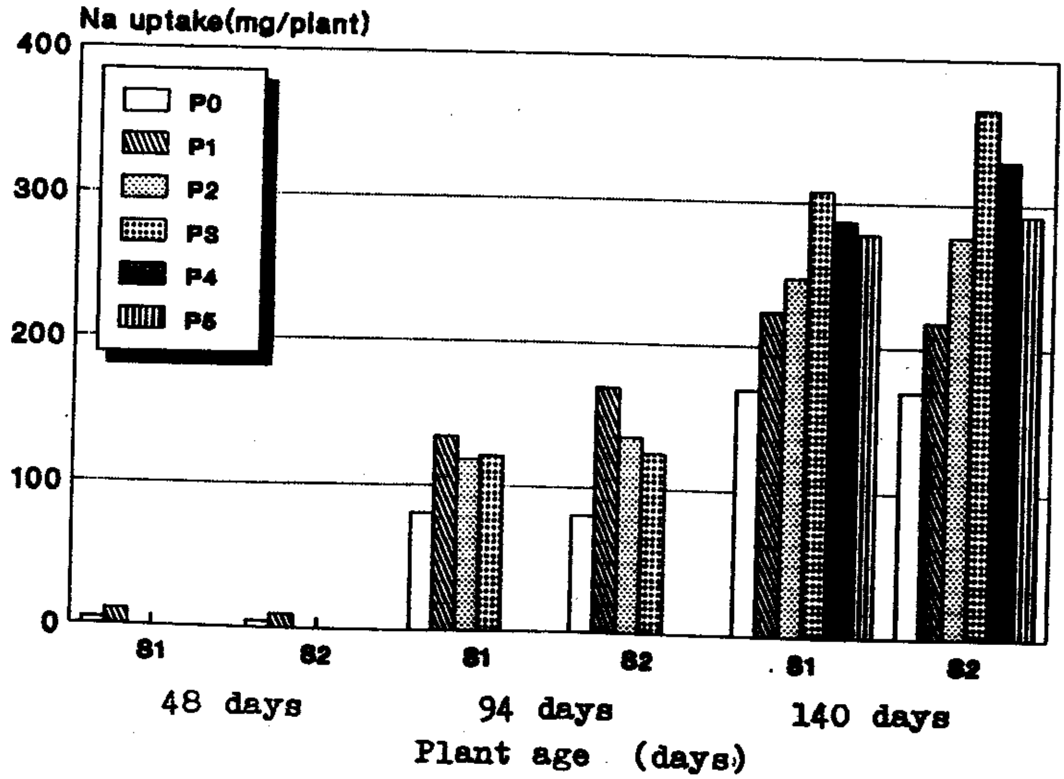


Fig (11) : Effect of salinity levels and growth periods on sodium content at different plant ages (days) of two varieties of cotton, (first season) .

Table (11) : Effect of salinity levels and growth periods on sodium content and concentration at different ages (days) of two varieties of cotton (first season) .

Type of treatments		Giza 45						Giza 81					
		plant ages (days)						plant age (days)					
		48		94		140		48		94		140	
		%	mg/ plant	%	mg/ plant	%	mg/ plant	% %	mg/ plant	%	mg/ plant	%	mg/ plant
Control		0.12	4	0.13	65	0.18	170	0.15	5	0.16	97	0.17	170
10000 (ppm)	P_1	0.42	10	0.32	123	0.29	222	0.48	12	0.35	145	0.30	225
	$P_2O.$	0.11	3	0.29	116	0.36	258	0.15	5	0.27	120	0.31	235
	P_3	0.11	4	0.28	117	0.50	348	0.14	5	0.29	125	0.41	271
	P_4	0.12	4	0.13	67	0.41	326	0.15	5	0.15	90	0.30	247
	P_5	0.12	4	0.12	62	0.35	300	0.15	5	0.16	96	0.29	255
15000 (ppm)	P_1	0.79	12	0.51	167	0.40	188	0.71	8	0.49	172	0.38	247
	P_2	0.13	4	0.35	129	0.42	217	0.15	5	0.30	123	0.51	337
	P_3	0.12	4	0.33	126	0.72	361	0.16	5	0.30	123	0.56	369
	P_4	0.13	4	0.13	67	0.53	338	0.14	5	0.16	97	0.42	322
	P_5	0.13	4	0.12	61	0.44	335	0.15	5	0.16	99	0.29	249

L.S.D. (uptake)	5 %	1 %		5 %	1 %		5 %	1 %
V	N.S.	N.S.	V x S	8.60	11.30	V x G	8.60	11.30
S	6.08	7.99	V x P	11.10	N.S.	S x G	10.53	13.84
P	7.85	10.32	S x P	13.59	N.S.	P x G	13.59	17.87
G	6.08	8.00						

Table (12) : Effect of salinity levels and growth periods on N , P , K , Na , Ca and Mg content at harvest (second season) .

Treatments		Nutrients uptake (mg/plant)					
		N	P	K	Na	Ca	Mg
Control		993	143	902	48	651	370
10000 (ppm)	P_1	536	78	577	136	536	261
	P_2	511	73	447	263	549	194
	P_3	507	53	362	299	441	198
	P_4	695	64	496	276	575	251
	P_5	799	87	579	236	643	292
15000 (ppm)	P_1	293	42	270	150	208	129
	P_2	333	35	261	241	247	147
	P_3	470	44	327	356	302	154
	P_4	546	57	381	349	334	178
	P_5	627	63	432	292	333	269
30000 (ppm)	P_1	-	-	-	-	-	-
	P_2	227	25	161	245	181	98
	P_3	382	37	261	420	298	162
	P_4	533	55	322	354	374	192
	P_5	606	67	355	315	342	204

Nutrients	N		P		K	
L.S.D.	5 %	1 %	5 %	1 %	5 %	1 %
S	22.04	29.49	2.80	3.75	16.07	21.50
P	24.64	32.97	3.13	4.19	17.96	24.03
S x P	49.28	65.94	6.26	8.38	36.28	48.07
	Na		Ca		Mg	
S	17.34	23.20	31.74	42.47	13.59	18.18
P	19.38	25.94	35.49	47.48	15.19	20.33
S x P	38.77	51.87	70.98	94.96	30.38	40.65

Table (13) : Effect of salinity levels and growth periods on N , P , K , Na , Ca and Mg concentration at at harvest (second season) .

Treatments		Nutrients percent					
		N	P	K	Na	Ca	Mg
Control		2.50	0.36	2.27	0.12	1.64	0.93
10000	P_1	2.50	0.35	2.58	0.61	2.40	1.17
(ppm)	P_2	2.31	0.33	2.02	1.19	2.48	0.92
	P_3	2.29	0.24	1.64	1.35	1.99	0.93
	P_4	2.49	0.23	1.78	0.99	2.06	0.93
	P_5	2.40	0.26	1.74	0.71	1.93	0.88
15000	P_1	2.34	0.33	2.15	1.20	1.66	1.03
(ppm)	P_2	2.28	0.24	1.78	1.65	1.69	1.01
	P_3	2.27	0.21	1.58	1.72	1.46	0.74
	P_4	2.39	0.25	1.67	1.53	1.46	0.78
	P_5	2.60	0.26	1.76	1.21	1.38	1.09
30000	P_1	-	-	-	-	-	-
(ppm)	P_2	2.21	0.24	1.57	2.39	1.76	0.96
	P_3	2.28	0.22	1.56	2.51	1.78	0.98
	P_4	2.35	0.24	1.42	1.56	1.65	0.85
	P_5	2.73	0.30	1.60	1.42	1.54	0.91

Sodium contemt at G_1 , cotton plant took up 2.1 time of sodium under salinity treatments than control .

Sodium content at G_2 , cotton plant has taken up sodium under P_1 more than that under P_2 or P_3 , while P_2 and P_3 are nearly the same .

Sodium content a at G_3 , the peak of content was at P_3 for S_1 , S_2 or S_3 but the least increasing was at P_1 for every salinity level . The ascending order was $P_3 > P_4 > P_5 > P_2 > P_1$. These results showed that cotton plant took up sodium at every plant age but highly absorbed sodium at P_3 i.e. at flowering growth period . This findings agreedwith those reported by Appling and Giddens (1954) who stated that sodium decrease in plants from presquare to full-square stage and increase at full maturity .

4.3. Effect of salinity on cotton yield :

Some yield parameters are valid to be used for predicting reduction in cotton yield under tested variables . Dry matter yield and flowering production may throw light on the magnitude of adversely salinity effects on cotton plants . Also, yield of cotton lint , boll retention and average boll weight are important parameters to be determined . These yield parameters are regarded as outcome and give reflection about previous plant life under certain conditions . Results of yield are shown in tables (14-18) and illustrated in figs (12-18) .

4.3.1. Effect of salinity on cotton dry weight :

Results of cotton dry weight (g/plant) are shown in tables (14 and 18) and illustrated in fig (12) . Mean values revealed that dry weight of two cotton varieties did not behave as the same way . Giza 81 yield dry weight was more than Giza 45 . Under S_1 and S_2, the relative dry weights of Giza 81 was less than Giza 45 . The relative decrease of dry weights of Giza 45 and Giza 81 caused by salinity levels were 37 and 47 % at G_1 , 23 and 32 % at G_2 ; and 28 and 24 % at G_3 . In spite of Giza 81 was higher yielded of dry weight, it was more affected with salinity than Giza 81 .

S_2 level decreased dry weights of the two cotton varieties more than S_1 level . The relative decrease of dry weight of cotton shoots caused by S_1 and S_2 were 25 and 59 % at G_1, 24 , 31 % at G_2 and , 20 and 32 % at G_3, respectively . In most cases, the relative decrease was higher at G_1 under S_2 and lower at G_3 under S_1, i.e., cotton plants were affected by salinity level at early growth ages more than later ones . Similar findings were reported by Khalil et al (1976) and El-Saidi (1973) .

Dry weight of cotton plants at G_1 was severely reduced under salinity levels .

Dry weight of cotton plant at G_2 was affected with salinity, where plants at P_1 were the most adversely affected than those of P_2 and P_3 came after, under the two salinity levels . Shannon (1985) revealed that, during the course of plant growth, the form and function of the various organs change. Plant response and consequently, its effective salt tolerance are

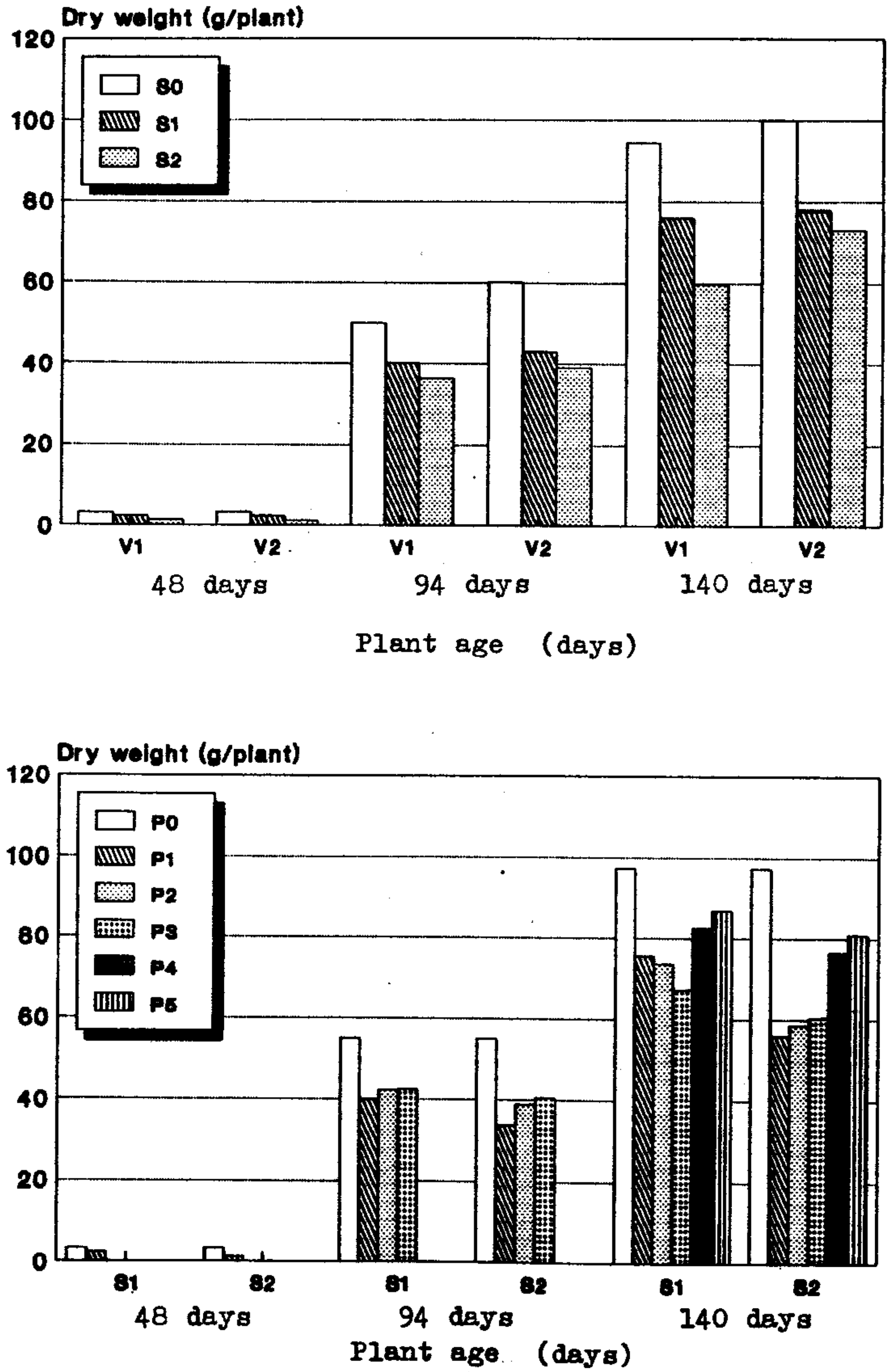


Fig (12) : Effect of salinity levels and growth periods on dry weight at different ages (days) of two varieties of cotton (first season) .

Table (14) : Effect of salinity levels and growth periods on dry weight at different ages (days) of two varieties of cotton (first season) .

Treatments		Giza 45 Plant ages(days)			Giza 81 Plant ages(days)		
		48	94	140	48	94	140
Control		3.18	50.16	94.51	3.39	60.32	99.97
10000 (ppm)	P_1	2.47	38.50	76.66	2.42	41.40	74.98
	P_2	3.16	40.09	71.78	3.38	44.54	75.85
	P_3	3.19	41.94	68.60	3.39	43.22	65.99
	P_4	3.18	51.35	79.55	3.37	59.94	85.45
	P_5	3.17	51.34	85.76	3.39	59.95	88.04
15000 (ppm)	P_1	1.52	32.65	47.10	1.14	35.04	65.01
	P_2	3.17	36.73	51.57	3.38	40.97	66.03
	P_3	3.19	40.08	55.11	3.39	41.05	65.92
	P_4	3.18	51.77	69.73	3.40	60.36	83.77
	P_5	3.17	50.56	76.14	3.40	61.53	85.96

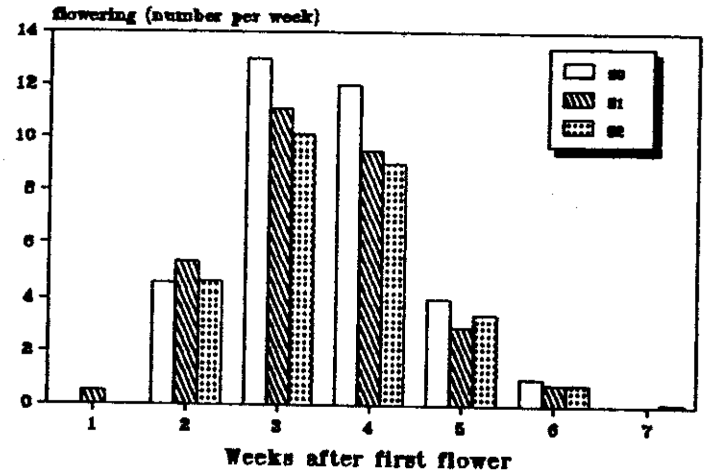
L.S.D.	5 %	1 %		5 %	1 %
V	0.74	0.96	V x S	1.04	1.36
S	1.04	1.36	V x P	N.S.	N.S.
P	0.90	1.18	S x P	1.47	1.92
G	0.90	1.18	V x G	0.90	1.18
			S x G	1.47	1.92
			P x G	1.04	1.36

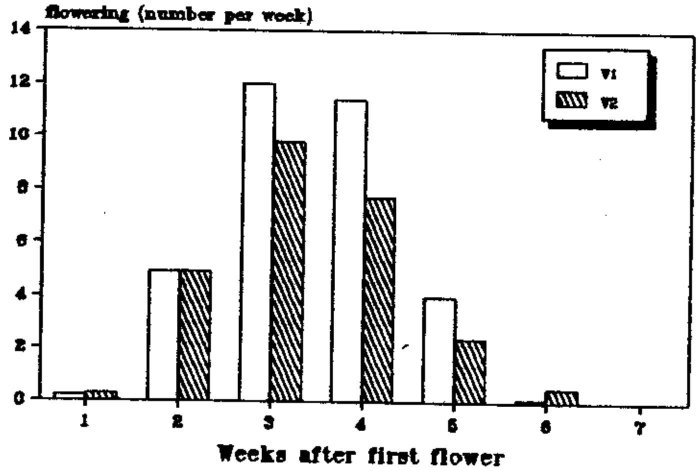
influenced by its ontagenic stage . Thus, salinity effects may vary depending upon the growth stage at the time of stress .

Dry weight of cotton plants at G_3 , under S_1, was more depressed at P_3 than other growth periods , whereas the ascending order of relative dry weights was $P_3 < P_2 < P_1 < P_4$ P_5 . But the ascending order under S_2 and S_3 was $P_1 < P_2 < P_3 < P_4$ P_5 . This means that plants under S_1 , P_3 were more adversely affected with salinity but at P_1 , plants that received diluted sea water at 20-48 days after planting became adaptable and were able to be recovered by receiving tap water at the next growth stages . Under S_2 level, cotton plant dry matter was severely inhibited at any age caused due to high salinity level and ion effect that plants could not recover themselves, but the most drastic effect occurred at P_1 (early growth period) . Joham and Calahan, (1978) mentioned that 50 day old plants were especially sensitive to Na and concluded that plant growth was strongly affected by the osmotic effect of Na toxicity, whereas the vegetative and fruit yields were markedly influenced by the specific ion effect and were closely associated with tissue Na:Ca ratio .

4.3.2. Effect of salinity on flowering :

Data of daily recording of cotton flowers developed per plant are shown in tables(15 and 16),illustrated in figs(13,14 and 15) and appendix(4). Cotton varieties showed a clear effect on total flower number, where Giza 45 gave flowers numbers per plant more than did Giza 81. The mean value of flower numbers were 34 and 26 for V_1 and V_2 . These differences were highly significant .





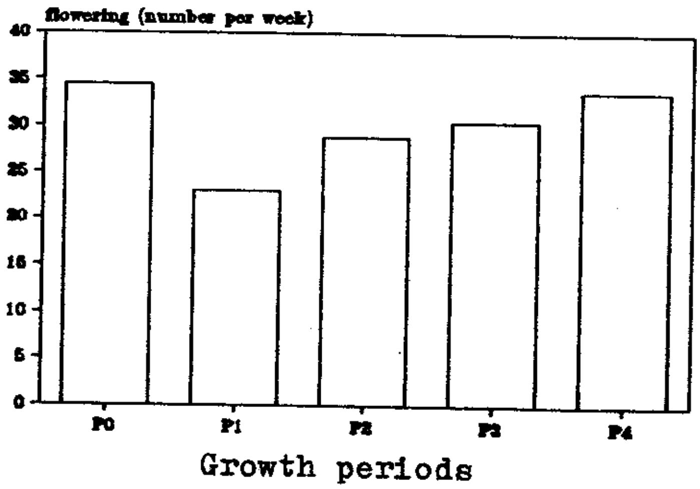
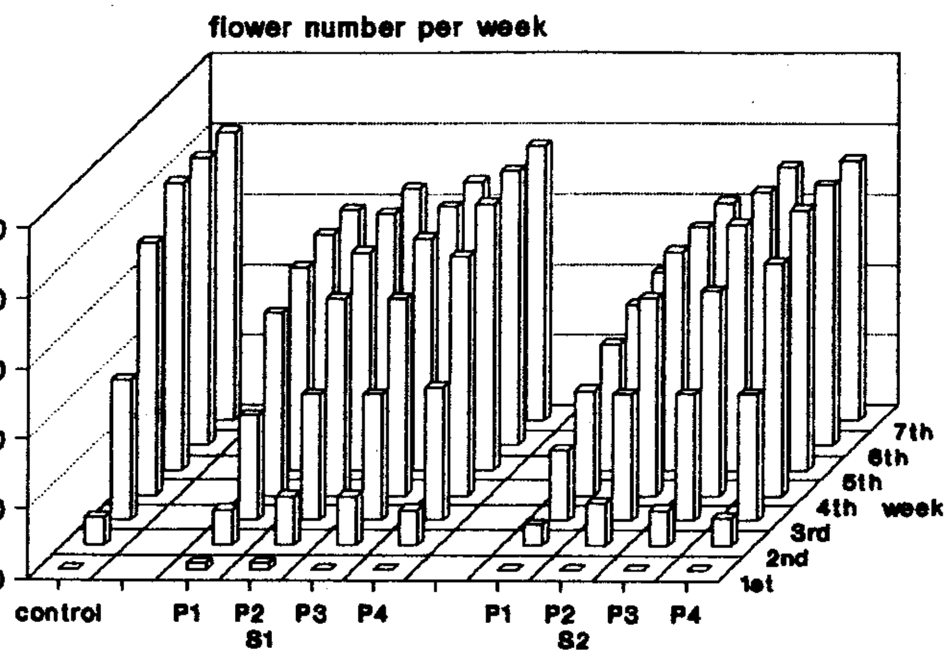


Fig (13) : Effect of salinity levels and growth periods on flowers number per plant of two varieties (first season) .

Table (15) : Effect of salinity levels and growth periods on flowers number per plant of two varieties (first season) .

Treatments		Weeks						
		1	2	33	4	5	6	7
Giza 45 (250)		-	4	16	16	5	-	-
Giza 45 (10000) (ppm)	P_1	1	4	10	11	3	1	-
	P_2	1	6	11	10	3	2	-
	P_3	-	7	11	10	5	1	-
	P_4	-	7	11	10	5	1	-
Giza 45 (15000) (ppm)	P_1	-	3	7	5	3	2	1
	P_2	-	6	12	10	3	-	-
	P_3	-	5	13	11	6	1	-
	P_4	-	4	14	15	4	-	-
Giza 81 (250)		-	5	10	8	3	2	-
Giza 81 (10000) (ppm)	P_1	1	4	9	6	3	-	-
	P_2	1	5	12	8	1	-	-
	P_3	-	6	11	7	1	-	-
	P_4	-	5	11	9	3	1	-
Giza 81 (15000) (ppm)	P_1	-	2	6	7	2	1	-
	P_2	-	5	8	7	3	1	-
	P_3	-	6	10	8	3	-	-
	P_4	-	6	11	9	3	1	-

Giza 45



Giza 81

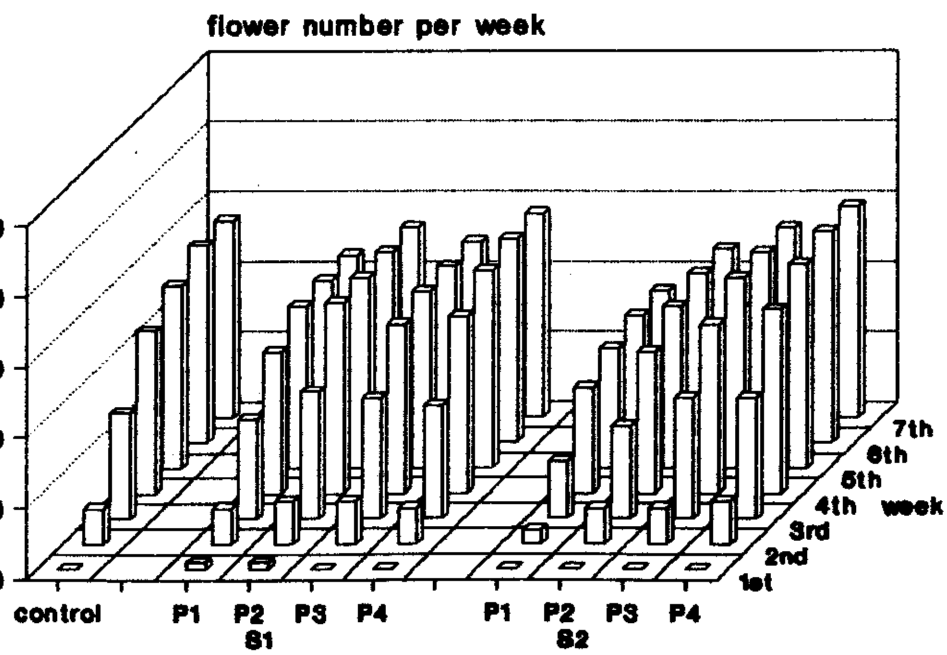


Fig (14) : Effect of salinity levels and growth periods on cumulative number of flowers per plant of two varieties ,(first season) .

Table (16) : Effect of salinity levels and growth periods on cumulative number of flowers per plant of two varieties, (first season) .

Treatments		Flowers cumulative number/plant weekly						
		1	2	3	4	5	6	7
Giza 45 (250)		0	4	20	36	41	41	41
Giza 45 (10000)	P_1	1	5	15	26	29	30	30
(ppm)	P_2	1	7	18	28	31	33	33
	P_3	0	7	18	28	33	34	34
	P_4	0	5	19	34	38	39	39
Giza 45 (15000)	P_1	0	3	10	15	18	20	21
(ppm)	P_2	0	6	18	28	31	31	31
	P_3	0	5	18	29	35	36	36
	P_4	0	4	18	33	37	37	37
Giza 81 (250)		0	5	15	23	26	28	28
Giza 81 (10000)	P_1	1	5	14	20	23	23	23
(ppm)	P_2	1	6	18	27	27	27	27
	P_3	0	6	17	24	25	25	25
	P_4	0	5	16	25	28	29	29
Giza 81 (15000)	P_1	0	2	8	15	17	18	18
(ppm)	P_2	0	5	13	20	23	24	24
	P_3	0	5	17	24	27	27	27
	P_4	0	6	17	26	29	30	30

for total flowers number per lant (cumulative at week, seven)

L.S.D.	5 %	1 %		5 %	1 %
V	0.31	0.42	V x S	0.54	0.73
S	0.38	0.51	V x P	0.63	0.84
P	0.44	0.59	S x P	0.77	1.03

Salinity level, also affected the total number of flowers which decreased with increased salinity level . The decrease of flowers number caused by salinity level were 21 and 11 % for Giza 45 and Giza 81 , respectively . Similar results were reported by Iyengar et al (1978) ,who concluded that the total number of flowers per plant was reduced with salinity due to increasing flowers shedding . It is worthy to mention that the obtained results suggest more severe shedding with Giza 45 (V_1) than with Giza 81 (V_2) . The decrease of flowers number caused by salinity levels on the two tested varieties were 13 and 19 % under S_1 and S_2 , respectively . The higher salinity level was the most effective on flowering reduction .

General trend can be observed for flowers number under growth periods . Flowers per plant were 23 , 29 , 31 , 35 and 35 under P_1 , P_2 , P_3 , P_4 and P_0 respectively . It is shown from the mean values that a clear trend for all growth periods resembling control (P_0). For the two tested varieties, P_1 was more effective on depressing flower number per plant than others, while the decrease caused by salinity under P_4 can be neglected . The descend order for S_1 and S_2 were 23 , 12 , 14 , 3 and 43 , 19 , 8 , 5 under P_1 , P_2 , P_3 , P_4 , respectively .

It is interesting to observe that the low salinity level (S_1) slightly stimulated flowering . It could be observed from recorded date of the first flower under salinity level, where the accelarating flowers under P_1 and P_2 were 1 and 3 days than control for Giza 45, and 3 and 1 days respectively for Giza 81 . Also , the flowering number of second week as precentage of total , showed that accelar-ating effect of salinity levels on cotton flowering compared with control . On the other hand, all growth periods results

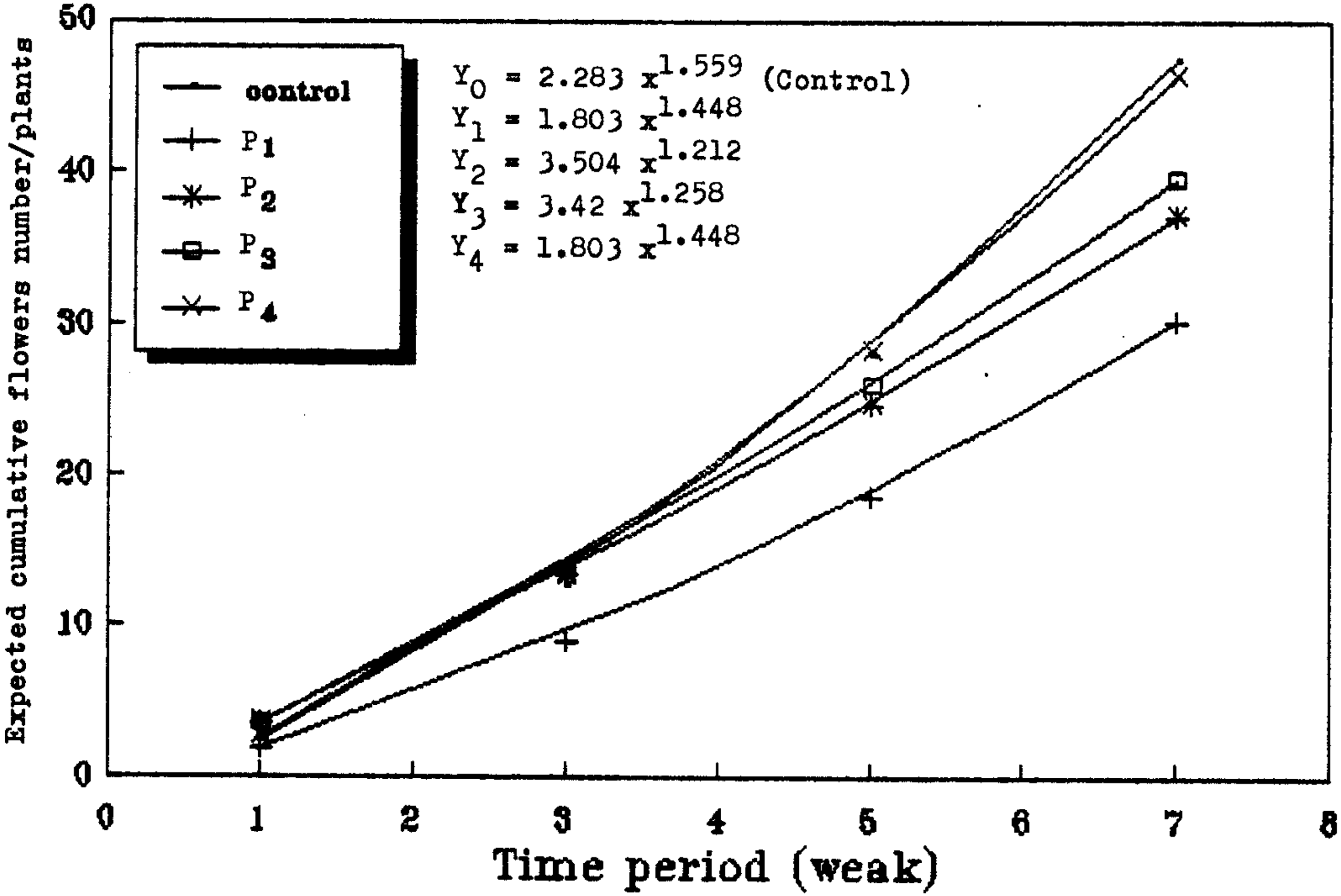


Fig (15) : Fit regression power equation of flower cumulative number per plant at ages and growth periods (days).

accelarated flowering in Giza 45, but some growth periods did that in Giza 81 . This finding agreed with those reported by Soliman et al (1976) who concluded that salinity (up to 6000 ppm) made cotton plant to flower than under nonsaline conditions .

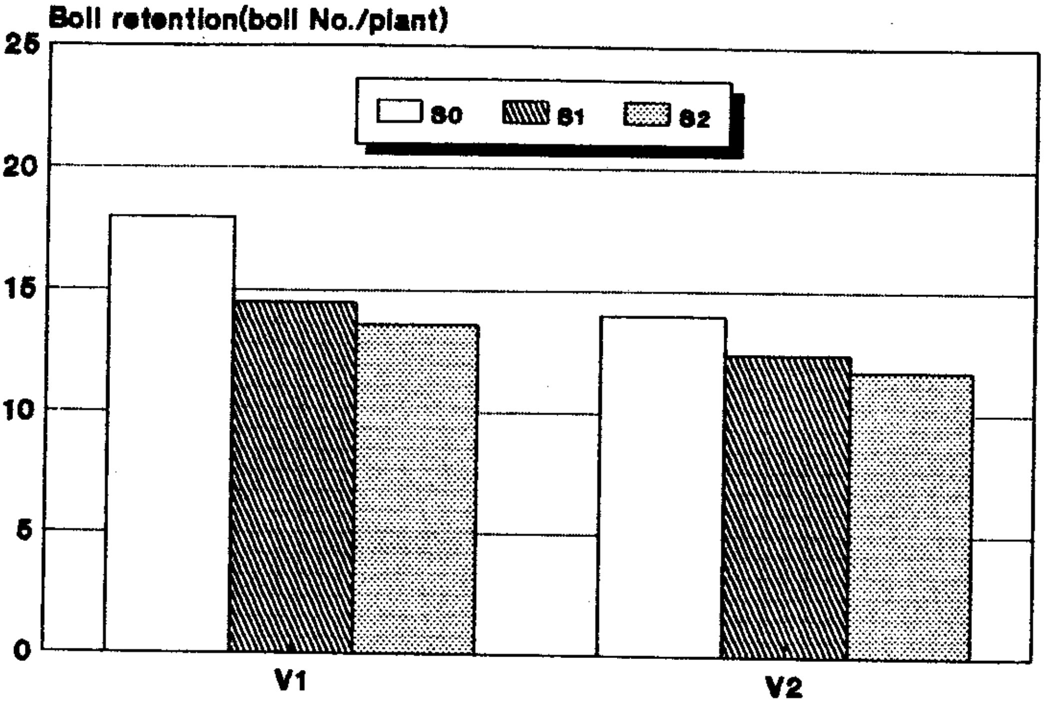
The recorded date of first flower revealed that high salinity level delayed flower . Also the flowering number of the second week delayed flowers under some growth periods . Similar results were reported by Pulatov (1970), El-Saidi (1973) and Soliman et al (1976) . They pointed out that salinity delayed the flowering of cotton plant .

Fit equation of cumulative number of flowers per plant revealed that power equation is the suitable one for cumulative number where r values are; 0.88** , 0.86** , 0.89** , 0.89** and 0.89** for P_0 , P_1 , P_2 , P_3 and P_4 respectively .

4.3.3. Effect of salinity on boll production :

A.. Effect of salinity on boll retention :

Data of boll retention of the two tested varieties in the two seasons are shown in tables(17 and 18) and illustrated in figs(16 and 17) . Highly significant differences between varieties were found, whereas the mean values of boll retention in Giza 45 and Giza 81 were 14.4 and 12.2 boll/plant respectively . Also, salinity level affected boll retention for every cotton variety . For Giza 45 the relative decreases in boll retention were 19 and 24 % for S_1 and S_2 respectively . Also for Giza 81 the corresponding values were 11 and 26 % respectively . The decreasing effect of salinity on boll retention was induced with increasing the level of salinity in irrigation water. These



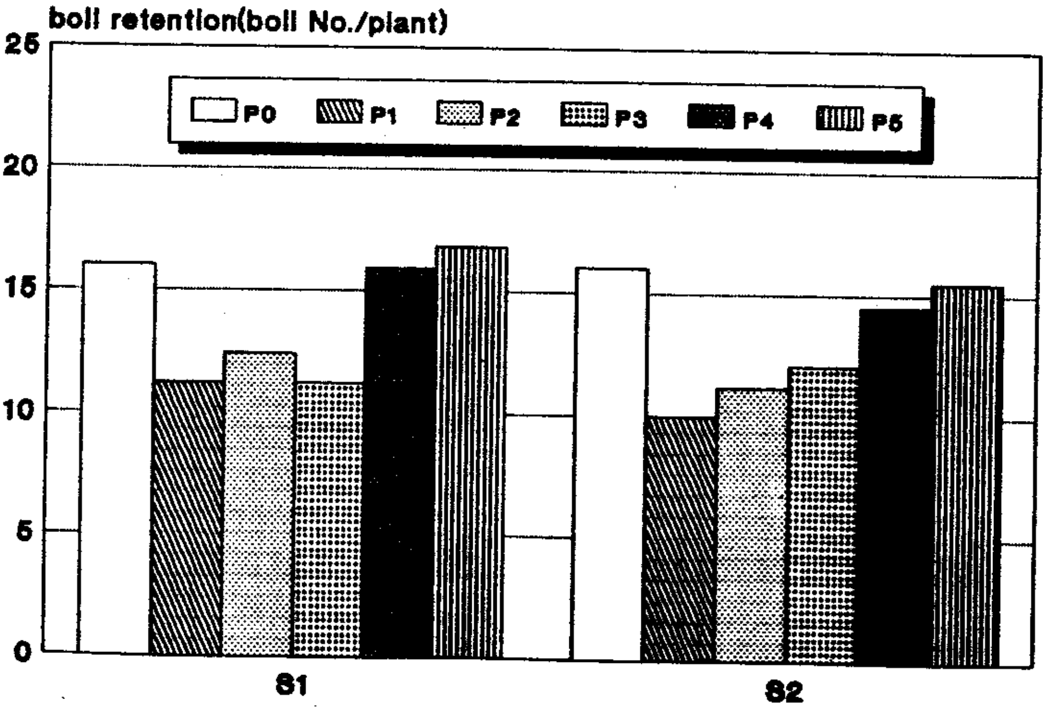
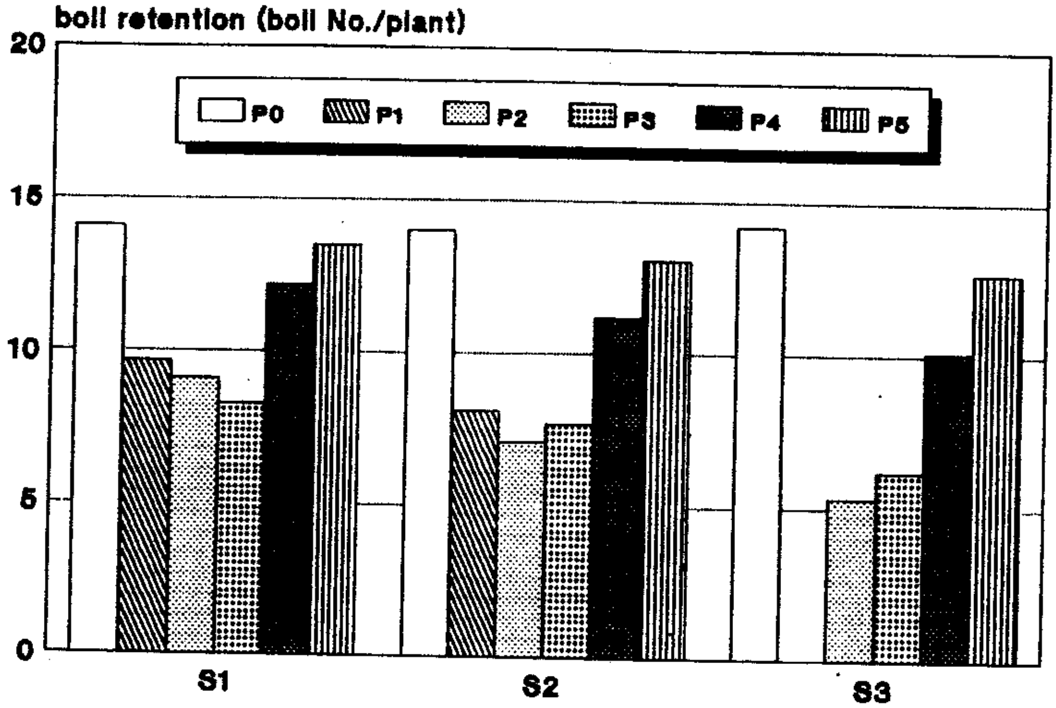


Fig (16) : Effect of salinity levels and growth periods on boll retention of cotton plants,(first season).



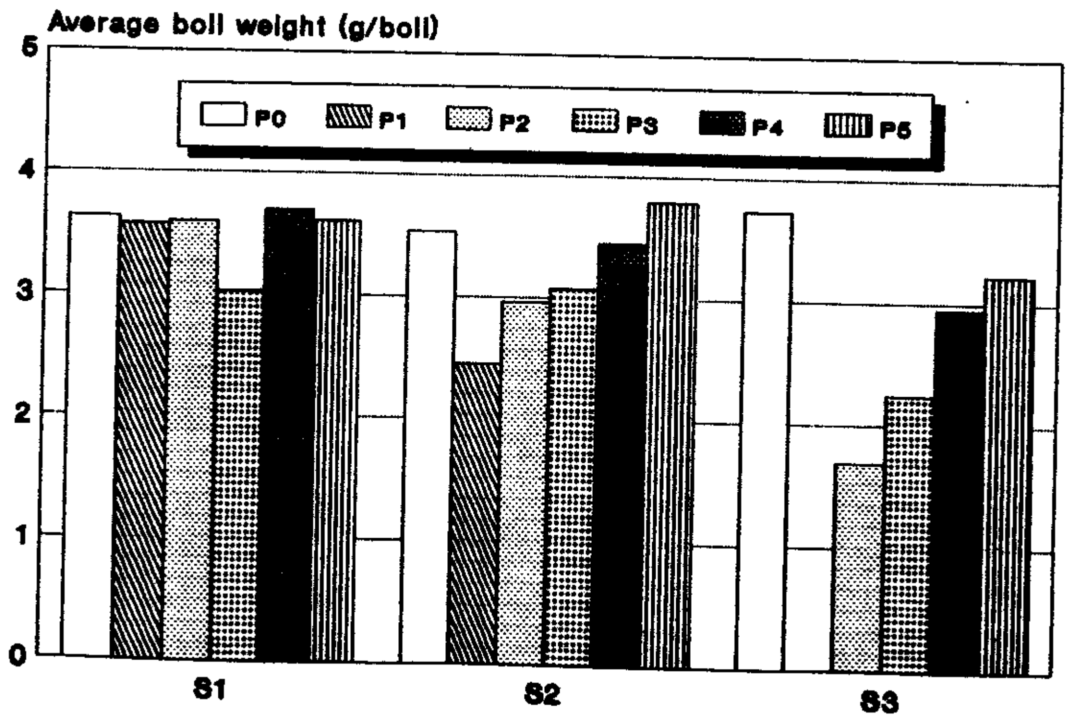


Fig (17) : Effect of salinity levels and growth periods on boll retentions and average boll weights of cotton plant (second season) .

Table (17) : Effect of salinity levels and growth periods on boll retention and lint yield of the two varieties of cotton plant , (first season) .

Treatments		Cotton varieties			
		Giza 45		Giza 81	
		Boll No./ plant	gm lint/ plant	Boll No./ plant	gm lint/ plant
Control		18.0	24.31	14.0	21.42
10000 (ppm)	P_1	12.3	16.55	10.0	18.20
	P_2	12.7	16.75	12.0	17.30
	P_3	11.3	14.32	11.0	15.07
	P_4	17.3	20.99	14.5	21.17
	P_5	19.0	20.31	14.5	21.68
15000 (ppm)	P_1	10.7	11.40	9.3	13.16
	P_2	12.3	12.59	10.0	11.17
	P_3	12.5	13.16	11.7	13.78
	P_4	15.3	20.65	13.7	19.54
	P_5	17.0	20.11	14.0	20.44

	Boll number per plant		Lint yield/plant	
L.S.D.	5 %	1 %	5 %	1 %
V	0.17	0.23	0.12	0.16
S	0.21	0.28	0.15	0.20
P	0.27	0.36	0.20	0.26
V x S	0.30	0.39	0.21	0.28
V x P	0.38	0.51	0.28	0.37
S x P	0.47	0.62	0.34	0.45

Table (18) : Effect of salinity levels and growth periods on boll retentions and average boll weights of cotton plant (second season) .

Treatments		Dry weight gm/plant		Boll No./plant		gm/boll	
Control		39.72		14.1		3.63	
10000 (ppm)	P_1	22.35		9.7		3.57	
	P_2	21.12		9.7		3.60	
	P_3	22.14		8.3		3.02	
	P_4	27.89		12.2		3.69	
	P_5	33.29		13.5		3.61	
15000 (ppm)	P_1	12.54		8.1		2.45	
	P_2	14.60		7.1		2.96	
	P_3	20.71		7.7		3.07	
	P_4	22.84		11.2		3.45	
	P_5	24.10		13.1		3.80	
30000 (ppm)	P_1	0.0		0.0		0.0	
	P_2	10.25		5.3		1.69	
	P_3	16.75		6.2		2.25	
	P_4	22.68		10.1		2.95	
	P_5	22.19		12.7		3.22	
L.S.D.		5 %	1 %	5 %	1 %	5 %	1 %
S		0.80	1.07	0.07	0.10	0.10	0.13
P		0.90	1.20	0.08	0.11	0.11	0.14
S x P				0.14	0.19	0.21	0.29

are harmony with those obtained by Novikov (1942), Gumarove (1957), Soliman et al (1976), Ahmed and Abdullah (1982) and Babu et al (1987) who mentioned that increasing salinity decreased boll retention .

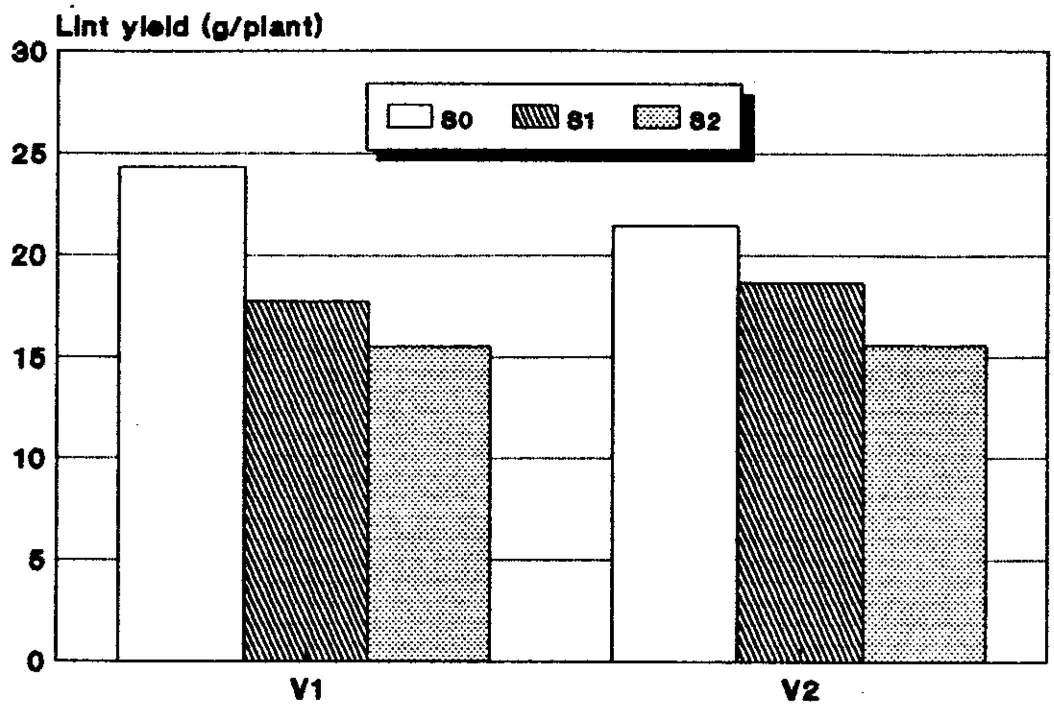
However the boll retention of Giza 45 was higher than of Giza 81 . Such results are in harmony with those of flower number per plant supported by Christidis and Harrison (1955), who stated that the boll retention depend on the number of flowers per plants .

For growth periods, P_1 , P_2 and P_3 were the most affected ones by salinity levels . In general P_3 was the most one affected by salinity than the others under S_1 , while P_1 was the most affected one under S_2 and S_3 . The less affected one was P_5 under the three tested salinity levels .

Mean values of recorded data reveal that the higher salinity level was the lower weight of boll did . In general the mean boll weight increased either with the later growth period or with salinity levels itself . Comparable findings were reported by Selem et al (1989) who stated that irrigation with drainage water (EC 2.91 mmhos/cm)reduced weight of blossom .

B.. Effect of salinity on lint yield :

Data of lint yield are shown in table (17) and illustrated in fig (18) . Lint yield of Giza 45 was higher than that of Giza 81 . The mean values for V_1 and V_2 were 19.22 and 18.57 g/plant . The relative lint yield of cotton plant under S_1 and S_2 were 73 and 64 % for Giza 45 and, 87 and 73 % for Giza 81 compared with the control,respectively. While,the absoluted lint



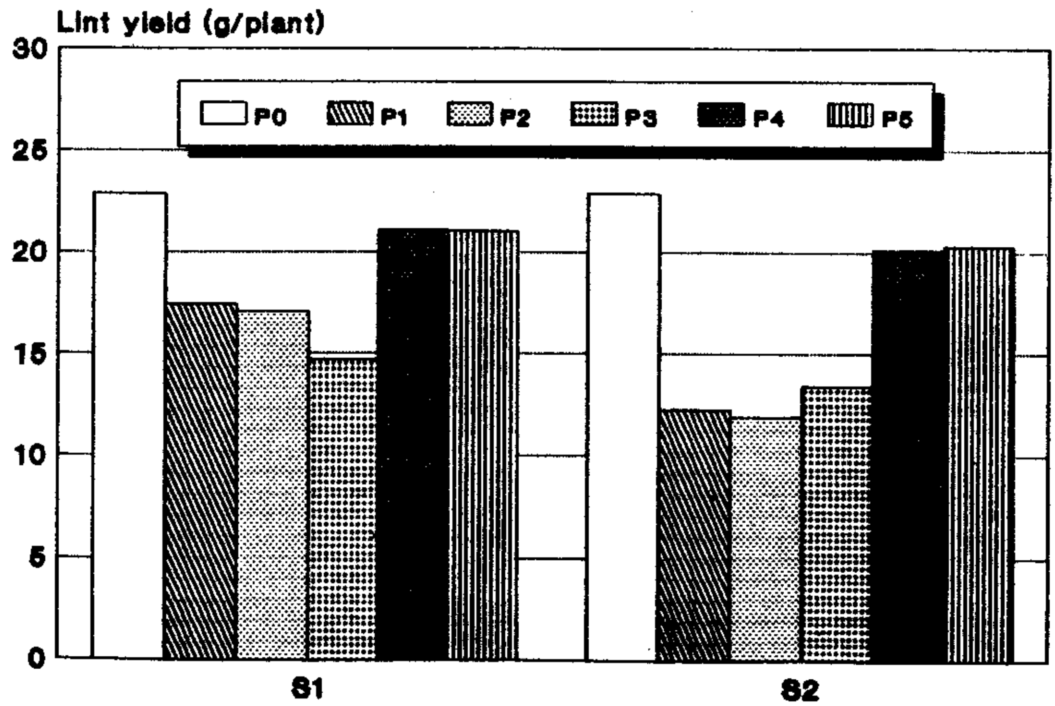


Fig (18) : Effect of salinity levels and growth periods on lint yield of cotton plant, (first season) .

yield was realized by Giza 45, the relative one was realized by Giza 81 . It could be said that the higher lint yield of Giza 45 , was the more depressed by salinity level . Analysis of variance for lint yield revealed highly significant differences concerning the tested variables . The depression caused by the two salinity levels were 20 and 32 % under S_1 and S_2, respectively. These results agree with the fingings of Hoffman et al (1971), Korloeve (1978) and Selem et al (1989). They summarized that lint yield was reduced with salinity . Longenker (1973) stated a significant reduction of cotton lint caused by salinity .

The ascending order of growth period was $P_3 < P_2 < P_1 < P_4 < P_5$ under S_1, whereas cotton plant under P_3 yielded the least lint yield, while under P_5 yielded the highest one . The relative lint yield in accordance with this order was 64 , 74 , 76 , 92 and 92 % respectively compared with the control. Also, the ascending order under S_2 was $P_2 < P_1 < P_3 < P_4 < P_5$. The relative lint yield in accordance with this order was 54, 52, 59, 88 and 89 % respectively, compared with the control . P_1 and P_2 are nearly the same on their effect on reducing lint yield while P_5 represent the least effective. In general, lint yield under P_4 and P_5 were the same but the depression caused under S_1 could be niglected .

4.4. Relationship of soil soluble salts with plant chemical components and yield :

Using diluted sea water for irrigation affected soil soluble salts and reaction. Moreover, there were manyyother effects either on cotton plant chemical components or cotton yield .