Australian Journal of Basic and Applied Sciences, 4(12): 6154-6168, 2010
ISSN 1991-8178

Effect of Saline Irrigation Water and Humic Acid Application on Growth and Productivity of Two Cultivars of Cowpea (*Vigna unguiculata* L. Walp)

Eslah M. El-Hefny

Plant production division - Desert Research Center

Abstract: Two field experiment was carried out in the Experimental Farm of the Desert Research Center at Ras Sudr, South Sinai Governorate, during the two successive summer seasons of 2008 and 2009 to study the effect of the combinations between two cowpea cultivars, i.e. Kafr El- Shekh and Cream 7 with three saline irrigation water treatments, i.e., (3500, 4500 and 5500 ppm) and four levels of humic acid application (0, 2, 4 and 6 kg/ fed.) on growth, yield and its components, also chemical compositions of leaves and seeds of cowpea plants. Results revealed that: 1.Kafr El-Shekh cultivar surpassed than cream 7 cultivar in plant fresh weight, total pods yield, N, P, K uptake in addition to K/Na and Ca/Na ratio. Also, N, P, K, protein and carbohydrate content in cowpea seeds tissues. 2. The lowest values of plant growth, total pods yield N, P, K uptake and K/Na, Ca/Na ratio. Also, N, P, K, protein and carbohydrate content in cowpea seeds tissues were observed by the highest salinity level (5500 ppm). But this level significantly increased Na, Ca and Cl uptake by plant leaves, in addition to Cl and proline content in seeds tissues. 3. The effect of humic acid on the vegetative growth of cowpea plant i.e. plant height, number of branches, fresh weight, leaf area/ plant, total pods yield, N, P, K uptake and K/Na, Ca/Na ratio. Also N, P, K, protein and carbohydrate content in cowpea seeds showed significant increase with increasing the rate of humic acid application from 0, 3, 4.5 up to 6 kg/fed. 4. The interaction between cultivars and water salinity with humic acid application showed no statistical differences in both seasons.

Key words:

INTRODUCTION

Cowpea (*Vigna unguiculata* L. Walp) is one of the important vegetable legumes due to its high protein content, heat tolerant, low fertilizer requirements and it can grow easily in the new reclaimed lands. Cowpea cultivated in Egypt for dry seeds yield and green pods. Cowpea is inherently more drought and salinity tolerant than other legumes crops, but it still suffers considerable damage, due to frequent drought and salinity stresses in different regions where rainfall is scanty and irregular (Singh et a., 2003).

Salt stress conditions is an osmotic which is apparently similar to that brought by water deficit (Almogaera *et al*., 1995). Injurious ions such as Na^+ and Cl^- negatively affect nutrient uptake and balance (Sauram and Tyagi, 2004 and Hussein *et al*, 2007 b).

Hafiz and Damarany (2006) found that there is variation among some cowpea cultivars because of differences among genotypes. They evaluated five cowpea cultivars in northern upper Egypt at Assiut governorate. B-Crowder cultivars appeared to be resistant cultivars to pests. There were no significant differences in no. of pods / plant and seeds/ pod, but TV u-21 cultivars produced the highest weight of 1000-seeds (g).

In another study, at El-Kassasein, Ismailia Governorate, Zaki *et al*. (2009) studied the effect of irrigation with saline water on three sweet fennel cultivars. They found differences among cultivars in vegetative growth, green yield and chemical content, cv. zefa fino surpassed than other two cultivars in all characters under saline irrigation water with increasing salinity of irrigation water, vegetative growth and green yield decreased.

Humic acid is a commercial product contain many elements which improve the soil fertility and increase the availability of nutrients and consequently increase plant growth and yield. It particularly is used to ameliorate or reduce the negative effect of salt stress. Many investigators reported that humic acid applications led to a significant increase in soil organic matter which is improves plant growth and crop production. Abd El- Al (1994). Erik *et al*. (2000) on onion plant and Hafez (2003) on squash, found that the dry matter yield

Corresponding Author: Eslah M. El-Hefny, Plant production division - Desert Research Center

of barley plants grown on sandy and calcareous soils was significantly increased with increasing the addition rate of humic acid from 450 to 900 mg/kg soil.

Therefore, this work was conducted to study the effect of three levels of saline irrigation water and four rates of humic acid on growth, yield and its components and chemical compositions of two cowpea cultivars.

MATERIALS AND METHODS

Two field experiments were conducted at the Experimental Farm of the Desert Research Center at Ras Sudr, South Sinai Governorate, the soil is highly calcareous and saline drip irrigation system was used during summer of 2008 and 2009. The physical and chemical analysis of the experimental soil are presented in Table (A), also, the chemical analysis of irrigation water is given in Table (B). The analysis carried out according to the methods described by Chapman and Pratt (1961).

Table A: Physical and Chemical properties of the experimental soil.

			Physical properties							
Depth (cm)	$CaCO_3$ %	Coarse sand (1-0.5)	Fine sand (0.25-0.10)	total sand (1-0.1)	silt (0.05-0.002)	clay < 0.002)	class texture %			
0-30	55.85	54.51	25.88	8.24	80.39	11.15	Sandy loam			
30-60	51.21	25.49	64.12	7.20	89.61	6.45	Sandy loam			
			Chemical properties							
			Saturation soluble extract							
			Soluble anions (me/L)				Soluble Cations (me/l)			
			CO^{-2}_3	HCO_3	SO^{-2}_4	Cl^-	Ca^{++}	Mg^{++}	Na^+	K^+
0-30	7.7	4.77	0.00	6.00	10.50	31.20	24.00	11.00	10.52	2.18
30-60	7.4	4.16	0.00	3.00	16.10	22.50	16.83	6.00	17.80	0.097

Table B: Chemical analysis of irrigation water.

Salinity (ppm)	pH	$ECds/m^{-2}$	Anions meq/ L				Cations meq/L			
			CO^-_3	HCO^-_3	SO^-_4	Cl^-	Ca^{++}	Mg^{++}	Na^+	K^+
3500	8.4	5.47	0.00	2.50	81.23	16.22	23.65	19.18	56.66	0.51
4500	8.6	7.03	0.00	2.50	21.23	41.28	4.50	13.43	47.05	0.12
5500	7.9	8.59	0.00	2	27.8	84.0	29.0	28.0	57.7	0.31

Seeds of two cowpea (*Vigna unquiculata* L.) cultivars (Kafr El-Shekh and Cream7) were sown on March 22 and 26 of 2008 and 2009 seasons, respectively. The experiment included 24 treatments with three replicates in a split split design, which were the combination of three saline irrigation levels, two cowpea cultivars and four humic acid application rates. Levels of saline irrigation water were assigned in the main plots, cowpea cultivars were arranged in sub-plots, while humic acid applications were distributed in the sub-sub plots. The experimental area was 10.5 m^2. The irrigation lines were 21m long and 50 cm apart, the seeds were sown at 20 cm apart on one side of the lines and thinned to one plant/ hille. The treatments used were as follows:

I. Treatments of saline irrigation water:
a) Irrigation from well with salinity of 3500 ppm.
b) mixed irrigation water (1:1) between saline irrigation water of 3 500 and 5500 ppm.
c) Irrigation from well with salinity of 5500 ppm.

II. Two cowpea cultivars i.e. Kafr El-Shekh and Cream 7 were used.

III. Humic acid application rates :
a) Control (without humic acid).
b) 3 kg humic acid/fed.
c) 4.5 kg humic acid/fed.
d) 6 kg humic acid/fed.

which were added at 4 times, i.e. one half after planting directly while the second half were three times intervals 10 days between them.

Drip irrigation system was used, calcium super phosphate ammonium was added month before planting but ammonium sulphate and potassium sulphate were added through water irrigation (Fertigation). The recommended NPK doses were (60 kg N, 40 kg P_2O_5 and 60 K_20/fed). Conventional culture practices commonly used for cowpea growing in the experimental site. Irrigation treatments with saline water were started after one month from planting.

Data Recorded:

I. Plant Growth Measurements:

After three months from planting a random sample of 6 plants from each experimental plot was taken and the following data were recorded:

Plant height, number of leaves/ and number of branches/plant and leaf area using leaf area meter. Fresh and dry weight/plant by drying plant at 70°C until constant weight.

II. Chemical Composition of Leaves:

1. Total chlorophyll was colorimetrically determined as described in A.O.A.C. (1995) in fresh leaf samples.
2. Mineral constituents:

Total nitrogen and phosphorus were determined by methods which were described by Peach and Tracey (1959) and Frie *et al*. (1964) respectively. While, potassium, calcium and sodium were determined by methods suggested by A.O.A.C. (1995). Also, chloride content was assessed according to the method described by Jackson (1958).

3. Free proline was determined according to Bates *et al*. (1973).

III. Total Yield and its Components:

At harvest time the dry pods yield/plant (gm) and the total yield/fed. were recorded. Also, samples of 20 pods were taken from each experimental plot to measure the average pod length, No. of seeds/pod, weight of 100 seeds (seed index) as g. Finally, samples of dry seeds were taken for chemical analysis, i.e., N, P, K, Ca, Na, Cl as previously described in leaves. Total carbohydrate percentage was determined according to A.O.A.C. (1995). The protein percentage in dry seeds was accounted by multiplying nitrogen content by 6.25.

Anatomical Studies:

Anatomical studies were done to shed more light on the changes in the structure of cowpea roots in response to the different saline irrigation treatments. At the harvest time, root samples (2 cm or less in thickness) were taken, cleaned and cut to suitable parts and fixed in FAA solution. Staining schedule of saffranin light green combination was followed as described by Johansen (1940). The cross section were mounted in Canada balsam, air dried, examined and microscopically photographed. All the obtained data were statistically analyzed according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

A-Plant Growth:

1-Effect of Cultivars:

The effect of cowpea cultivars on plant growth characters is cleared in Tables (1, 2). Cream 7 cultivar was significantly superior on plant growth characters expresed as, plant height, number of branches and leaf area / plant compared to Kafr- ElShekh cultivar. On the other hand, Kafr-ElShekh cultivar was significantly surpassed in fresh and dry weight of plant. These results were true during the tow experimental seasons. This might be due to the genetic differences among cultivars and their ability for utilizing the environmental sources expecially light, CO2, water and nutrients (Hafiz and Damarany, 2006 and Zaki *et al*., 2009).

2-Effect of Irrigation Water Salinity:

Results in Tables (1,2) indicated that vegetative growth characters of cowpea plants were significantly decreased by increasing irrigation water salinity. Generally, plant height, number of branches, leaf area / plant and fresh weight showed the lowest values by increasing salinity of irrigation water up to the highest level 5500 ppm. These findings are similar in both growing seasons. Irrigation by well with salinity of 3500 ppm resulted in the tallest plant, best branches and leaf area/plant and the heaviest fresh and dry weight of plants. The results might be related to the injurious effect of specific ions such as NaCl and $NaSO_4$ which inhibited the production of chlorophyll and carotene in leaves. Also, high sodium concentration that induced calcium and magnesium nutritional deficiencies and influenced the respiration pathways in plant roots (Abel and Mackenzie, 1964). In addition, long term exposure of roots to high salt concentration make the plants suffer from drought (Bernstein, 1975), reduced water and nutrient availability, make direct toxic effect of different ions because of imbalances of minerals nutrition (Bower, 1976), minimized photosynthesis due to reduction in stomata conductance and increasing stomata limitation to CO_2 uptake (Pascale and Barbieri, 1995) and changed enzymatic activities in the plant (Abd El- Razaek, 1997). Similar results were obtained by (Singh, *el al* 1986. Pascal and Barbieri 1995. Amin, 1997. Ahmad 1999. Abou El- Magd *et al*. 2008 and Zaki *et al*. 2009).

Table 1: Effect of cultivars, saline irrigation water and humic acid application on plant length , no. of branches, leaf area, fresh and dry weight during summer season of 2008.

Treatments culliars	salinity levels	Humic Appli	plant length cm	No. of branches	leaf area	fresh weight gm/plant	Dry weight gm/plant
					2008		
Kafr-El-Shekh	3500 ppm	cont.	46.00	4.00	88.00	40.00	46.10
		2 kg/fed.	49.00	4.30	109.00	44.00	53.90
		4 kg/fed.	51.00	4.70	120.00	50.00	68.20
		6 kg/fed.	56.00	5.40	154.00	61.33	80.30
	Mean		50.50	4.60	117.75	48.83	62.13
	4500 ppm	cont.	41.00	3.57	76.00	32.00	45.23
		2 kg/fed.	43.00	3.77	82.00	36.00	47.30
		4 kg/fed.	44.00	4.33	90.00	39.00	64.73
		6 kg/fed.	48.00	4.77	110.00	45.00	68.00
	Mean		44.00	4.11	89.50	38.00	56.32
	5500 ppm	cont.	39.00	3.20	66.00	28.00	32.50
		2 kg/fed.	42.00	3.60	70.00	29.00	46.20
		4 kg/fed.	44.00	4.00	76.00	33.67	53.40
		6 kg/fed.	45.00	4.40	80.33	37.00	56.20
	Mean		42.50	3.80	73.08	31.92	47.08
	Mean		45.67	4.17	93.44	39.58	55.17
Cream 7	3500 ppm	cont.	52.00	6.30	80.00	38.33	69.90
		2 kg/fed.	54.00	6.50	87.00	40.33	77.90
		4 kg/fed.	55.00	7.00	106.00	43.33	85.30
		6 kg/fed.	58.00	7.60	144.00	58.33	91.30
	Mean		58.75	6.85	104.25	45.08	81.10
	4500 ppm	cont.	40.00	5.40	68.00	30.33	61.40
		2 kg/fed.	42.00	5.60	71.00	34.00	66.60
		4 kg/fed.	43.00	6.00	77.33	38.00	78.10
		6 kg/fed.	48.00	6.40	89.33	41.67	83.60
	Mean		54.75	5.85	76.42	36.00	72.43
	5500 ppm	cont.	34.00	4.60	50.00	25.33	44.00
		2 kg/fed.	36.00	4.90	54.00	28.00	47.07
		4 kg/fed.	39.00	5.20	62.00	30.33	58.30
		6 kg/fed.	40.00	5.70	72.33	35.00	77.00
	Mean		47.75	5.10	59.58	29.67	56.59
	Mean		53.75	5.93	80.08	36.92	70.04
L.S.D. at 5 %		V	0.41	0.74	12.72	N.S.	1.00
		S	1.73	0.59	7.74	3.40	1.67
		V X S	2.44	N.S.	N.S.	N.S.	2.36
		H	21.24	6.94	25.10	17.23	24.43
		V X H	N.S.	N.S.	N.S.	N.S.	N.S.
		S X H	N.S.	N.S.	6.60	N.S.	N.S.
		VXSXH	N.S.	N.S.	N.S.	N.S.	5.77

3. Effect of Haumic Acid Application:

Data in Tables (1, 2) show that the vegetative growth of cowpea plant i.e. plant height, number of branches, fresh weight and leaf area / plant were gradualy and significantly increased with increasing the rate of humic acid application from 0 , 3 ,4.5 up to 6 kg/fed. in two seasons. This result may be due to the role of humic acid as a nutrient supplying which increase soil fertility and increase the availability of nutrient elements as reported by (Chen and Aviod, 1990. David *et al*. 1994 and Hartwigson and Evans, 2000). In the same respect, Erik *et al* (2000) and El-Desuki (2004) on onion plant found that humic acid application caused an improve in plant vegetative growth.

4- Effect of Interactions:

The interaction between cultivars and water salinity did not reflect any significant effect on plant growth characters, except dry weight/ plant (g) in both seasons and plant height in the first season only as shown in Tables (1, 2). These results were obtained from Cream 7 cultivar which irrigated with low level of salinity (3500 ppm).

The interaction between cowpea cultivars and humic acid application showed no statistical differences in all plant growth characters as shown in Tables (1, 2) in both seasons

The interaction between water salinity and humic acid, did not show significant effect on plant growth except leaf area/plant (cm) in both seasons and dry weight in the second season only.

The interaction among cultivars, water salinity and humic acid showed no statistical differences in plant growth of cowpea plant, except dry weight of plant in the second season only as shown in Tables (1, 2) which

Table 2: Effect of cultivars, saline irrigation water and humic acid application on plant length , no. of branches, leaf area, fresh and dry weight during summer season of 2009.

Treatments culliars	salinity levels	Humic Appli	plant length cm	No. of branches	leaf area	fresh weight gm/plant	Dry weight gm/plant
				2009			
Kafr-El-Shekh	3500 ppm	cont.	41.00	3.70	80.00	36.33	42.00
		2 kg/fed.	44.00	4.00	99.00	40.00	49.43
		4 kg/fed.	46.00	4.20	107.00	46.00	62.60
		6 kg/fed.	50.00	5.00	132.00	55.00	73.50
	Mean		45.25	4.23	104.50	44.33	56.88
	4500 ppm	cont.	37.00	3.20	70.00	30.00	41.00
		2 kg/fed.	39.00	3.50	75.00	33.33	43.57
		4 kg/fed.	40.00	3.90	83.00	38.00	58.67
		6 kg/fed.	43.00	4.30	100.00	41.33	55.23
	Mean		39.75	3.73	82.00	35.67	49.62
	5500 ppm	cont.	35.00	3.00	61.33	26.33	31.83
		2 kg/fed.	38.00	3.30	68.00	28.00	39.20
		4 kg/fed.	39.00	3.80	70.00	31.00	48.50
		6 kg/fed.	41.00	4.00	75.33	36.00	51.60
	Mean		38.25	3.53	68.67	30.33	42.78
	Mean		41.08	3.83	85.06	36.78	49.76
Cream 7	3500 ppm	cont.	48.00	6.00	72.00	35.00	63.50
		2 kg/fed.	49.00	6.10	78.00	37.00	70.27
		4 kg/fed.	49.00	6.70	96.00	39.67	77.33
		6 kg/fed.	52.00	6.50	130.00	50.33	83.20
	Mean		52.75	6.33	94.00	40.50	73.58
	4500 ppm	cont.	39.00	4.70	61.00	27.33	55.63
		2 kg/fed.	41.00	5.00	64.00	30.33	60.00
		4 kg/fed.	43.00	5.20	68.00	34.33	73.83
		6 kg/fed.	45.00	6:00	79100	37.33	75.80
	Mean		49.25	5.23	68.00	32.33	66.32
	5500 ppm	cont.	30.00	4.40	46.00	23.00	39.63
		2 kg/fed.	32.00	4.60	50.00	25.00	42.33
		4 kg/fed.	34.00	5.00	57.00	29.00	48.37
		6 kg/fed.	37.00	5.50	67.00	30.33	66.03
	Mean		43.25	4.88	55.00	26.83	49.09
	Mean		48.42	5.48	72.33	33.22	62.99
L.S.D. at 5 %		V	3.11	0.65	0.84	N.S.	6.87
		S	3.48	0.72	2.72	N.S.	4.01
		V X S	N.S.	N.S.	N.S.	N.S.	5.67
		H	20.15	6.56	23.67	N.S.	23.38
		V X H	N.S.	N.S.	N.S.	N.S.	N.S.
		S X H	N.S.	N.S.	8.67	N.S.	4.21
		VXSXH	N.S.	N.S.	N.S.	N.S.	5.96

was appeared with interaction of cream cultivar, 3500 ppm irrigation water and 6 kg humic acid application. Generally, Kafr El-Shekh cultivar which irrigated with low level of salinity (3500ppm) and humic acid at level of 6 kg /fed. resulted the highest leaf area / plant (cm).

B-Total Yield:

1-Effect of Cultivars:

Results in Tables (3 and 4) indicated that Kafr El-Shekh cultivar gave the heaviest total pods yield i.e. number of pods/plant, number of seeds/ pod, seed pod weight (g), seed plant weight (g), total yield ton/fed. and pod length (cm). Cream 7 cultivar. These results showed the same trend in both seasons. The results agree with those obtained by Hafize and Damarany (2006) and Zaki *et al*. (2009). The differences may be due to the differences between genotypes and tolerance of stresses.

2-Effect of Irrigation Water Salinity:

Total pods yield of cowpea expressed as (number of pods/ plant, number of seeds / pod, seed pod weight (g) , weight of 100 seeds, seeds plant weight (g), total yield ton/ fed. and pod length (cm) were statistically decreased as salinity of irrigation water increased. Tables (3 and 4). These results held well in both seasons. The decrease in total pods yield might be due to the gradual decrease in the vegetative growth of cowpea plants. The lowest values of total pod yield was observed by the highest salinity level. Consequently, photosynthesis and the other metabolic activities were lowered, and carbohydrate metabolism would be decreased. However, other investigations suggested that this effect might be due to decrease in photosynthesis

Table 3: Effect of cultivars, saline irrigation water and humic acid application on plant length , no. of pods/plant, no. of seeds/ pod, wt. of seeds/ pod and plant, wt. of 100 seed and total yield of two cultivars of cow pea during 2008 summer season.

Treatments			Number		Weight (gm)			pod length	total yield
culliars	salinity levels	Humic Appli	pods/p.	seeds/ pod	seeds/ pod	seeds/ plant	100 seed		
					2008				
Kafr-	3500 ppm	cont.	22.17	12.00	1.83	41.20	14.50	17.00	1.56
El-Shekh		2 kg/fed.	25.40	12.60	1.89	48.00	14.90	18.00	1.90
		4 kg/fed.	28.80	13.00	1.95	56.20	17.40	18.90	2.60
		6 kg/fed.	32.00	13.50	2.03	65.00	18.00	20.10	3.10
	Mean		27.09	12.78	1.93	52.60	16.20	18.50	2.29
	4500 ppm	cont.	19.80	10.60	1.59	31.50	12.00	13.30	1.01
		2 kg/fed.	21.50	11.00	0.65	35.50	13.60	14.80	1.32
		4 kg/fed.	24.50	11.80	0.77	43.40	14.30	16.50	1.61
		6 kg/fed.	27.00	12.20	0.84	49.70	16.00	19.00	2.11
	Mean		23.20	11.40	0.71	40.03	13.98	15.90	1.51
	5500 ppm	cont.	15.00	8.40	0.26	18.90	10.00	8.60	0.62
		2 kg/fed.	17.10	8.80	0.32	22.60	12.80	11.90	0.77
		4 kg/fed.	19.00	9.50	0.43	27.20	13.50	14.00	0.98
		6 kg/fed.	22.60	10.13	0.62	35.30	15.00	16.80	1.40
	Mean		18.43	9.21	1.41	26.00	12.83	12.83	0.94
	Mean		22.91	11.13	1.68	39.54	14.33	15.74	1.58
Cream 7	3500 ppm	cont.	15.40	6.40	0.77	12.94	12.70	15.00	0.55
		2 kg/fed.	16.90	6.90	0.88	15.02	13.90	14.50	0.64
		4 kg/fed.	18.70	8.30	1.11	20.68	15.50	15.00	0.98
		6 kg/fed.	22.10	9.20	1.26	25.70	16.60	15.50	1.37
	Mean		18.28	7.70	1.01	18.59	14.68	15.00	0.89
	4500 ppm	cont.	12.00	6.20	0.67	8.93	12.00	11.10	0.41
		2 kg/fed.	13.20	7.40	0.78	11.08	12.80	12.00	0.47
		4 kg/fed.	14.50	7.20	0.80	13.61	13.70	12.80	0.64
		6 kg/fed.	17.40	7.90	0.88	18.27	15.80	13.50	0.87
	Mean		14.28	7.18	0.78	12.97	13.58	12.35	0.60
	5500 ppm	cont.	10.00	5.40	0.62	6.16	10.00	8.50	0.30
		2 kg/fed.	11.33	5.60	0.70	7.06	11.00	10.00	0.38
		4 kg/fed.	12.70	6.30	0.76	10.00	12.00	11.50	0.49
		6 kg/fed.	13.93	6.70	0.81	12.60	12.80	12.00	0.71
	Mean		11.99	6.00	0.72	8.96	11.45	10.50	0.47
	Mean		14.85	6.96	0.84	13.50	13.23	12.62	0.65
		V	3.51	1.33	0.29	5.61	N.S.	2.81	0.41
		S	1.86	0.58	0.15	0.55	0.92	0.91	0.30
		V X S	2.63	0.82	N.S.	0.77	N.S.	N.S.	0.43
L.S.D. at 5 %		H	10.85	7.69	2.54	10.34	10.58	10.09	2.22
		V X H	2.98	N.S.	N.S.	1.85	N.S.	0.84	0.20
		S X H	N.S.	N.S.	N.S.	2.26	N.S.	1.03	0.24
		VXSXH	5.17	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

and protein building (Debuba *et al*., 2006). Disturbance in growth regulators (Brenant *et al* 2007), or enzymes activity (Thapon *et al* 2008).

3- Effect of Humic Acid Application:

The response of total pods yield to the different levels of humic acid application Tables (3 and 4) revealed that number of pods/ plant, number of seeds / pod, seed pod weight (g) , weight of 100 seeds, seed plant weight (g), total yield ton/ fed. and pod length (cm). were gradually and significantly increased with increasing the level of humic acid application from 0, 3, 4.5 up to 6 kg / fed. These results were in the 2 same trend in the two growing seasons. This result may be due to the role of humic acid as soure of nutrients and increasing the soil fertility which consequently increased the vegetative growth of cowpea plant (Table 1). Our results here were in harmony with those gained by Abd El- Al, 1994 ; Erik *et al*. 2000; El- Desuki, 2004 and Abd El- Al Faten *et al*. 2005.

4- Effect the Interactions:

The results of the effect, of the interaction between cultivars and water salinity presented in Tables (3 and 4). These results indicated that the highest pod length, number of seeds pod, total pods yield/ plant and total pods yield / fed. were obtained from Kafr El-Shekh cultivar and low level of salinity (3500 ppm). The results were similar and true in the two seasons. It is obvious that cv. Kafr El-Shekh cultivar was salt tolerance when compared with Cream 7 cultivar.

Table 4: Effect of cultivars, saline irrigation water and humic acid application on plant length , no. of pods/plant, no. of seeds/ pod, wt. of seeds/ pod and plant, wt. of 100 seed and total yield of two cultivars of cow pea during 2009 summer season.

Treatments			Number		Weight (gm)			pod length	total yield
culliars	salinity levels	Humic Appli	pods/p.	seeds/ pod	seeds/ pod	seeds/ plant	100 seed		
					2009				
Kafr-	3500 ppm	cont.	21.60	11.50	1.73	37.40	12.00	15.40	1.19
El-Shekh		2 kg/fed.	22.50	12.20	1.83	41.37	12.50	17.00	1.37
		4 kg/fed.	25.40	12.80	1.92	48.80	14.53	18.20	1.89
		6 kg/fed.	28.50	13.20	1.98	56.40	15.60	19.30	2.31
	Mean		24.50	12.43	1.87	45.99	13.66	17.48	1.69
	4500 ppm	cont.	17.80	10.40	1.56	27.80	11.33	12.00	0.84
		2 kg/fed.	19.40	11.00	1.65	32.00	12.27	13.20	1.06
		4 kg/fed.	22.00	11.60	1.74	38.30	12.90	15.30	1.32
		6 kg/fed.	24.30	12.00	1.80	43.70	14.40	18.30	1.68
	Mean		20.88	11.25	1.69	35.45	12.73	14.70	1.23
	5500 ppm	cont.	14.30	8.50	1.28	17.90	9.03	8.00	0.60
		2 kg/fed.	15.40	8.60	1.29	19.90	11.53	10.80	0.65
		4 kg/fed.	17.00	9.30	1.43	23.80	12.20	13.00	0.76
		6 kg/fed.	20.50	10.00	1.50	30.56	13.43	15.20	1.10
	Mean		16.80	9.10	1.37	23.04	11.55	11.75	0.78
	Mean		20.73	10.93	1.64	34.83	12.64	14.64	1.23
Cream 7	3500 ppm	cont.	15.00	5.70	0.69	11.35	11.43	12.07	0.50
		2 kg/fed.	17.00	6.10	0.74	13.57	12.53	14.00	0.58
		4 kg/fed.	17.70	6.90	0.85	16.02	13.00	14.80	0.88
		6 kg/fed.	19.00	7.50	0.93	17.95	13.90	15.20	1.26
	Mean		17.18	6.55	0.80	14.72	12.72	14.02	0.81
	4500 ppm	cont.	12.00	5.10	0.62	7.90	10.80	10.00	0.37
		2 kg/fed.	12.50	5.33	0.70	8.75	11.53	11.00	0.42
		4 kg/fed.	13.80	5.90	0.72	10.63	12.00	12.00	0.58
		6 kg/fed.	15.00	6.20	0.80	12.18	12.80	13.20	0.78
	Mean		13.33	5.63	0.71	9.87	11.78	11.55	0.54
	5500 ppm	cont.	8.80	4.50	0.59	6.02	9.90	8.00	0.27
		2 kg/fed.	9.50	5.07	0.63	7.41	10.70	9.60	0.34
		4 kg/fed.	10.93	5.87	0.69	8.86	11.70	11.00	0.43
		6 kg/fed.	13.27	5.67	0.74	10.66	12.00	11.80	0.62
	Mean		10.63	5.28	0.66	8.24	11.08	10.10	0.42
	Mean		13.71	5.82	0.73	10.94	11.86	11.89	0.59
		V	1.11	1.24	0.05	8.34	N.S.	2.20	0.15
		S	0.63	0.61	0.08	2.72	1.11	0.50	0.07
		V X S	N.S.	0.87	0.12	3.85	N.S.	0.71	0.09
L.S.D. at 5 %		H	10.48	6.81	2.42	9.02	9.85	9.76	2.10
		V X H	0.99	N.S.	N.S.	1.40	N.S.	0.93	0.10
		S X H	N.S.	N.S.	N.S.	1.72	N.S.	N.S.	0.13
		VXSXH	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

The data in Tables (3 and 4) indicated that number of pod/ plant, seed plant weight (g), total yield ton/ fed. and pod length (cm). were, significantly increased by application of humic acid (6 kg / fed) with Kafr El-Shekh cultivar. These findings in both growing seasons .

The highest total pods yield per feddan and pod length were resulted from that cowpea plant irrigated by low water salinity (3500ppm) with application of high level of humic acid (6 kg / fed.) in both growing seasons, while wt. of seeds/ plant gave the same trend statistically in the first season only as shown in Tables (3 and 4).

The interaction among cultivars, water salinity and humic acid showed no statistical differences in total yield of cowpea plant except number of pods/plant in the first season only, which was obtained from Kafr El-Shekh cultivar with irrigation from low level of salinity (3500 ppm) and application of high rate of humic acid (6 kg / fed.).

C-Minerals Content of Cowpea Leaves:

1- Effect of Cultivars:

The effect of cultivars on N, P , K , Na, Ca and C1 content and K/ Na and Ca / Na ratio of cowpea plants are shown in Tables (5, 6) that Kafr El-Shekh cultivar had the superiority in plant content of N, P and K and ratio of K / Na and Ca / Na in tissues of it leaves. Meanwhile, Cream 7 cultivar produced the highest Na, Ca and Cl content in both seasons. The differences were significantly in Ca content and K/ Na and Ca/ Na ratio in both growing seasons, while the difference in Cl content was significant in the first season only, but the content of P, K and Na differences ware significant in the second season only. These differences

Table 5: Effect of cultivars, saline irrigation water and humic acid application on N, P, K, Ca, Na, Cl, K: Na and Ca: Na determination in leaves of cow pea during 2008 summer season.

Treatments			N	P	K	Ca	Na	Cl	K: Na	Ca: Na
culliars	salinity levels	Humic Appli								
Kafr-El-Shekh	3500 ppm	cont.	2.63	0.45	2.20	0.61	0.63	0.97	3.59	3.84
		2 kg/fed.	2.79	0.54	2.30	0.58	0.59	0.91	4.07	4.31
		4 kg/fed.	2.83	0.60	2.42	0.53	0.57	0.88	4.43	4.43
		6 kg/fed.	3.08	0.74	2.55	0.44	0.48	0.76	5.65	6.14
	Mean		2.83	0.58	2.37	0.54	0.57	0.88	4.44	4.68
	4500 ppm	cont.	2.34	0.42	1.99	0.66	0.69	1.06	2.95	3.40
		2 kg/fed.	2.37	0.46	2.01	0.63	0.65	1.00	3.22	3.74
		4 kg/fed.	2.43	0.49	2.16	0.57	0.59	0.91	3.75	4.13
		6 kg/fed.	2.49	0.59	2.30	0.54	0.56	0.86	4.19	4.41
	Mean		2.41	0.49	2.12	0.60	0.62	0.96	3.53	3.92
	5500 ppm	cont.	2.13	0.40	1.35	0.70	0.95	1.45	1.47	2.46
		2 kg/fed.	2.22	0.42	1.39	0.67	0.83	1.28	1.69	2.74
		4 kg/fed.	2.31	0.45	1.53	0.65	0.75	1.16	2.09	3.22
		6 kg/fed.	2.39	0.50	1.80	0.60	0.61	1.08	2.97	3.84
	Mean		2.26	0.44	1.52	0.66	0.78	1.24	2.06	3.06
	Mean		2.50	0.51	2.00	0.60 '	0.66	1.03"	3.34	3.89
Cream 7	3500 ppm	cont.	2.07	0.42	1.62	0.70	0.82	1.26	1.99	2.89
		2 kg/fed.	2.30	0.49	1.77	0.67	0.80	1.23	2.26	3.41
		4 kg/fed.	2.74	0.52	1.74	0.63	0.73	1.12	2.45	4.05
		6 kg/fed.	2.99	0.59	2.00	0.52	0.67	1.03	3.05	4.61
	Mean		2.53	0.50	1.78	0.63	0.76	1.16	2.44	3.74
	4500 ppm	cont.	1.54	0.40	1.43	0.74	0.89	1.37	1.63	2.62
		2 kg/fed.	1.79	0.45	1.41	0.68	0.81	1.25	1.76	3.22
		4 kg/fed.	2.09	0.49	1.49	0.65	0.76	1.17	1.99	3.55
		6 kg/fed.	2.65	0.55	1.68	0.59	0.70	1.08	2.44	3.38
	Mean		2.02	0.47	1.50	0.67	0.79	1.22	1.96	3.19
	5500 ppm	cont.	1.32	0.37	1.21	0.77	0.95	1.46	1.28	2.35
		2 kg/fed.	1.39	0.40	1.14	0.70	0.85	1.31	1.36	3.03
		4 kg/fed.	1.68	0.45	1.15	0.67	0.80	1.23	1.45	3.22
		6 kg/fed.	2.02	0.50	1.30	0.62	0.74	1.14	1.79	2.62
	Mean		1.60	0.43	1.20	0.69	0.84	1.29	1.47	2.81
	Mean		2.05	0.47	1.49	0.66	0.79	1.22	1.95	3.25
L.S.D. at 5 %		V	0	0.00	N.S.	0.10	N.S.	0.04	0.13	0.52
		S	0.01	0.01	0.04	0.10	N.S.	0.02	0.10	0.45
		V X S	0.01	0.01	N.S.	N.S.	N.S.	0.03	N.S.	0.63
		H	4.08	4.08	1.97	2.55	N.S.	2.34	3.17	4.01
		V X H	0.07	0.07	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
		S X H	0.09	0.09	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
		VXSXH	0.12	0.12	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

among cultivars might be due to the genetical differences which led to the differences in tissues of cowpea leaves (Hafiz and Damarany, 2006).

2- Effect of Irrigation Water Salinity:

The results of N, P , K , Na, Ca and Cl, content and K / Na and Ca / Na ratio of cowpea plants as affected by irrigation water salinity are presented in Tables (5, 6). The results show that decrease in minerals content (NPK) with the increase in salinity concentration up to (5500 ppm). On the other hand, Na, Ca and Cl content of cowpea leaves were statistically increased by increasing salinity up to (5500 ppm). These results were true during the tow experimental seasons, except, Na and N content differences were no significant only in the first and second seasons respectively. Many investigators obtained similar results (Caliandro *et al*, 2000, Abdou *et al*, 2006 and Zaki, *et al* 2009).

3- Effect of Humic Acid Application:

Data in Tables (5, 6) revealed that cowpea plants produced significantly more N, P , K , K / Na and Ca / Na content in leaves tissue, with application the highest level of humic acid (6 kg / fed.).

But, this level significantly decreased Na, Ca and Cl content of cowpea leaves when compared with other levels of humic acid. These results were true in both two seasons, except Na and N content differences have no significant effect in the first and second seasons respectively. Increments of N, P, K uptake with the high levels of humic acid (6 kg / fed.) may be attributed to the improvement of plant growth. Moreover, such

Table 6: Effect of cultivars, saline irrigation water and humic acid application on N, P, K, Ca, Na, Cl, K: Na and Ca: Na determination in leaves of cow pea during 2009 summer season.

Treatments			N	P	K	Ca	Na	Cl	K: Na	Ca: Na
culliars	salinity levels	Humic Appli								
Kafr-El-Shekh	3500 ppm	cont.	2.40	0.41	2.00	0.55	0.60	0.92	3.43	3.77
		2 kg/fed.	2.52	0.50	2.16	0.53	0.54	0.83	4.06	4.47
		4 kg/fed.	2.59	0.54	2.30	0.49	0.53	0.82	4.42	4.54
		6 kg/fed.	2.86	0.68	2.38	0.40	0.48	0.74	5.20	5.74
	Mean		2.59	0.53	2.21	0.49	0.54	0.83	4.28	4.63
	4500 ppm	cont.	8.91	0.39	1.80	0.60	0.65	1.00	2.77	3.36
		2 kg/fed.	2.15	0.43	1.89	0.56	0.60	0.92	3.17	3.85
		4 kg/fed.	2.22	0.44	2.07	0.51	0.55	0.85	3.76	4.31
		6 kg/fed.	2.27	0.53	2.13	0.49	0.51	0.79	4.30	4.67
	Mean		3.89	0.45	1.97	0.54	0.58	0.89	'3.50	4.05
	5500 ppm	cont.	2.00	0.36	1.22	0.63	0.89	1.37	1.36	2.26
		2 kg/fed.	2.06	0.39	1.26	0.60	0.80	1.23	1.56	2.58
		4 kg/fed.	2.12	0.42	1.40	0.59	0.74	1.14	1.96	2.96
		6 kg/fed.	2.18	0.47	1.68	0.54	0.70	1.08	2.46	3.09
	Mean		2.09	0.41	1.39	0.59	0.78	1.21	1.84	2.72
	Mean		2.86	0.46	1.86	0.54	0.63	0.97	3.21	3.80
Cream 7	3500 ppm	cont.	1.86	0.39	1.52	0.63	0.76	1.17	2.05	2.87
		2 kg/fed.	2.16	0.45	1.60	0.60	0.71	1.09	2.24	3.55
		4 kg/fed.	2.47	0.49	1.71	0.57	0.66	1.02	2.66	4.10
		6 kg/fed.	2.70	0.57	1.89	0.47	0.62	0.96	3.14	4.86
	Mean		2.30	0.48	1.68	0.57	0.69	1.06	2.52	3.84
	4500 ppm	cont.	1.40	0.35	1.13	0.67	0.81	1.25	1.43	2.48
		2 kg/fed.	1.64	0.41	1.35	0.61	0.73	0.12	1.83	3.16
		4 kg/fed.	1.92	0.45	1.44	0.58	0.70	0.08	2.03	3.53
		6 kg/fed.	2.42	0.51	1.53	0.53	0.66	0.02	2.37	3.79
	Mean		1.85	0.43	1.36	0.60	0.72	1.12	1.91	3.24
	5500 ppm	cont.	1.22	0.29	0.99	0.69	0.90	0.39	1.10	2.10
		2 kg/fed.	1.28	0.38	1.06	0.63	0.84	0.29	1.28	2.68
		4 kg/fed.	1.53	0.41	1.08	0.60	0.79	0.22	1.39	2.99
		6 kg/fed.	1.91	0.49	1.17	0.56	0.76	1.20	1.54	3.11
	Mean		1.49	0.39	1.08	0.62	0.82	1.28	1.33	2.72
	Mean		1.88	0.43	1.37	0.60	0.74	1.15	1.92	3.27
L.S.D. at 5 %		V	N.S.	0.02	0.11	0.05	0.01	N.S.	0.26	0.53
		S	N.S.	0.03	0.15	0.02	0.07	0.09	0.38	0.23
		V X S	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	0.54	0.32
		H	N.S.	1.88	3.35	2.22	2.44	3.03	3.97	5.17
		V X H	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
		S X H	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
		VXSXH	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

improvement reflect on the abundance of minerals in the soil solution which enhanced their uptake by plant roots. These results confirmed with those reported by (Erik *et al*. 2000; El- Desuki, 2004 and Abd El-Al, Faten *et al*., 2005).

4- Effect the Interactions:

The interaction between cultivars and water salinity as shown in Tables (5, 6) indicated that Kafr El-Shekh cultivar which was irrigated with low level of salinity (3500 pnm) significantly increased N and P content when compared with Cream 7 cultivar and high salinity level (5500 ppm) in the first season only. While K/Na gave the same trend significantly in the second season only, also, Ca/ Na ratio gave the same trend significantly in both growing seasons.

Data in Tables (5, 6) revealed that the interaction between cultivars and humic acid, did not show significant effect on K , Na, Ca, Cl content and K / Na and Ca/ Na ratio of cowpea plants, except N and P content were significantly increased by the interaction treatment between Kafr El-Shekh cultivar and the highest level of humic acid (6 kg / fed.) in the first season only.

The interaction between water salinity and humic acid Tables (5, 6) gave the same trend of interaction between cultivars and humic acid.

The data in Tables (5, 6) indicated that the percentage of nitrogen and phosphorus content in cowpea leaves tissue was statistically influenced by the combined effect of Kafr El-Shekh cultivar with the lowest salinity level (3500 ppm) and application humic acid (6 kg / fed.) these results was significantly in the first season only.

Table 7: Effect of cultivars, saline irrigation water and humic acid application on N, P, K, Ca, Cl, protein, carbohydrates and praline in seeds of two cultivars of cow pea during 2008 summer season.

Treatments			N%	P%	K%	Ca	Cl	Protein	Carbo	Proline
culliars	salinity levels	Humic Appli								
Kafr-El-Shekh	3500 ppm	cont.	3.10	0.46	2.21	2.40	0.90	19.38	45.70	0.19
		2 kg/fed.	3.16	0.60	2.28	2.46	0.83	19.75	47.60	0.18
		4 kg/fed.	3.28	0.66	2.56	2.46	0.80	20.50	49.00	0.16
		6 kg/fed.	3.53	0.71	2.64	2.80	0.68	22.06	55.00	0.14
	Mean		3.27	0.61	2.42	2.53	0.80	20.42	49.33	0.17
	4500 ppm	cont.	2.64	0.40	2.00	2.30	1.00	16.38	48.80	0.23
		2 kg/fed.	2.87	0.50	2.12	2.33	0.97	18.13	49.60	0.19
		4 kg/fed.	3.01	0.53	2.20	2.38	0.88	18.97	50.60	0.19
		6 kg/fed.	3.33	0.61	2.35	2.38	0.83	20.81	56.00	0.17
	Mean		2.96	0.51	2.17	2.35	0.92	18.57	51.25	0.20
	5500 ppm	cont.	2.17	0.38	1.53	2.23	1.08	13.75	55.30	0.26
		2 kg/fed.	2.37	0.44	1.74	2.26	1.03	15.06	56.80	0.21
		4 kg/fed.	2.83	0.50	1.97	2.36	1.00	17.50	59.40	0.19
		6 kg/fed.	3.07	0.56	2.09	2.32	0.92	19.44	61.00	0.18
	Mean		2.61	0.47	1.83	2.29	1.01	16.44	58.13	0.21
	Mean		2.95	0.53	2.14	2.39	0.91	18.48	52.90	0.19
Cream 7	3500 ppm	cont.	3.19	0.46	1.80	2.36	1.05	17.88	29.10	0.17
		2 kg/fed.	2.94	0.50	1.93	2.70	1.01	18.38	33.00	0.16
		4 kg/fed.	3.20	0.62	2.01	2.92	0.95	20.00	42.30	0.15
		6 kg/fed.	3.43	0.67	2.19	3.04	0.78	21.44	44.00	0.15
	Mean		3.19	0.56	1.98	2.76	0.95	19.43	37.10	0.16
	4500 ppm	cont.	2.60	0.40	1.38	2.30	1.11	16.25	34.20	0.19
		2 kg/fed.	2.80	0.44	1.50	2.59	1.03	17.50	38.60	0.18
		4 kg/fed.	3.00	0.52	1.65	2.65	0.98	18.75	44.30	0.17
		6 kg/fed.	3.10	0.57	1.76	2.33	0.80	19.81	45.00	0.15
	Mean		2.88	0.48	1.57	2.47	0.98	18.08	40.53	0.17
	5500 ppm	cont.	2.18	0.37	1.09	2.23	1.16	13.63	40.90	0.21
		2 kg/fed.	2.31	0.41	1.20	2.54	1.08	14.44	43.00	0.19
		4 kg/fed.	2.70	0.46	1.31	2.56	1.03	17.08	45.40	0.17
		6 kg/fed.	2.77	0.50	1.45	1.92	0.96	18.81	49.60	0.13
	Mean		2.49	0.44	1.26	2.31	1.06	15.99	44.73	0.18
	Mean		2.85	0.49	1.61	2.51	1.00	17.83	40.78	0.17
L.S.D. at 5 %		V	N.S.	N.S.	0.02	N.S.	0.03	0.45	11.35	0.01
		S	0.12	0.02	0.05	0.17	0.03	0.36	3.98	0.01
		V X S	N.S.	N.S.	0.07	N.S.	0.04	N.S.	N.S.	0.01
		H	4.87	1.99	3.60	4.51	2.84	12.21	18.28	1.20
		V X H	N.S.	N.S.	N.S.	0.16	N.S.	N.S.	N.S.	N.S.
		S X H	0.19	N.S.	N.S.	0.20	N.S.	0.82	N.S.	N.S.
		VXSXH	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

D- Chemical Content of Cowpea Seeds Characters:

1-Effect of Cultivars:

Data in Tables (7, 8) show that the highest values of chemical content of cowpea seeds tissue expressed as (K, protein, carbohydrate and proline) content were recorded by Kafr El-Shekh cultivar significantly. On the contrary, Cream 7 cultivar significantly increased Cl content of cowpea seeds tissue. These findings were true in both seasons. While, P content increased significantly in the first season only in Kafr El- Shekh cultivar than the other cultivar.

2- Effect of Irrigation Water Salinity:

Results in Tables (7, 8) indicated that chemical characters of cowpea seeds were significantly decreased by increasing irrigation water salinity. In addition, seeds caracters, i.e.(N, P, K, protein, carbohydrate, and Ca) gave the highest values by lower water salinity level (3500 ppm). On the other hand, Cl and proline contents were statistically increased by increasing salinity concentration up to its highest level (5500 ppm) . These results were similar and true in the two seasons. It could be concluded that with increasing salinity, proline content increased in cowpea seeds in order to resist the injurious effect of salinity. Similar findings were obtained by (Caliandro *et al*, 2000; Ashraf and Akhtar, 2004; Abdou *et al*, 2006 and Zaki, *et al* 2009).

3- Effect of Humic Acid Application:

Data in Tables (7, 8) clearly show that N, P. K, protein, carbohydrate, and Ca content were significantly increased by increment the level of humic acid application as shown in both seasons. On the contrary, Cl and

Table 8: Effect of cultivars, saline irrigation water and humic acid application on N, P, K, Ca,Cl, protein, carbohydrates and praline in seeds of two cultivars of cow pea during 2009 summer season.

Treatments			N%	P%	K%	Ca	Cl	Protein	Carbo	Proline
culliars	salinity levels	Humic Appli								
Kafr-El-Shekh	3500 ppm	cont.	2.79	0.42	1.90	2.25	0.81	17.44	42.10	0.17
		2 kg/fed.	2.85	0.53	2.00	2.32	0.76	17.81	43.80	0.16
		4 kg/fed.	2.95	0.59	2.26	2.36	0.72	18.44	46.00	0.14
		6 kg/fed.	3.19	0.66	2.35	2.61	0.61	19.94	50.40	0.13
	Mean		2.95	0.55	2.13	2.39	0.73	18.41	45.58	0.15
	4500 ppm	cont.	2.33	0.37	1.80	2.16	0.90	14.75	44.90	0.21
		2 kg/fed.	2.61	0.45	1.89	2.24	0.87	16.31	45.50	0.17
		4 kg/fed.	2.73	0.47	1.96	2.32	0.79	17.06	46.80	0.17
		6 kg/fed.	3.00	0.54	2.07	2.31	0.74	18.75	51.50	0.15
	Mean		2.67	0.46	1.93	2.26	0.83	16.72	47.18	0.17
	5500 ppm	cont.	1.98	0.34	1.36	1.98	0.97	12.38	50.30	0.23
		2 kg/fed.	2.16	0.41	1.50	2.04	0.93	13.50	52.90	0.19
		4 kg/fed.	2.50	0.47	1.76	2.15	0.90	15.63	54.80	0.17
		6 kg/fed.	2.80	0.51	1.85	2.13	0.84	17.50	57.20	0.16
	Mean		2.36	0.43	1.62	2.08	0.91	14.75	53.80	0.19
	Mean		2.66	0.48	1.89	2.24	0.82	16.63	48.85	0.17
Cream 7	3500 ppm	cont.	2.57	0.43	1.62	2.15	0.95	16.26	27.20	0.14
		2 kg/fed.	2.61	0.47	1.71	2.52	0.91	16.31	30.60	0.14
		4 kg/fed.	2.88	0.55	1.80	2.63	0.86	18.00	39.60	0.14
		6 kg/fed.	L3.09	0.60	1.96	3.00	0.70	19.31	41.30	0.13
	Mean		2.79	0.51	1.77	2.58	0.86	17.47	34.68	0.14
	4500 ppm	cont.	2.30	0.38	1.23	2.00	1.00	14.28	31.50	0.17
		2 kg/fed.	2.52	0.42	1.35	2.30	0.93	15.75	35.60	0.16
		4 kg/fed.	2.69	0.49	1.48	2.48	0.88	16.81	40.90	0.15
		6 kg/fed.	2.84	0.52	1.59	2.46	0.80	17.75	42.00	0.14
	Mean		2.59	0.45	1.41	2.31	0.90	16.15	37.50	0.16
	5500 ppm	cont.	1.90	0.34	0.98	1.90	1.05	11.88	37.70	0.19
		2 kg/fed.	2.07	0.39	1.08	2.22	0.97	12.94	40.00	0.17
		4 kg/fed.	2.43	0.42	1.17	2.36	0.93	15.19	41.90	0.16
		6 kg/fed.	2.70	0.47	1.30	2.30	0.86	16.88	45.90	0.13
	Mean		2.28	0.41	1.13	2.20	0.95	14.22	41.38	0.16
	Mean		2.55	0.46	1.44	2.36	0.90	15.95	37.85	0.15
L.S.D. at 5 %		V	N.S.	0.02	0.01	N.S.	0.03	0.43	5.71	0.02
		S	0.09	0.03	0.03	0.09	0.05	0.09	3.30	0.01
		V X S	N.S.	N.S.	0.04	N.S.	N.S.	0.13	N.S.	N.S.
		H	4.62	1.93	3.41	4.36	2.73	11.54	17.58	1.13
		V X H	N.S.	N.S.	0.04	N.S.	N.S.	N.S.	N.S.	0.01
		S X H	0.11	N.S.	N.S.	N.S.	N.S.	0.37	N.S.	0.01
		VXSXH	N.S.	N.S.	0.08	N.S.	N.S.	N.S.	N.S.	N.S.

proline content were statistically reduced by increasing the level a-of humic acid. This result may be due to the role of humic acid in increasing the soil content of organic matter which remove the negative effect of salts, also proline increase with increasing salinity as reaction to resist salinity. (David *et al*., 1994; Erik *et al*., 2000 and El- Desuki, 2004).

4- Effect the Interactions:

The interaction between two cultivars and 3 levels of salinity had a slow great effect on some chemical nutritional composition of cowpea seeds tissues Tables (7, 8). Whereas, Kafr El-Shekh cultivar which was irrigated with low level of salinity (3500 ppm) resulted the highest content of K in two growing seasons and protein content in 1st seasons only. On the other hand, Cream 7 cultivar which was irrigated with low level of salinity resulted the lowest proline and Cl content significantly in 1st season only.

The resulted data of Tables (7, 8) show that cowpea Cream 7 cultivar and supplying with humic acid up to 6 kg / fed. gave the highest Ca content of seed in the first seasons only. However, Kafr El-Shekh cultivar applied with humic acid at 6 kg / fed. gave the highest K content in the second seasons only. Concerning, the highest proline content in cowpea seeds was found with Kafr El-Shekh cultivar without addition of humic acid in 2nd season only.

Data in Tables (7, 8) show that seeds content i.e.(P, K, carbohydrate, Cl, and Ca) have no significant effect by the interaction treatment in both seasons, except N and protein content were significantly increased with increasing rates of humic acid and decrease water salinity in both seasons, but Ca content in 1st season only. On the contrary, the highest proline content in cowpea seeds was found when plants irrigated by high level of salinity (5500 ppm) without the addition of humic acid.

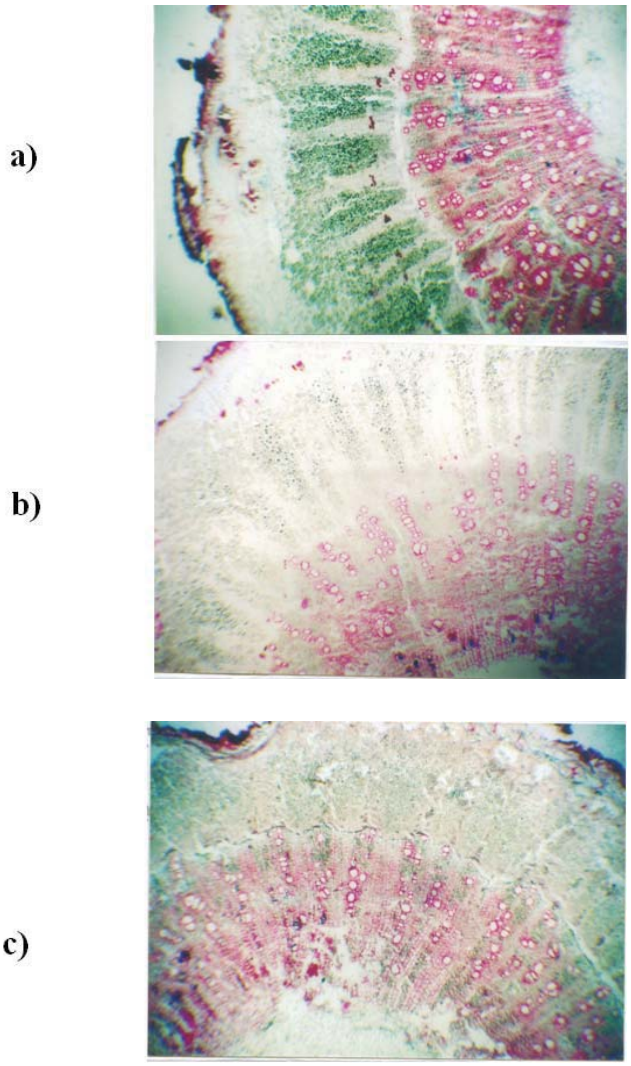

Photo 1: Cross sections in the root of Kafr- El- Shekh cultivar as affected by various saline irrigation water.
a) Control where (E.C of irrigation water was 3500 ppm)
b) S_1 where (E.C of irrigation water was 4500 ppm)
c) S_2 where (E.C of irrigation water was 5500 ppm)

The interaction between cultivars, water salinity and humic acid showed no statistical differences in chemical content of cowpea seeds, except K content in the 1st season as shown in Tables (7, 8). Generally, Kafr El-Shekh cultivar which was irrigated with low level of salinity (3500ppm) and treated with humic acid at rate of 6 kg /fed. resulted the highest K content in the 2nd season only.

Table 9: Root anatomy of two cowpea cultivars as affected by different levels of saline irrigation water.

Cultivars	Irrigation salinity levels	Cortex thikness (mu)	Phloem thikness (mu)	xylem thikness (mu)
Kafr B El Shekh	E.C. 3500 ppm	90	228	300
	E.C. 4500 ppm	60	210	298
	E.C. 5500 ppm	40	180	292
Cream 7	E.C. 3500 ppm	72	300	300
	E.C. 4500 ppm	62	240	288
	E.C. 5500 ppm	60	120	210

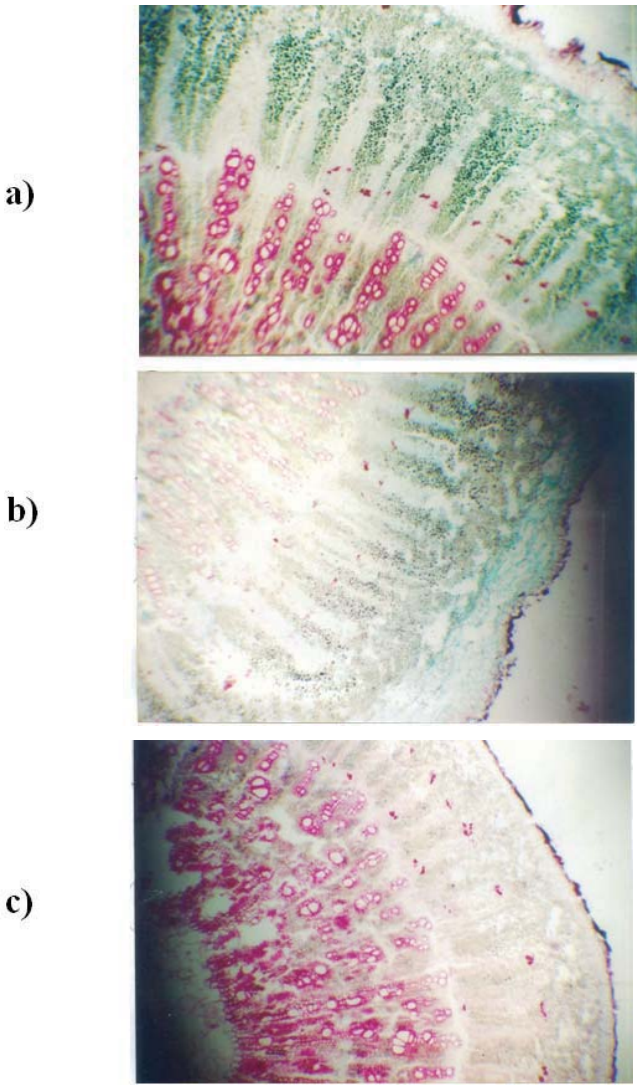

Photo 2: Cross sections in the root of Cream 7 cultivar as affected by various saline irrigation water.
a) Control where (E.C of irrigation water was 3500 ppm)
b) S_1 where (E.C of irrigation water was 4500 ppm)
c) S_2 where (E.C of irrigation water was 5500 ppm)

Results illustrated in Table (13) and Plate (1, 2) show effect of different levels of saline irrigation water on the anatomical structure of roots of Kafr- El- Shekh and Cream 7 cowpea cultivars, respectively.

The high salinity level (5500 ppm) decreased both cortex, xylem and phloem tissues and consequently reduced the thikness of vascular bundles when compared with those of low salinity level (3500 ppm).

Results declare a general reduction in thinkness of vascular tissue with the increase in salinity of the irrigation water. The highest salinity (5500 ppm) caused a pronounced decrement in both xylem and phloem in two cultivars under study.

Data reveal that Cream 7 plants showed the higher loss in xylem and phloem tissues, due to irrigation with saline water. Whereas, Kafr- El- Shekh showed the least loss in vascular elements (phloem and xylem) where they were irrigated with same saline water. It is well known that xylem is responsible for raising the absorped nutrients in the root and stem while phloem is responsible for the delivery of mature sap to the developing sites of plant organs. Hence, the decrement in the thikness of vascular elements (phloem and xylem) reduce the upward conduction and consequently root absorption to the lowest level.

Such results greatly serve to decleare the difference in behaviour within cowpea cvs, i.e. the most and the least tolerant cultivar to salinity stress.

The obtained results are in harmony with those found by mitisya et al. 2000 on sweet potato and Khafagy *et al*. 2009 on sweet pepper.

Generally irrigation with saline water (5500 ppm) decreased the total mean area of the vascular elements of cowpea root, the most pronounced effect of salinity on vascular elements was observed for roots of Cream 7 while Kafr- El- Shekh cultivar was not greatly affected. The above results confirm that Kafr- El- Shekh cv. was best (with least decrement effect) than Cream 7.

REFERENCES

Abd E1-A1, Faten, S., M.R. Shafeek, A.A. Ahmed and A.M. Shaheen, 2005. Response of growth and yield of onion plants to potassium fertilizer and humic acid. J. Agric. Sci. Mansoura Univ., 30(1): 441-452.

Abd El- Aal, N.L., 1994. Influence of soil organic matter on the behaviour of some trace elements in soil. Ph.D. Thesis Fac. Of Agric., Cairo Univ., Egypt.

Abd El-Razaek, M.K.M., 1997. Effect of salinity on garden beet and carrot. M. Sc. Theses, Faculty of Agric. Cairo Univ., Egypt.

Abdou, A.A., A.S.A.A. Hamd and M.E. Ahmad, 2006. Effect of irrigation with saline water on growth and yield of sweet fennel. Annals of Agric. Sci. Moshtohor, 44(1): 265-277.

Abel, G.H. and A.J. Mackenzie, 1964. Salt tolerance of soybean varieties (Glycine max L.) during germination and later growth. Crop Sci., 4: 157-161.

Abou El-Magd, M.M., M.F. Zaki and S.D. Adou Hussein, 2008. Effect of organic manure and different levels of saline irrigation water on growth, green yield and chemical content of sweet fennel. Australian J. of Basic and Applied Sci., 2(1): 90-98.

Ahmad, M. E., 1999. Studies on the development and production of sweet fennel. M. Sc. Thesis, Fac. of Agric., Al-Azhar Univ., Egypt.

Almogaera, C., M.A. Coca and I. Jouanin, 1995. Differential accumulation of sunflower le Tran liquation RNA, during zygotic embryogenesis and developmental regulation of their heat shock response. Plant Physiol., 107(3): 765-773.

Amin, I.S., 1997. Effect of bio and chemical fertilization on growth and production of Coriandrum sativum, Foeniculum vulgare and Carum carvi L. plants. Annals of Agric., Sci., Moshtohor, 35(4): 2327-2334.

A.O.A.C., 1995. Official methods of analysis Association of Officinal Analytical Chemists. 16th Ed. Washington, D.C, U.S.A.

Ashraf, M. and N. Akhtar, 2004. Influnce of salt strees on growth, ion accumulation and seed oil content in sweet fennel. Biologia -Plantarum, 48(3): 461-464.

Bates, L.S., R.P. Waldren and I.D. Teare, 1973. Rapid detemrinaiton of free praline for water stresses studies. Plant and soil, 39: 205-207.

Bernstein, L., 1975. Effect of salinity and sodicity on plant growth. Ann. Rev. Phytopathology, 13: 295-311.

Bower, M.A., 1976. The effect of soluble salts on soil water availability. North Dakata. Agric., Ex. Sta. Rep. No. 874, Form. Res., 33: 9-14.

Brenant, T.F., A. Fowzio and M.R. Kessler, 2007. Modulation of spemadine and spermine levels in maize seedlings subjected to long term salt stress. Plant Physiol. Biochem., 43(11): 812-821.

Caliandro, A., V. Cantore, S. Musacchi, 2000. Application of brackish water for orchard fruit growing in Italy. Rivista di Frutticolture di Ortofloricoltura, 62(7/8): 26-36.

Chapman, H.D. and D.F. Pratt, 1961. Methods of Analysis for soils, Plant and Waters. Univ. of California, Division of Agric. sciences.

Chen and Aviod, 1990. Effect of humic acid substances on plant growth.Amer. Soc. Of Agron. And Soil Sci. Madison, WL.

David, P.P., P.V. Nelson and D.C. Sanders, 1994. A humic acid improves growth of tomato seedling in solution culture. J. Plant Nutr., 17(1): 173-184.

Debuba, M., H. Gonia, A. Suzuki and M.H. Gorbel, 2006. Na Cl stress effects on enzymes involved in nitrogen assimilation pathway in tomato seedlings. J. Plant Physiol., 163(12): 1247-1258.

El-Desuki, M., 2004. Response of onion plants to humic acid and mineral fertilizers application. Annals of Agric. Sci., Moshtohor, 42(4): 1955-1964.

Erik, B.G. Feibert, Clint G. Shock and Lament D.Saundres, 2000. Evaluation of humic acid and other nonconventional fertilizer additiones for onion production. Malheur Experiment Station Oregon State University. Ontario, OR,

Frie, E., K. Peyers and E. Schultz, 1964. Determinaiton phosphorus by ascorbic acid. Schw Land Schaft Forshung Heft, 3: 318-328.

Gomez, K.A. and A.A. Gomez, 1984. Statistical procedures for Agricultural Research (Second Ed. John Wiley and Sons. New York, pp: 680.

Hafez, M. Magda, 2003. Effect of some sources of nitrogen fertilizer and concentration of humic acid on the productivity of squash plant. Egypt J.Appl. Sci., 19(10): 293-309.

Hafiz, N.A. and A.M. Damarany, 2006. Variation in the susceptibility of some cowpea (*vigna unguiclata* L.) genotypes to infestation with certain pests in upper Egypt. Ass. Univ. Bul.. Environ. Res., 9(1).

Hussein, M.M., A.A. Abdel-Kadierf, M.S. Abou El-Khair and O.M. Kassab, 2007b. Effect of diluted seawater and benzul adenine on macro and micronutrient content of barley shoots. Egypt. J. Agron., 28(2): 97-107.

Jackson, M.L., 1958. Chemical Constable & Co. Ltd. D. London, pp: 49.

Johansen, D.A., 1940. Plant microtechnquie Mc. Gow Hill Book Company. London, pp: 523.

Khafagy, M.A, A.A. Arafa and El- M.F. Banna, 2009. Glycnebetaine and ascorbic acid can alleviate the harmful effects of NaCl salinity in sweet pepper. Australian Journal of Crop Science, 3(5): 257-267.

Pascale, S.D. and G. Barbieri, 1995. Effect of soil salinity from long term irrigation with saline sodic water on yield and quality of winter vegetable crops. Sci. Hort., 64: 145-157.

Peach, K. and M.R. Tracey, 1959. Modern Methods of Plant Analysis. 1, Springer, Verlage, 4: 64.

Sauram, R.K. and A. Tyagi, 2004. Physiology and molecular biology of salinity stress tolerance in plants. Curr. Sci., 86(3): 407-421.

Singh, B.B., P. Hartmannr, C. Fatokun, M. Tamo S. Tarawali and R. Ortiz, 2003. Recent progress, on cowpea improvement. Chronica Hontic, 43(2): 8-12.

Singh, G.P., A. Yadava and J.L. Mangal, 1986. Effect of different levels of soil salinity on germination, growth, yield and quality of coriander and fennel. South Indian Hort,

Thapon, R., A.K. Shriristava, P. Bahrgava, Y. Mishra and L.C. Rai, 2008. Improving different abiotic stresses on growth, photosynthetic electron transport chain, nutrient uptake and enzymes activity of Cu acclimated Anabaena doliokim. Plant physiol., 165(3): 306-316.

Zaki, M.F., S.D. Abou-Hussein, M.M. Abou El-Magd and H.M.H. El-Abagy, 2009. Evaluation of some sweet fennel cultivars under saline irrigation water. European Jour. Sci. Res., 30(1): 67-78.