

## IMPACT OF SOME TREATMENTS ON GROWTH AND YIELDING OF PEA PLANTS GROWN UNDER SALINE RECLAIMED SOIL CONDITIONS

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### ABSTRACT

The possibility of improving growth and yielding of pea plants grown under reclaimed soil conditions which having salinity level of about 5000 ppm was investigated in a private Farm, Fayoum, Egypt, during the two successive seasons of 2007/2008 and 2008/2009. For achievement this aim, the calcium paste treated-seeds of pea were sown in beds fecundated with ground sunflower heads. The producing pea plants were sprayed with ascorbic acid at the rates of 0, 100, 200, 300 and 400 mgL<sup>-1</sup>. Significant positive influences of calcium paste plus ground sunflower heads applied alone or in combination with all ascorbic acid treatments used under this study were observed on growth, yield of green pods and seeds as well as the tested chemical constituents. In comparison with untreated seeds sown in non-fecundated beds, the plants producing from the calcium paste treated-seeds sown in beds fecundated with ground sunflower heads represented significant increases in growth traits (i.e. plant height, No. of branches plant<sup>-1</sup> and shoot dry weight plant<sup>-1</sup>) and green pods yield and its components (i.e. No. of green pods plant<sup>-1</sup>, pod weight and green pods yield feddan<sup>-1</sup>) as well as green seeds yield and its components (i.e. No. of green seeds pod<sup>-1</sup>, 100-seed weight and green seeds yield feddan<sup>-1</sup>). In addition, the concentrations of some chemical constituents (i.e. total chlorophyll, total carotenoids, ascorbic acid, free proline, total soluble sugars, total phenols, N, P, K, Ca, Ca/Na ratio, Fe, Mn and Zn in shoots of plants besides, starch% and protein% were increased with the shortage in total soluble sugars% in green seeds). As for ascorbic acid foliar application, plants sprayed at all studied rates (i.e. 100, 200, 300 and 400 mgL<sup>-1</sup>) revealed significant increases in all investigated parameters (i.e. growth traits, green pods and seeds yields and their components as well as chemical constituents of plant shoots and green seeds) as compared with untreated plants. Ascorbic acid treatment at the rate of 300 mgL<sup>-1</sup> combined with calcium paste treated-seeds sown in beds fecundated with ground sunflower heads proved to be the best and may counteracted the inhibitory effects of salinity on pea plants.

In view of above mentioned results, it has been concluded that spraying pea plants "cv. Master-B", producing from calcium paste treated-seeds sown in beds fecundated with ground sunflower heads, with ascorbic acid at the rate of 300 mgL<sup>-1</sup> could be counteracted the adverse conditions particularly, salinity up to 5000 ppm and consequently, economic green pods and seeds yield is obtainable.

**Keywords:** Pea, calcium paste, ascorbic acid, growth, yield, chemical constituents

### INTRODUCTION

Pea (*Pisum sativum* L.) is one of the popular vegetable crops in Egypt, usually cultivated as a winter crop for consumption, processing and exportation as well. It acts as a rich source in protein, carbohydrates and other nutrients for human diet. Beside the trials for improving pea productivity in the old soils, others must be carried to improve the growth and yield of pea in the newly reclaimed soils (this kind of soil is saline). Pea is classified as a

salt sensitive vegetable crop (Pasternak, 1987). It is nevertheless an important crop in new reclaimed areas in Egypt, where much of soils is saline. Saline conditions disrupt several physiological processes in plants leading to a general reduction in growth and yield (El-Saidi, 1997 and Greenway and Munns, 1980). The drastic influence of salinity on plant growth and metabolism was attributed, principally, to the enhanced  $\text{Na}^+$  uptake which causes ion excess in plant tissues (Abbas *et al.*, 1991). One of the primary effects of increasing salinity in the growth medium is the inhibition of  $\text{K}^+$ ,  $\text{Ca}^{2+}$  and  $\text{NO}_3^-$  uptake by plant roots (Maas, 1986). In addition, it is well established that salinity stress damages plant cells through production of reactive oxygen species including superoxide, hydrogen peroxide, hydroxyl anions and singlet oxygen (Scandalios, 1997). Efforts have been made to control salinity by technological means; reclamation, drainage, use of high leaching fractions and application of soil amendments (Abdel-Naby *et al.*, 2001). On the other hand, some trials have been made to alleviate the disturbances in plant metabolism excreted by salinity stress. It has been suggested that ascorbic acid is one of natural and safety substances may help to overcome some of these inhibitory effects (Rady, 2006).

Ascorbic acid is an important antioxidant defense in plant cells (Foyer and Halliwell, 1976) to protect them by scavenging the reactive oxygen species. It also stimulates respiration activities, cell division and many enzymes activities (Rautenkranz *et al.*, 1994). It has synergistic effects on growth, yield and its components as well as chemical composition of several crops under favourable and unfavourable environmental condition i.e. salinity (Ahmed *et al.*, 2002 and 2003; Mostafa, 2004 and Rady, 2006). It has been also suggested that calcium is an important factor in maintenance of membrane integrity and ion-transport regulation. It is essential for  $\text{K}^+/\text{Na}^+$  selectivity and membrane integrity (Epstein, 1961 and Hanson, 1984). Elevated  $\text{Ca}^{++}$  concentrations in the nutrient solution mitigated the adverse effects of salinity by inhibition of  $\text{Na}^+$  uptake (Greenway and Munns, 1980) and reduction in leakage of membranes (Leopold and Willing, 1984). LaHaye and Epstein (1969) clearly postulated that the  $\text{Ca}^{++}/\text{Na}^+$  interaction takes place at the plasmalemma. They suggested that  $\text{Na}^+$  acted by displacing  $\text{Ca}^{++}$  from membranes, leading to increased membrane permeability and intracellular  $\text{Na}^+$  concentrations.

Accordingly, this work was planned for studying the influence of foliar application with ascorbic acid, seed treatment by calcium paste and fecundating seed-beds with ground sunflower heads on growth, green yield and its components as well as some chemical constituents of pea plants grown under saline reclaimed soil conditions.

## **MATERIALS AND METHODS**

During the two successive winter seasons of 2007/2008 and 2008/2009, a field trial was carried out at a private Farm, Fayoum, Egypt. This successive experimental attempt aimed to study the influence of ascorbic acid foliar application, seed treatment with calcium paste and fecundating seed-bed with ground sunflower heads on growth, green yield

and some of its components as well as some chemical constituents of pea (*Pisum sativum* L.) plants cultivated in saline reclaimed soil (ca. 5000 mgL<sup>-1</sup>). Before sowing, soil samples to 25 cm depth from the experimental site were collected and analyzed by the standard procedures of Jackson (1967). Results of the soil samples analysis are presented in Table (1).

**Table (1): Physical and chemical properties of the selected site in both 2007/2008 and 2008/2009 seasons.**

Property	2007/2008	2008/2009
<b>Physical:</b>		
Clay%	29.75	29.15
Silt%	20.05	20.45
Sand%	50.20	50.40
Soil texture	Loamy sand	Loamy sand
<b>Chemical:</b>		
pH (1:2.5)	7.850	7.690
ECe (dS m <sup>-1</sup> )	7.890	7.780
Organic matter%	1.190	1.230
CaCO <sub>3</sub> %	8.140	8.060
Total N%	0.074	0.071
<b>Available nutrients (mg Kg<sup>-1</sup> soil):</b>		
K	71.25	69.70
P	18.07	18.65
Fe	06.14	06.00
Mn	04.69	05.04
Zn	01.05	00.96
Cu	01.63	01.70

Seeds of pea cv. "Master-B" obtained from agricultural research center, Giza, Egypt were sown on November 15, 2007 and 2008. A seasonal total of 200, 200 and 100 kg feddan<sup>-1</sup> calcium superphosphate (15.5% P<sub>2</sub>O<sub>5</sub>), ammonium sulphate (20.5% N) and potassium sulphate (48% K<sub>2</sub>O), respectively were applied. N and K<sub>2</sub>O amounts were split into two halves. One half is applied in one month after sowing and the other half applied after 15 days later while, P amount applied on the surface soil at the beginning of the experiment. Recommended cultural practices for growing pea plants were followed. Treatments comprised 5 ascorbic acid rates; 0, 100, 200, 300 and 400 mgL<sup>-1</sup>. These treatments were applied alone or in combination with seed treatment with calcium paste sown in beds fecundated with ground sunflower heads.

**Method of ascorbic acid application:**

Ascorbic acid at mentioned concentrations was sprayed on shoots of plants to run off, two times; 25 and 40 days after sowing. Few drops of tween-20 were added to the spraying solution as a wetting agent.

**Method of seed treatment with calcium paste:**

**a. Preparation of calcium paste:**

Calcium nitrate was mixed with wheat bran (a by-product of wheat) (1:2 W/W) and kneaded together by using Arabic Gum solution (8%) as a sticking agent to obtain paste of calcium able to remaining around seeds to longer time.

**b. Treatment of seeds with calcium paste:**

Before sowing, pea seeds were covered with calcium paste through the better mixing between them. Treated seeds were allowed to dry.

**Fecundating seed-bed with ground sunflower heads:**

Air-dried sunflower heads (a by-product of sunflower crop) were well cleaned by washing in tap water and dried in forced-air oven at 70°C for 48h. Then, grinded in high-speed laboratory grinding mill (The Straub Company Model 4E Grinding Mill) to pass through 2.5 mm sieve. The ground sunflower heads were added at fair amounts in seed-beds before sowing directly as a water retention agent in the rizhosphere.

Chemical analysis of wheat bran and ground sunflower heads were determined (Table, 2) as outlined by A.O.A.C. (1995). Moisture content was estimated at 105°C/3h. Ash was estimated by aching in an electric muffle at 550°C for 6 hours. Total fibers (%) were determined by an enzymatic gravimetric method as described by Prosky *et al.* (1988) as well as water holding capacity was measured as outlined by Eastwood (1973).

**Total (2): Some constituents of wheat bran and ground sunflower heads used in the experiment (mean of the two seasons).**

Property	Wheat bran	Ground sunflower heads
Moisture%	4.50	10.80
Ash%	5.20	15.36
Total fibers%	35.30	39.10
Water holding capacity (g/g)	3.30	7.70

The experimental design used was a split-plot design with four replicates. The main plots were calcium paste treated-seeds sown in beds fecundated with ground sunflower heads or untreated seeds sown in non-fecundating beds, and the submain plots included ascorbic acid treatments. Each experimental unit consisted of 5 rows 3m long and 70 cm width, within row spacing 20 cm apart.

**Recorded data:**

**1. Vegetative growth traits:**

Sixty days after sowing, four plants were randomly chosen from each experimental unit and cut off at ground level and submitted to the following determinations: plant height (cm), No. of branches plant<sup>-1</sup> and shoot dry weight plant<sup>-1</sup> (g).

**2. Green yield and its components:**

At the proper stage of marketable green pods, harvesting was done and samples of 20 pods were randomly taken from each experimental unit and the following data were recorded: No. of green pods plant<sup>-1</sup>, green pod weight (g), No. of seeds pod<sup>-1</sup>, 100-seed weight (g), green pods yield feddan<sup>-1</sup> (ton) and green seeds yield feddan<sup>-1</sup> (Kg).

**3. Chemical constituents:**

Shoots of 6 randomly selected plants were collected on January 15, in both seasons (fresh seeds at the marketable stage) from each experimental unit for chemical determinations. Total chlorophyll and total carotenoids were

extracted from fresh leaves by acetone (80%) then; their concentrations were determined ( $\text{mg g}^{-1}$ ) using colorimetric method as described by Arnon (1949). Total phenols were extracted from fresh shoots using 80% ethanol then, colorimetrically determined ( $\text{mg g}^{-1}$ ) using Folin-Denis reagent by the method of Srtell and Snell (1953). Ascorbic acid was determined using the dye 2,6-dichlorophenol indophenol method as outlined by A.O.A.C. (1995) in fresh shoots. Starch (%) was extracted from fresh seeds using 80% ethanol then, hydrolyzed by concentrated HCl then, determined by using Fehling reagent (A+B) and methylene blue as an indicator (A.O.A.C., 1995). The following parameters were determined using dry matter of shoots and harvested fresh seeds. Total soluble sugars % (in shoots and seeds) were colorimetrically determined using phosphomolybdic acid reagent according to Dubois *et al.* (1956). Free proline was extracted from dry matter of shoots by 5-sulphosalicylic acid (3%) then, determined colorimetrically ( $\text{mg g}^{-1}$ ) using acid ninhydrin reagent as outlined by Bates *et al.* (1973). Nitrogen ( $\text{mg g}^{-1}$  dry matter of shoots and seeds) was colorimetrically determined by using the Orange G dye according to the method of Hafez and Mikkelsen (1981) then, protein % in seeds was calculated by multiplying N% x 6.25. For P, K, Ca, Na, Fe, Mn and Zn determinations; the wet digestion of 0.1 g of fine dry material of shoots of each treatment was done with sulphuric and perchloric acids mixture as mentioned by Piper (1947). Phosphorus ( $\text{mg g}^{-1}$ ) was colorimetrically estimated using chlorostannus molybdo-phosphoric blue color method in sulphuric acid system as described by Jackson (1967). Potassium and sodium ( $\text{mg g}^{-1}$ ) was determined using a Perkin-Elmer, Flame Photometer (Page *et al.*, 1982). Calcium ( $\text{mg g}^{-1}$ ), iron (ppm), manganese (ppm) and zinc (ppm) were determined using a Perkin-Elmer, Model 3300, Atomic absorption Spectrophotometer (Chapman and Pratt, 1961).

#### **Statistical analysis.**

All data obtained in both seasons of this study were subjected to the analysis of variance. LSD at 0.05 was used to differentiate means according to Snedecor and Cochran (1980).

## **RESULTS AND DISCUSSION**

All discussed data of this study are the mean values of the two seasons because of the similarity of results trend in the two seasons.

### **1. Vegetative growth traits:**

Plant height, branches number  $\text{plant}^{-1}$  and shoot dry weight  $\text{plant}^{-1}$  presented in Table (3) were significantly increased by 24.09%, 57.50% and 60.19%, respectively when seeds treated with calcium paste then, sown in beds fecundated with ground sunflower heads as compared with these parameters when seeds sown in their beds without any treatments for both seeds and their beds alike. These improving effects on studied vegetative growth parameters may be due to that  $\text{Ca}^{2+}$  in calcium paste reduced the harmful effects of salinity on seeds and consequently positively reflected on germination and emergence percentages. In addition, it has been explained in a way that root hairs of plants were able to maintain higher levels of

membrane-associated  $\text{Ca}^{2+}$  when exposed to high concentrations of NaCl (Cramer *et al.*, 1985). In fact, it is essential to have  $\text{Ca}^{2+}$  of selective permeability, i.e. membrane integrity (Poovaiah and Reddy, 1993). This helped in improving vegetative growth traits through improving plant growth. Furthermore, ground sunflower heads found in seed-beds are able to maintenance of water (Table 2) in rizhosphere and consequently dilution of salinity around roots. Regarding results of this study, increasing macro-and microelements (N, P, K, Ca, Fe, Mn and Zn) as shown in Tables (8-10) and the decrease in  $\text{Na}^{+}$  (Table 9) induced by seed treatment with calcium paste and fecundating seed-beds with ground sunflower heads led to the significant increase in vegetative growth traits.

Table (3): Effect of calcium paste treated-or untreated-seeds sown in beds fecundated or non-fecundated with ground sunflower heads and foliar application with ascorbic acid on some growth traits of pea plants grown under reclaimed soil conditions during 2007/2008 and 2008/2009 seasons.

Ascorbic acid (mgL <sup>-1</sup> )	2007/2008		Mean (B)	2008/2009		Mean (B)	Mean of the two seasons		Mean (B)
	-Ca <sup>2+</sup>	+Ca <sup>2+</sup>		-Ca <sup>2+</sup>	+Ca <sup>2+</sup>		-Ca <sup>2+</sup>	+Ca <sup>2+</sup>	
	Plant height (cm)								
0	29.5	39.2	34.4	30.1	39.0	34.6	29.8	39.1	34.5
100	34.1	45.3	39.7	34.0	46.2	40.1	34.1	45.8	40.0
200	40.8	50.4	45.6	38.7	50.8	44.8	39.8	50.6	45.2
300	51.6	59.2	55.4	50.3	60.4	55.4	51.0	59.8	55.4
400	51.4	58.8	55.1	50.2	60.4	55.3	50.8	59.6	55.2
Mean (A)	41.5	50.6		40.7	51.4		41.1	51.0	
LSD <sub>0.05</sub> A		2.9			2.5			2.7	
B		4.4			3.9			4.2	
AxB		5.3			4.8			5.1	
	No. of branches plant <sup>-1</sup>								
0	1.12	2.00	1.56	1.20	2.00	1.60	1.16	2.00	1.58
100	1.29	2.28	1.79	1.38	2.31	1.85	1.34	2.30	1.82
200	1.50	2.56	2.03	1.52	2.60	2.06	1.51	2.58	2.05
300	2.02	2.82	2.42	2.00	2.90	2.45	2.01	2.86	2.44
400	2.00	2.81	2.41	2.00	2.90	2.45	2.00	2.86	2.43
Mean (A)	1.59	2.49		1.62	2.54		1.60	2.52	
LSD <sub>0.05</sub> A		0.14			0.12			0.13	
B		0.21			0.19			0.20	
AxB		0.27			0.25			0.26	
	Shoot of dry weight plant <sup>-1</sup> (g)								
0	6.09	10.21	8.15	6.20	10.03	8.12	6.15	10.12	8.14
100	7.01	11.96	9.49	7.14	11.84	9.49	7.08	11.90	9.49
200	8.18	13.80	10.99	8.12	13.69	10.91	8.15	13.75	10.95
300	10.16	15.12	12.64	9.98	15.52	12.75	10.07	15.32	12.70
400	10.09	15.10	12.60	9.95	15.50	12.73	10.02	15.30	12.66
Mean (A)	8.31	13.24		8.28	13.32		8.29	13.28	
LSD <sub>0.05</sub> A		0.64			0.60			0.62	
B		0.96			0.89			0.93	
AxB		1.28			1.18			1.23	

+Ca = Seed covered with calcium paste and sown in beds fecundated with ground sunflower heads.

-Ca = Seed without calcium paste and sown in beds free from ground sunflower heads.

All sub-main treatments; ascorbic acid at the rates of 0, 100, 200, 300 and 400 mgL<sup>-1</sup> (Table 3) reveal a gradual significant increase in all studied vegetative growth traits, i.e. plant height, branches number plant<sup>-1</sup> and shoot dry weight plant<sup>-1</sup> was observed as a result in raising ascorbic acid rate gradually applied up to 300 mgL<sup>-1</sup>. The rate of 400 mgL<sup>-1</sup> ascorbic acid proved to slightly decreased the mentioned parameters as compared with the rate of 300 mgL<sup>-1</sup>. The maximum results were recorded with ascorbic acid foliar application at the rate of 300 mgL<sup>-1</sup> which surpassed the results of water foliar spray (the rate of zero mgL<sup>-1</sup> ascorbic acid) by 60.58%, 54.43% and 56.02% for plant height, branches number plant<sup>-1</sup> and shoot dry weight plant<sup>-1</sup>, respectively. These results indicate that the most pronounced counteracted effects of studied soil salinity (Ca. 5000 ppm) on vegetative growth traits under study were overcome by the exogenous application of ascorbic acid which led to the increase in endogenous level of this substance (Table 6) and consequently led to protect plant cells including protect the photosynthetic apparatus by scavenging reactive oxygen species (Zhang and Schmidt, 2000) thus, vigorous plant growth will be obtained under salinity stress. In this connection, Prusky (1988) and Elade (1992) stated a positive action for antioxidants especially, ascorbic acid on growth and attributed this finding to their effects on counteracting drought, salinity and diseases stresses and protecting plant cells against free radicals that responsible for plant senescence as well as to their auxinic action and consequently enhancing growth characters. In addition, ascorbic acid might regulate cell wall expansion, cell division and cell elongation through its action in cell vacuolarization (Arrigoni, 1994; Navas and Gomez-Diaz, 1995 and Cordoba-Pedregosa *et al.*, 1996), improves the nutritional status (Tables 8, 9 and 10) and absorbing phenolic compounds which lead to save the growing tissues from toxic effects of the oxidized phenols (Gupta *et al.*, 1980) and/or enhances the biosynthesis of soluble sugars (Table 7) and carbohydrates (Rady, 2006). These findings are in coincidence with those obtained by Ahmed *et al.* (1998); Ragab (2002); Ahmed *et al.* (2003); Mostafa (2004) and Rady (2006).

The effect of the interactions between the main treatments (untreated seed sown in non-fecundated beds or treated seeds with calcium paste and sown in beds fecundated with ground sunflower heads) and sub-main treatments (ascorbic acid foliar application) was significant. The highest values of plant height, branches number plant<sup>-1</sup> and shoot dry weight plant<sup>-1</sup> were recorded from the treatment 300 mgL<sup>-1</sup> ascorbic acid under seed treatment with calcium paste plus seed-beds fecundated with ground sunflower heads which recorded 52.94%, 43.00% and 51.38% increases for plant height, branches number plant<sup>-1</sup> and shoot dry weight plant<sup>-1</sup>, respectively above the treatment zero mgL<sup>-1</sup> ascorbic acid under seed treatment with calcium paste plus seed-beds fecundated with ground sunflower heads and recorded 100.67%, 146.55% and 149.11% increases above the treatment zero mgL<sup>-1</sup> ascorbic acid under untreated seeds and their beds. The superiority of the treatment having the highest values might come from improving the nutritional status of plants of this treatment (Tables 8-10), the shortage of Na<sup>+</sup> (Table 9) and the increase in total soluble sugars

and proline (Table 7) saving more osmotic solutes which enable plant cells to maintain more water against salinity.

**2. Green yield and its components:**

Data in Tables (4 and 5) indicate that all green yield and its components under study, i.e. No. of green pods plant<sup>-1</sup>, pod weight, total green pods yield feddan<sup>-1</sup>, No. of green seeds pod<sup>-1</sup>, 100-seed weight and green seeds yield feddan<sup>-1</sup> were significantly increased as a result of calcium paste-treated seeds sown in ground sunflower heads-fecundated beds which recorded 76.26%, 33.43%, 134.85%, 30.72%, 30.97% and 176.24% for above mentioned green yield and its components, respectively as compared with calcium paste-untreated seeds sown in ground sunflower heads-non-fecundated beds.

**Table (4):** Effect of calcium paste treated-or untreated-seeds sown in beds fecundated or non-fecundated with ground sunflower heads and foliar application with ascorbic acid on green yield and some of its components of pea plants grown under reclaimed soil conditions during 2007/2008 and 2008/2009 seasons.

Ascorbic acid (mgL <sup>-1</sup> )	2007/2008		Mean (B)	2008/2009		Mean (B)	Mean of the two seasons		Mean (B)
	-Ca <sup>+2</sup>	+Ca <sup>+2</sup>		-Ca <sup>+2</sup>	+Ca <sup>+2</sup>		-Ca <sup>+2</sup>	+Ca <sup>+2</sup>	
	<b>No. of green pods plant<sup>-1</sup></b>								
0	5.38	8.10	6.74	5.41	8.39	6.90	5.40	8.24	6.82
100	5.49	8.54	7.02	5.54	9.14	7.34	5.52	8.84	7.18
200	5.81	10.68	8.24	5.98	10.92	8.45	5.90	10.80	8.35
300	7.40	14.21	10.81	7.56	13.97	10.77	7.48	14.09	10.79
400	7.36	14.29	10.83	7.60	13.90	10.75	7.48	14.10	10.79
Mean (A)	6.29	11.16		6.42	11.26		6.36	11.21	
LSD <sub>0.05</sub> A	0.21			0.24			0.22		
B	0.30			0.36			0.33		
AxB	0.36			0.42			0.39		
	<b>Pod weight (g)</b>								
0	2.61	3.98	3.30	2.58	4.05	3.32	2.60	4.02	3.31
100	2.98	4.11	3.55	2.89	4.19	3.54	2.94	4.15	3.55
200	3.24	4.46	3.85	3.18	4.38	3.78	3.21	4.42	3.82
300	4.00	5.10	4.55	4.03	4.91	4.47	4.02	5.01	4.52
400	4.01	5.05	4.53	3.98	4.97	4.48	4.00	5.01	4.51
Mean (A)	3.37	4.54		3.33	4.50		3.35	4.52	
LSD <sub>0.05</sub> A	0.18			0.14			0.16		
B	0.27			0.21			0.24		
AxB	0.33			0.27			0.30		
	<b>Total green pods yield feddan<sup>-1</sup> (ton)</b>								
0	0.42	0.97	0.70	0.42	1.02	0.72	0.42	1.00	0.71
100	0.49	1.05	0.77	0.48	1.15	0.82	0.49	1.10	0.80
200	0.56	1.43	1.00	0.57	1.43	1.00	0.57	1.43	1.00
300	0.89	2.15	1.52	0.90	2.08	1.49	0.90	2.12	1.51
400	0.88	2.19	1.54	0.92	2.05	1.49	0.90	2.12	1.51
Mean (A)	0.65	1.56		0.66	1.55		0.66	1.55	
LSD <sub>0.05</sub> A	0.07			0.05			0.06		
B	0.09			0.07			0.08		
AxB	0.12			0.08			0.10		

+Ca = Seed covered with calcium paste and sown in beds fecundated with ground sunflower heads.

-Ca = Seed without calcium paste and sown in beds free from ground sunflower heads.



**Table (5): Effect of calcium paste treated-or untreated-seeds sown in beds fecundated or non-fecundated with ground sunflower heads and foliar application with ascorbic acid on green seed yield and some of its components of pea plants grown under reclaimed soil conditions during 2007/2008 and 2008/2009 seasons.**

Ascorbic acid (mgL <sup>-1</sup> )	2007/2008		Mean (B)	2008/2009		Mean (B)	Mean of the two seasons		Mean (B)
	-Ca <sup>++</sup>	+Ca <sup>++</sup>		-Ca <sup>++</sup>	+Ca <sup>++</sup>		-Ca <sup>++</sup>	+Ca <sup>++</sup>	
	No. of green seeds pod <sup>-1</sup>								
0	4.08	8.62	6.35	3.99	8.54	6.27	4.04	8.58	6.31
100	5.16	8.96	7.06	5.07	9.00	7.04	5.12	8.98	7.05
200	8.02	9.58	8.80	7.88	9.62	8.75	7.95	9.60	8.78
300	9.61	10.12	9.87	9.58	10.20	9.89	9.60	10.16	9.88
400	9.54	10.09	9.82	9.61	10.16	9.89	9.58	10.13	9.86
Mean (A)	7.28	9.47		7.23	9.50		7.26	9.49	
LSD <sub>0.05</sub> A	0.48			0.45			0.47		
B	0.71			0.66			0.68		
AxB	0.90			0.86			0.88		
100-seed weight (g)									
0	10.93	19.54	15.24	11.08	20.12	15.60	11.01	19.83	15.42
100	14.08	19.78	16.93	13.94	21.14	17.54	14.01	20.46	17.24
200	18.50	20.63	19.57	18.60	21.90	20.25	18.55	21.27	19.91
300	20.14	23.92	22.03	20.21	24.51	22.36	20.18	24.22	22.20
400	20.21	23.88	22.05	20.18	24.46	22.32	20.20	24.17	22.19
Mean (A)	16.77	21.55		16.80	22.43		16.79	21.99	
LSD <sub>0.05</sub> A	0.96			1.20			1.08		
B	1.46			1.74			1.60		
AxB	1.78			2.14			1.95		
Green seeds yield feddan <sup>-1</sup> (kg)									
0	71.9	409.3	240.6	71.7	432.4	252.1	71.8	420.9	245.4
100	119.6	454.0	286.8	117.4	521.6	319.5	118.5	487.8	303.2
200	258.6	633.2	445.9	262.9	690.1	475.5	260.8	661.7	461.3
300	429.6	1031.9	730.8	439.1	1047.7	743.4	434.4	1039.8	737.1
400	425.7	1032.9	729.3	442.1	1036.3	739.2	433.9	1034.6	734.3
Mean (A)	261.1	712.3		266.6	745.6		263.9	729.0	
LSD <sub>0.05</sub> A	34.2			32.9			33.6		
B	51.4			49.8			50.6		
AxB	62.6			60.2			61.4		

+Ca = Seed covered with calcium paste and sown in beds fecundated with ground sunflower heads.

-Ca = Seed without calcium paste and sown in beds free from ground sunflower heads.

The improving in green yield and its components may be due to the existence of Ca<sup>++</sup> to take the place of Na<sup>+</sup> in the rizhosphere and in plant shoots as shown in Table (9) in this study which may be positively reflected on plant growth (Table 3) and plant pigments (Table 6) as well as macro- and microelements (Tables 8-10) and other components; proline, total soluble sugars, total phenols (Table 7) as osmotic substances and consequently increase yield and its components. Moreover, the better water retention capacity of ground sunflower heads (Table 2) enable rizhosphere to retain water to counteract the harmful effect of salinity.

**Table (6): Effect of calcium paste treated-or untreated-seeds sown in beds fecundated or non-fecundated with ground sunflower heads and foliar application with ascorbic acid on some leaf pigments and shoot ascorbic acid of pea plants grown under reclaimed soil conditions during 2007/2008 and 2008/2009 seasons.**

Ascorbic acid (mgL <sup>-1</sup> )	2007/2008		Mean (B)	2008/2009		Mean (B)	Mean of the two seasons		Mean (B)
	-Ca <sup>+2</sup>	+Ca <sup>+2</sup>		-Ca <sup>+2</sup>	+Ca <sup>+2</sup>		-Ca <sup>+2</sup>	+Ca <sup>+2</sup>	
<b>Total chlorophyll (mg g<sup>-1</sup> F.wt.)</b>									
0	0.81	1.40	1.11	0.86	1.38	1.12	0.84	1.39	1.12
100	0.86	1.51	1.19	0.92	1.47	1.20	0.89	1.49	1.19
200	0.93	1.68	1.31	0.99	1.70	1.35	0.96	1.69	1.33
300	1.18	1.92	1.55	1.21	1.94	1.58	1.20	1.93	1.57
400	1.17	1.90	1.54	1.21	1.91	1.56	1.19	1.91	1.55
Mean (A)	0.99	1.68		1.04	1.68		1.02	1.68	
LSD <sub>0.05</sub> A	0.06			0.07			0.07		
B	0.08			0.10			0.09		
AxB	0.10			0.12			0.11		
<b>Total carotenoids (mg g<sup>-1</sup> F.wt.)</b>									
0	0.34	0.40	0.37	0.33	0.43	0.38	0.34	0.42	0.38
100	0.38	0.44	0.41	0.38	0.48	0.43	0.38	0.46	0.42
200	0.44	0.53	0.49	0.42	0.56	0.49	0.43	0.55	0.49
300	0.51	0.61	0.56	0.50	0.65	0.58	0.51	0.63	0.57
400	0.51	0.60	0.56	0.48	0.64	0.56	0.50	0.62	0.56
Mean (A)	0.44	0.52		0.42	0.55		0.43	0.54	
LSD <sub>0.05</sub> A	0.03			0.03			0.03		
B	0.04			0.05			0.05		
AxB	0.06			0.06			0.06		
<b>Ascorbic acid (mg g<sup>-1</sup> F.wt.)</b>									
0	0.78	1.58	1.18	0.72	1.49	1.11	0.75	1.54	1.15
100	0.84	1.79	1.32	0.76	1.60	1.18	0.80	1.70	1.25
200	0.89	2.10	1.50	0.84	1.81	1.33	0.87	1.96	1.42
300	1.14	2.53	1.84	1.07	2.38	1.73	1.11	2.46	1.79
400	1.15	2.49	1.82	1.05	2.39	1.72	1.10	2.44	1.77
Mean (A)	0.95	2.10		0.89	1.93		0.93	2.02	
LSD <sub>0.05</sub> A	0.08			0.07			0.08		
B	0.12			0.10			0.10		
AxB	0.15			0.12			0.13		

+Ca = Seed covered with calcium paste and sown in beds fecundated with ground sunflower heads.

-Ca = Seed without calcium paste and sown in beds free from ground sunflower heads.

Sub-main treatment of ascorbic acid foliar application at the rate 300 mgL<sup>-1</sup> gave the highest significant increase for green yield and its components as compared with other ascorbic acid rates; 100, 200 and 400 mgL<sup>-1</sup> except the two rates; 300 and 400 mgL<sup>-1</sup> in relation to No. of green pods plant<sup>-1</sup> and total green pods yield feddan<sup>-1</sup>. These increases which scored by 300 mgL<sup>-1</sup> ascorbic acid were 58.21%, 36.56%, 112.68%, 56.58%, 43.97% and 199.15% for No. of green pods plant<sup>-1</sup>, pod weight, total green pods yield feddan<sup>-1</sup>, No. of green seeds pod<sup>-1</sup>, 100-seed weight and green seeds yield feddan<sup>-1</sup>, respectively as compared to the treatment of zero rate ascorbic acid. The improving effect of ascorbic acid on green yield and its

components was mainly attributed to its positive action on enhancing growth traits (Table 3), photosynthetic pigments of plant leaves (Table 6), cellular solutes, i.e. free proline, soluble sugars and soluble phenols (Table 7) for sustenance of cells turgor leading to maintenance of metabolic activities in plants and plant nutritional status (Tables 8-10).

**Table (7): Effect of calcium paste treated-or untreated-seeds sown in beds fecundated or non-fecundated with ground sunflower heads and foliar application with ascorbic acid on some photosynthates in shoots of pea plants grown under reclaimed soil conditions during 2007/2008 and 2008/2009 seasons.**

Ascorbic acid (mgL <sup>-1</sup> )	2007/2008		Mean (B)	2008/2009		Mean (B)	Mean of the two seasons		Mean (B)
	-Ca <sup>+2</sup>	+Ca <sup>+2</sup>		-Ca <sup>+2</sup>	+Ca <sup>+2</sup>		-Ca <sup>+2</sup>	+Ca <sup>+2</sup>	
<b>Free proline (mg g<sup>-1</sup> D.wt.)</b>									
0	0.18	0.23	0.21	0.16	0.19	0.18	0.17	0.21	0.19
100	0.21	0.26	0.24	0.18	0.22	0.20	0.20	0.24	0.22
200	0.24	0.30	0.27	0.21	0.27	0.24	0.23	0.29	0.26
300	0.29	0.34	0.32	0.28	0.33	0.31	0.29	0.34	0.32
400	0.29	0.34	0.32	0.28	0.32	0.30	0.29	0.33	0.31
Mean (A)	0.24	0.29		0.22	0.27		0.24	0.28	
LSD <sub>0.05</sub> A	0.02			0.02			0.02		
B	0.03			0.02			0.03		
AxB	0.03			0.03			0.03		
<b>Total soluble sugars (mg g<sup>-1</sup> D.wt.)</b>									
0	21.06	25.18	23.12	20.01	23.16	21.59	20.54	24.17	22.36
100	24.67	29.40	27.04	23.72	27.80	25.76	24.20	28.60	26.40
200	28.84	32.96	30.90	27.66	30.98	29.32	28.25	31.97	30.11
300	34.10	38.28	36.19	32.10	36.84	34.47	33.10	37.56	35.33
400	34.10	38.10	36.10	32.00	36.80	34.40	33.05	37.45	35.25
Mean (A)	28.55	32.78		27.10	31.12		27.83	31.95	
LSD <sub>0.05</sub> A	1.63			1.72			1.68		
B	2.41			2.56			2.49		
AxB	2.96			3.04			3.00		
<b>Total phenols (mg g<sup>-1</sup> F.wt.)</b>									
0	0.87	1.02	0.95	0.89	1.05	0.97	0.88	1.04	0.96
100	0.97	1.11	1.04	0.98	1.16	1.07	0.98	1.14	1.06
200	1.15	1.30	1.23	1.14	1.29	1.22	1.15	1.30	1.23
300	1.36	1.49	1.44	1.29	1.51	1.40	1.34	1.50	1.42
400	1.38	1.48	1.43	1.27	1.51	1.39	1.33	1.50	1.42
Mean (A)	1.15	1.28		1.11	1.30		1.14	1.30	
LSD <sub>0.05</sub> A	0.05			0.04			0.05		
B	0.06			0.06			0.07		
AxB	0.11			0.08			0.10		

+Ca = Seed covered with calcium paste and sown in beds fecundated with ground sunflower heads.

-Ca = Seed without calcium paste and sown in beds free from ground sunflower heads.

In this respect, Al-Qubaie (2002) stated that ascorbic acid as an antioxidant compound has an auxinic action and also synergistic effect on the biosynthesis of carbohydrates and controlling the incidence of most fungi on plants makes them in vigour states and reflects on green pods and seeds

yields. Besides, the induced effect of ascorbic acid as one of vitamins on growth and yield may be due to that vitamins are recognized to be coenzymes involved in specific biochemical reactions in plants such as oxidative and non-oxidative decarboxylations (Robinson, 1973). The results regarding the beneficial effect of ascorbic acid on green yields of pods and seeds are confirmed with those reported by Ahmed *et al.* (2002) and (2003), Mostafa (2004) and Rady (2006).

As for the interaction between treated or untreated seeds with calcium paste sown in fecundated or non-fecundated beds with ground sunflower heads and ascorbic acid foliar application at various rates, data presented in Tables (4 and 5) represent that the highest significant increases were obtained from the application of 300 mgL<sup>-1</sup> ascorbic acid combined with treated seeds and fecundated seed-beds with calcium paste and ground sunflower heads, orderly for all tested green yield and its components. These increases obtained from this combined treatment scored at 71.00%, 24.63%, 122.00%, 18.41%, 22.14% and 147.04%, and

160.93%, 92.69%, 404.76%, 151.49%, 119.98% and 1348.19% as compared to zero mgL<sup>-1</sup> ascorbic acid under calcium paste-treated seeds sown in ground sunflower heads-fecundated beds and zero mgL<sup>-1</sup> ascorbic acid under untreated seeds with calcium paste sown in non-fecundated beds with ground sunflower heads, respectively for No. of green pods plant<sup>-1</sup>, pod weight, total green pods yield feddan<sup>-1</sup>, No. of green seeds pod<sup>-1</sup>, 100-seed weight and green seeds yield feddan<sup>-1</sup>, orderly. This favourable production may be due to the positive combined effect of calcium and ground sunflower heads. The former has antagonistic effect to the harmful effects of Na<sup>+</sup> and the latter has high percentage of fibers (Table 2) have several physiological effects, depending upon the physical and chemical properties among them the ability of fibers to retain water and to bind organic compounds (Schneeman, 1986 and 1989) deluting salinity concentration and saving acidity effect in rizhosphere and consequently more solubility and absorption of nutrients by plant roots.

### **3. Chemical constituents:**

#### **a. Leaf pigments, ascorbic acid, proline, sugars and total phenols:**

Data in Tables (6 and 7) reveal that total chlorophyll, total carotenoids, ascorbic acid, free proline, total soluble sugars and total soluble phenols in plant leaves or shoots were significantly increased in the order of 64.71%, 25.58%, 117.20%, 16.67%, 14.80% and 14.04%, respectively as a result of treating seeds with calcium paste plus fecundating seed-beds with ground sunflower heads as compared with the untreated seeds plus non-fecundated seed-beds. These pronounced increments may be due to the increase in ascorbic acid in plant shoots (Table 6) which has an auxinic actions and also synergistic effects on biosynthesis of sugars and carbohydrates (Al-Qubaie, 2002). The increase in phenois concentration in plant shoots (Table 7) resulting in the increase in ascorbic acid as an antioxidant thus, a linear relationship between ascorbic acid and total phenols concentration in plant shoots as represented in this study. Besides, the effective role of Ca<sup>++</sup> and ground sunflower heads in Na<sup>+</sup> driving away and more water retention in rizhosphere, respectively.

Regarding the influence of ascorbic acid on total chlorophyll, total carotenoids, ascorbic acid, free proline, total soluble sugars and total soluble phenols concentrations in plant leaves or shoots, data shown in Tables (6 and 7) exhibit that all these parameters were gradually increased by significant quantities as a result of foliar application with ascorbic acid up to 300 mgL<sup>-1</sup> then negligibly decreased. The proportion of 40.18%, 50.00% 55.65%, 68.42%, 58.01% and 47.92% for total chlorophyll, total carotenoids, ascorbic acid, free proline, total soluble sugars and total soluble phenols, respectively were the increments of the best treatment; spraying plant shoots with ascorbic acid at the rate of 300 mgL<sup>-1</sup> as compared with the treatment free from ascorbic acid (tap water). The promotive effect of ascorbic acid on chlorophyll and carotenoids and the other components under study might be attributed to the enhancing effects of this antioxidant on the nutritional status of pea plants (Tables 8-10) since, N is one of the essential chlorophyll components. Besides, Fe and Mn are necessary for biosynthesis of chlorophyll and Zn is necessary for biosynthesis of tryptophan which is the precursor of auxin biosynthesis and consequently more biosynthesis of these components in the face of cells elongation. Furthermore, the role of ascorbic acid as an antioxidant, which directly involved in the regulation and protection of photosynthetic processes (Farago and Brunhold, 1994) could be led to the enhancing effect of ascorbic acid on pigments and the components under study. This treatment having the highest values of the constituents under study bestowed the tested plants the ability to satisfactorily overcome soil salinity under study in respect that their containing sufficient amount of soluble sugars, proline and soluble phenols (Table 7) which form sufficient cellular solutes able to sustenance of cell turgor leading to maintenance of metabolic activities in plant cells and/or protect plants against adverse condition, i.e. drought and salinity of such soil under study. The enhancing effect of ascorbic acid on tested soluble sugars might be attributed to its promotive effect also on studied pigments (Table 6) leading to the enhancement of photosynthesis and consequently, the increase in the photosynthates. The positive effects of ascorbic acid on above mentioned pigments and photosynthates obtained in this study are in agreement with those obtained by Tarraf *et al.* (1999); Ali (2002), Ahmed *et al.* (2003) and Rady (2006).

As regard to the results of the combination between treated or untreated seeds with calcium paste plus fecundated or non-fecundated seed-beds with ground sunflower heads exhibited in Tables (6 and 7) reveal that the combination between calcium paste treated-seeds sown in ground sunflower heads fecundated-beds and spraying plant shoots with ascorbic acid at 300 mgL<sup>-1</sup> preferable to all other combinations since granted the increases: 38.85%, 50.00%, 59.74%, 61.90%, 55.40% and 44.23% for total chlorophyll, total carotenoids, ascorbic acid, free proline, total soluble sugars and total soluble phenols, respectively as compared to calcium paste treated-seeds plus ground sunflower heads fecundated-seed-beds interacted with foliar spray with water (zero rate ascorbic acid), while when compared with the combined treatment between zero rate ascorbic acid and calcium paste untreated-seeds plus ground sunflower heads non-fecundated-seed-beds it

scored increments at 129.76%, 85.29%, 228.00%, 100.00%, 82.86% and 70.45% for the same constituents, respectively. These significant increases scored as a result of the application with  $\text{Ca}^{++}$ , ground sunflower heads as a fibrous source having high water holding capacity and ascorbic acid. The former may be reduced the harmful effects of salinity by its taking the place of  $\text{Na}^+$  in rizhosphere and may on membranes in absorbing roots. The second; ground sunflower heads saves more water to overcome drought caused by salinity in the soil. The latter; ascorbic acid as one of antioxidants prevent enzyme inactivation, prevent the generation of more dangerous radicals and allow flexibility in the production of photosynthetic assimilatory power. Moreover, electron transfer to  $\text{O}_2$  prevented over reduction of electron transports chain, which reduced the risk of harmful back reaction within the photosystem (Foyer *et al.*, 1990). In addition, Elade (1992) and Farag (1996) proved that most antioxidants were responsible for accelerating the biosynthesis of various pigments and consequently more photosynthesis producing more quantities of photosynthates. Besides, Shahidi and Wanasundara (1992) stated that, phenolic antioxidants play important roles as free radical terminators and sometimes, as a metal chelators.

#### **B. Macro and micronutrients:**

It could be stated from data in Tables (8-10) that N, P, K, Ca, Ca/Na ratio, Fe, Mn and Zn were significantly increased with the treatment of calcium paste treated-seeds plus ground sunflower heads fecundated-seed-beds as compared with other treatment in which seeds and their beds were free from calcium paste and ground sunflower heads. These increases were recorded at 19.84%, 39.06%, 18.43%, 106.62%, 132.18%, 10.47%, 8.03% and 11.41% for N, P, K, Ca and Ca/Na ratio, Fe, Mn and Zn, respectively. On the other side, Na represents reversed behaviour, since decreased with increasing other elements at 13.17% in plant shoots. The shortage occurred in  $\text{Na}^+$  and the increase in  $\text{Ca}^{++}$ ; the increase in Ca/Na ratio under this study besides, the high water retention capacity and having some minerals such as Ca, Fe and Zn as well as some vitamins (i.e. A and E) of ground sunflower heads and wheat bran (Kahlan *et al.*, 1986 and Klopfenstein, 1990) might be explained these results.

Data presented in Tables (8-10) reveal that regardless Na which behaved contrary case, all nutrients under studies i.e. N, P, K, Ca, Ca/Na ratio, Fe, Mn and Zn represented significant gradual increases with increasing ascorbic acid rate. The applied treatment of ascorbic acid at the rate of  $300 \text{ mgL}^{-1}$  proved to be the best, and exhibited, in general, the most pronounced counteracted effect on soil salinity of this study. Such treatment surpassed the treatment of zero  $\text{mgL}^{-1}$  ascorbic acid (water) by 30.11%, 44.15%, 36.63%, 27.82%, 50.00%, 23.38%, 22.18% and 22.71% for N, P, K, Ca, and Ca/Na ratio, Fe, Mn and Zn, respectively. On the other hand, Na recorded shortage at 20.59% under the best treatment as compared with spraying water treatment. The beneficial effect of ascorbic acid on increasing tolerance of pea plants, especially at the rate of  $300 \text{ mgL}^{-1}$  under studied soil salinity which reflected on improving vegetative growth traits (Table 3), photosynthates (Table 7), photosynthetic pigments and endogenous ascorbic acid (Table 6) and green yield of pods and seeds (Tables 4 and 5), surely

reflected also on stimulating the nutritional status of plants. These results were supported by the results of Ahmed and Abd El-Hameed (2004) and Rady (2006) who reported that the effect of antioxidants, especially ascorbic acid on producing healthy plants leads to enhancing the plants to have a great ability for uptake of elements. Moreover, Gonzalez-Reyes *et al.* (1994) concluded that ascorbate free radical caused hyperpolarization of plasma membranes, and this energization could then facilitate transport processes across such membranes. Most of the previous results are consistent with those of Ali (2000); Ahmed *et al.* (2002) and Rady (2006).

**Table (8): Effect of calcium paste treated-or untreated-seeds sown in beds fecundated or non-fecundated with ground sunflower heads and foliar application with ascorbic acid on some macronutrients in shoots of pea plants grown under reclaimed soil conditions during 2007/2008 and 2008/2009 seasons.**

Ascorbic acid (mgL <sup>-1</sup> )	2007/2008		Mean (B)	2008/2009		Mean (B)	Mean of the two seasons		Mean (B)
	-Ca <sup>2+</sup>	+Ca <sup>2+</sup>		-Ca <sup>2+</sup>	+Ca <sup>2+</sup>		-Ca <sup>2+</sup>	+Ca <sup>2+</sup>	
	<b>N (mg g<sup>-1</sup> D.wt.)</b>								
0	21.36	25.10	23.23	20.18	23.96	22.07	20.77	24.53	22.65
100	22.49	27.08	24.79	21.20	25.44	23.32	21.85	26.26	24.06
200	24.13	29.74	26.94	22.84	27.18	25.01	23.49	28.46	25.98
300	27.56	33.26	30.41	26.07	30.95	28.51	26.82	32.11	29.47
400	27.40	33.30	30.35	26.11	30.90	28.51	26.76	32.10	29.43
Mean (A)	24.59	29.70		23.28	27.69		23.94	28.69	
LSD <sub>0.05</sub> A	1.49			1.56			1.53		
B	2.12			2.29			2.21		
AxB	2.65			2.81			2.73		
	<b>P (mg g<sup>-1</sup> D.wt.)</b>								
0	1.52	2.21	1.87	1.60	2.18	1.89	1.56	2.20	1.88
100	1.61	2.33	1.97	1.68	2.30	1.99	1.65	2.32	1.99
200	1.80	2.62	2.21	1.83	2.54	2.19	1.82	2.58	2.20
300	2.30	3.12	2.71	2.24	3.17	2.71	2.27	3.15	2.71
400	2.31	3.09	2.70	2.27	3.13	2.70	2.29	3.11	2.70
Mean (A)	1.91	2.67		1.92	2.66		1.92	2.67	
LSD <sub>0.05</sub> A	0.06			0.07			0.07		
B	0.09			0.10			0.10		
AxB	0.11			0.12			0.12		
	<b>K (mg g<sup>-1</sup> D.wt.)</b>								
0	17.12	20.17	18.65	16.88	21.05	18.97	17.00	20.61	18.81
100	18.20	20.96	19.58	18.24	21.97	20.11	18.22	21.47	19.85
200	20.14	23.66	21.90	19.86	23.40	21.63	20.00	23.53	21.77
300	23.08	27.43	25.26	22.90	26.86	24.88	22.99	27.15	25.07
400	23.10	27.38	25.24	22.86	26.80	24.83	22.98	27.09	25.04
Mean (A)	20.33	23.92		20.15	24.02		20.24	23.97	
LSD <sub>0.05</sub> A	0.72			0.68			0.70		
B	1.05			0.96			1.01		
AxB	1.24			1.20			1.22		

+Ca = Seed covered with calcium paste and sown in beds fecundated with ground sunflower heads.

-Ca = Seed without calcium paste and sown in beds free from ground sunflower heads.

**Table (9): Effect of calcium paste treated-or untreated-seeds sown in beds fecundated or non-fecundated with ground sunflower heads and foliar application with ascorbic acid on Ca, Na and Ca/Na ratio in shoots of pea plants grown under reclaimed soil conditions during 2007/2008 and 2008/2009 seasons.**

Ascorbic acid (mgL <sup>-1</sup> )	2007/2008		Mean (B)	2008/2009		Mean (B)	Mean of the two seasons		Mean (B)
	-Ca <sup>+2</sup>	+Ca <sup>+2</sup>		-Ca <sup>+2</sup>	+Ca <sup>+2</sup>		-Ca <sup>+2</sup>	+Ca <sup>+2</sup>	
<b>Ca (mg g<sup>-1</sup> D.wt.)</b>									
0	2.29	4.61	3.45	2.51	5.08	3.80	2.40	4.85	3.63
100	2.41	4.90	3.66	2.68	5.31	4.00	2.55	5.11	3.83
200	2.58	5.29	3.94	2.84	5.69	4.27	2.71	5.49	4.10
300	2.81	6.34	4.58	3.09	6.31	4.70	2.95	6.33	4.64
400	2.80	6.29	4.55	3.13	6.30	4.72	2.97	6.30	4.64
Mean (A)	2.58	5.49		2.85	5.74		2.72	5.62	
LSD <sub>0.05</sub> A	0.12			0.13			0.13		
B	0.18			0.20			0.19		
AxB	0.22			0.24			0.23		
<b>Na (mg g<sup>-1</sup> D.wt.)</b>									
0	3.61	2.96	3.29	3.50	3.01	3.26	3.56	2.99	3.28
100	3.42	2.93	3.18	3.46	2.95	3.21	3.44	2.94	3.19
200	3.19	2.87	3.03	3.28	2.90	3.09	3.24	2.89	3.07
300	2.74	2.61	2.68	2.90	2.63	2.77	2.82	2.62	2.72
400	2.73	2.60	2.67	2.92	2.65	2.79	2.83	2.63	2.73
Mean (A)	3.14	2.79		3.21	2.83		3.18	2.81	
LSD <sub>0.05</sub> A	0.08			0.08			0.08		
B	0.11			0.12			0.12		
AxB	0.13			0.14			0.14		
<b>Ca / Na ratio</b>									
0	0.63	1.58	1.11	0.72	1.69	1.21	0.68	1.64	1.16
100	0.70	1.67	1.19	0.77	1.80	1.29	0.74	1.74	1.24
200	0.81	1.84	1.33	0.67	1.96	1.42	0.84	1.90	1.37
300	1.03	2.43	1.73	1.07	2.40	1.74	1.05	2.42	1.74
400	1.03	2.42	1.73	1.07	2.38	1.73	1.05	2.40	1.73
Mean (A)	0.84	1.99		0.90	2.05		0.87	2.02	
LSD <sub>0.05</sub> A	0.05			0.06			0.06		
B	0.08			0.08			0.08		
AxB	0.10			0.10			0.10		

+Ca = Seed covered with calcium paste and sown in beds fecundated with ground sunflower heads.

-Ca = Seed without calcium paste and sown in beds free from ground sunflower heads.

Data presented in Tables (8-10) show that the best treatment by which plant shoots collected the highest amounts of nutrients except with the reverse regarding Na, was treating seeds with calcium paste plus fecundating seed-beds with ground sunflower heads interacted with spraying plant shoots with 300 mgL<sup>-1</sup> ascorbic acid solution. This treatment scored 30.90%, 43.18%, 31.73%, 30.52%, 47.56%, 24.21%, 22.33% and 20.75% for N, P, K, Ca, Ca/Na ratio, Fe, Mn and Zn, respectively when compared with the treatment in which seeds and their beds treated plus fecundated with calcium paste and ground sunflower heads interacted with plant shoots sprayed with water, orderly, while Na decreased down to 14.12%. in addition, the same



best treatment granted increases at 54.60%, 101.92%, 59.71%, 163.75%, 255.88%, 35.64%, 32.09% and 37.02% for the same parameters, respectively as compared with the treatment under the interaction between calcium paste untreated-seeds plus ground sunflower heads non-fecundated-seed-beds and spraying plant foliage with water, whereas Na reduced at 35.88%.

**Table (10): Effect of calcium paste treated-or untreated-seeds sown in beds fecundated or non-fecundated with ground sunflower heads and foliar application with ascorbic acid on some micronutrients in shoots of pea plants grown under reclaimed soil conditions during 2007/2008 and 2008/2009 seasons.**

Ascorbic acid (mgL <sup>-1</sup> )	2007/2008		Mean (B)	2008/2009		Mean (B)	Mean of the two seasons		Mean (B)
	-Ca <sup>++</sup>	+Ca <sup>++</sup>		-Ca <sup>++</sup>	+Ca <sup>++</sup>		-Ca <sup>++</sup>	+Ca <sup>++</sup>	
<b>Fe (ppm)</b>									
0	420.6	461.4	441.0	431.2	468.8	450.0	425.9	465.1	445.6
100	439.8	489.6	464.7	454.7	496.4	475.6	447.3	493.0	470.2
200	464.9	518.9	491.9	478.3	531.0	504.7	471.6	525.0	498.3
300	516.9	573.6	545.3	526.6	581.7	554.2	521.8	577.7	549.4
400	518.3	571.2	544.8	524.8	582.9	553.9	521.6	577.1	549.8
Mean (A)	472.1	522.9		483.1	532.2		477.6	527.6	
LSD <sub>0.05</sub> A	16.3			15.8			16.1		
B	24.5			23.7			24.1		
AxB	29.8			30.2			30.0		
<b>Mn (ppm)</b>									
0	250.0	271.6	260.8	246.7	264.7	255.7	248.4	268.2	258.3
100	264.8	290.3	277.6	258.8	278.9	268.9	261.8	284.6	273.2
200	281.7	304.9	293.3	274.6	295.1	284.9	278.2	300.0	289.1
300	309.6	326.8	318.2	296.9	329.4	313.2	303.3	328.1	315.6
400	310.0	324.3	317.2	296.0	326.9	311.5	303.0	325.6	314.3
Mean (A)	283.2	303.6		274.6	299.0		278.9	301.3	
LSD <sub>0.05</sub> A	8.4			9.2			8.8		
B	12.6			13.8			13.2		
AxB	14.8			15.6			15.2		
<b>Zn (ppm)</b>									
0	168.4	194.7	181.6	171.4	190.8	181.1	169.9	192.8	181.4
100	176.3	203.9	190.1	180.6	198.9	189.8	178.5	201.4	190.0
200	190.8	214.7	202.8	189.8	212.4	201.1	190.3	213.6	202.0
300	219.3	233.6	226.5	205.4	231.9	218.7	212.4	232.8	222.6
400	219.7	234.0	226.9	203.9	230.7	217.3	211.8	232.4	222.1
Mean (A)	194.9	216.2		190.2	212.9		192.6	214.6	
LSD <sub>0.05</sub> A	5.8			5.4			5.6		
B	8.1			8.0			8.1		
AxB	10.0			9.8			9.9		

+Ca = Seed covered with calcium paste and sown in beds fecundated with ground sunflower heads.

-Ca = Seed without calcium paste and sown in beds free from ground sunflower heads.

The increments which obtained from the above mentioned best treatment may be explained with the increasing value of Ca/Na ratio which reveals that Ca<sup>++</sup> behaves on its own when it takes out Na<sup>+</sup> at significant amounts from

rizhosphere and consequently from plant shoots (Table 9) which reflected on increasing nutrients in plants.

Besides, the water imbibing properties of ground sunflower heads and wheat bran fibers (Schneeman, 1986), and their ability to absorb water and/or organic compound (Mongeau and Brassard, 1982) support the rizhophere by water to face of drought and salinity, and acidity to facilitate more solubility and absorption of nutrients. As for ascorbic acid, Wise and Naylor (1987) stated that antioxidants such as ascorbate, glutathione and  $\alpha$ -tocopherol are directly correlated with the ability to defend plant cells against oxidative damage resulting from salinity stress and consequently producing healthy plants having a great ability for nutrients uptake.

### **C. Chemical composition of green seeds:**

Starch, total soluble sugars and protein concentrations as shown in Table (11) were significantly affected under the application with  $\text{Ca}^{++}$  and ground sunflower heads. This influence was positive for starch% and protein% up to 12.00% and 18.12%, respectively and negative for total soluble sugars% calculated at 9.88% under the treatment of calcium paste treated-seeds sown in ground sunflower heads fecundated-beds as compared with the treatment of untreated seeds with calcium paste plus non-fecundating seed-beds with ground sunflower heads. The improving effect of the best treatment of calcium paste treated-seeds sown in beds fecundated with ground sunflower heads on the nutritional status of plant shoots (Tables 8-10) reflected on photosynthetic pigments, growth characters and their photosynthates (Tables 3, 5 and 6) and thus reflected on green seeds yield, surely reflected on stored photosynthates in seeds. The reduction in total soluble sugars may be due to that soluble carbohydrates store in pea seeds in the form of starch.

A gradual significant increase was observed for starch% and protein% and the contrary for total soluble sugars% as a result of increasing the ascorbic acid rate from zero up to  $300 \text{ mgL}^{-1}$  then, maintained at almost the same result with  $400 \text{ mgL}^{-1}$  ascorbic acid solution. The best treatment; foliar application with  $300 \text{ mgL}^{-1}$  ascorbic acid solution surpassed the treatment of water foliar application by 13.01% and 18.57% for starch% and protein%, respectively while, reduced total soluble sugars% up to 17.79%. The positive role of ascorbic acid on photosynthetic pigments (Table 6), photosynthates (Table 7) and nutritional status (Tables 8-10) which reflected on green seed yield, surely reflected on stored seed photosynthates.

The results presented in Table (11) show that the combined treatment of foliar application with ascorbic acid at the rate of  $300 \text{ mgL}^{-1}$  under sown calcium paste treated-seeds in beds fecundated with ground sunflower heads granted the highest values at 12.93% and 20.76% for the percentage of starch and protein, respectively as compared with the combined treatment of zero rate of ascorbic acid solution under sown calcium paste treated-seeds in beds fecundated with ground sunflower heads, and at 25.81% and 38.82% for the same parameter, respectively as comparison with the combined treatment of foliar application with water under sown calcium paste untreated-seeds in beds non-fecundated with ground sunflower heads. The favourable positive effect of  $\text{Ca}^{++}$ , ground sunflower heads and ascorbic

acid on tested growth traits (Table 3), photosynthetic pigments (Table 6) nutritional and photosynthates status (Tables 7-10) which positively reflected on green seed yield (Table 5), surely reflected on stored materials in these seeds.

**Table (11): Effect of calcium paste treated-or untreated-seeds sown in beds fecundated or non-fecundated with ground sunflower heads and foliar application with ascorbic acid on some stored components in green seeds of pea plants grown under reclaimed soil conditions during 2007/2008 and 2008/2009 seasons.**

Ascorbic acid (mgL <sup>-1</sup> )	2007/2008		Mean (B)	2008/2009		Mean (B)	Mean of the two seasons		Mean (B)
	-Ca <sup>+2</sup>	+Ca <sup>+2</sup>		-Ca <sup>+2</sup>	+Ca <sup>+2</sup>		-Ca <sup>+2</sup>	+Ca <sup>+2</sup>	
<b>Starch% (in fresh seeds)</b>									
0	4.69	5.20	4.95	4.61	5.15	4.88	4.65	5.18	4.92
100	4.88	5.52	5.20	4.73	5.40	5.07	4.81	5.46	5.14
200	4.99	5.69	5.34	5.00	5.61	5.31	5.00	5.65	5.33
300	5.31	5.83	5.57	5.24	5.86	5.55	5.28	5.85	5.56
400	5.30	5.85	5.58	5.24	5.82	5.53	5.27	5.84	5.56
Mean (A)	5.03	5.62		4.96	5.57		5.00	5.60	
LSD <sub>0.05</sub> A	0.15			0.13			0.14		
B	0.23			0.19			0.21		
AxB	0.27			0.23			0.25		
<b>Total soluble sugars% (in fresh seeds)</b>									
0	4.04	3.62	3.83	4.00	3.70	3.85	4.02	3.66	3.84
100	3.90	3.45	3.68	3.85	3.55	3.70	3.88	3.50	3.69
200	3.70	3.26	3.48	3.64	3.38	3.51	3.67	3.32	3.50
300	3.38	3.08	3.23	3.43	3.12	3.28	3.41	3.10	3.26
400	3.36	3.04	3.20	3.41	3.19	3.30	3.39	3.11	3.25
Mean (A)	3.68	3.29		3.67	3.39		3.67	3.34	
LSD <sub>0.05</sub> A	0.09			0.11			0.10		
B	0.14			0.16			0.15		
AxB	0.18			0.19			0.19		
<b>Protein% (in fresh seeds)</b>									
0	17.80	20.12	18.96	16.98	19.86	18.42	17.39	19.99	18.69
100	17.94	21.24	19.59	17.81	20.93	19.37	17.88	21.09	19.49
200	18.81	22.10	20.46	18.63	22.06	20.35	18.72	22.08	20.40
300	20.16	24.06	22.11	20.20	24.21	22.21	20.18	24.14	22.16
400	20.13	24.10	22.12	20.24	24.15	22.20	20.19	24.13	22.16
Mean (A)	18.97	22.32		18.77	22.24		18.87	22.29	
LSD <sub>0.05</sub> A	0.42			0.61			0.52		
B	0.63			0.93			0.78		
AxB	0.79			1.11			0.95		

+Ca = Seed covered with calcium paste and sown in beds fecundated with ground sunflower heads.

-Ca = Seed without calcium paste and sown in beds free from ground sunflower heads.

## Conclusion

Within the experimental conditions studied, it has been concluded that the work within hand gave an evidence to the role of Ca<sup>++</sup> (as a calcium paste covers the seeds before sowing) and ground sunflower heads (as a

material, having high water holding capacity, by which seed-beds were fecundated before planting) besides, the role of ascorbic acid (as an antioxidant by which plant foliage sprayed especially at the concentration of 300 mgL<sup>-1</sup>) in inducing salinity tolerance of pea plants cultivated in salt-affected reclaimed soils containing salts concentration at about 5000 ppm leading to favourable growth and consequently obtain economic yield under such contitions.

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## تأثير بعض المعاملات على النمو والقدرة المحصولية لنباتات البسلة النامية تحت ظروف الأراضي المستصلحة الملحية

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أجرى هذا البحث فى مزرعه خاصة - بالفيوم - مصر خلال موسمى ٢٠٠٧/٢٠٠٨ وذلك بهدف دراسة تأثير تغليف البذور بعجينة الكالسيوم وزراعتها فى مرآد تحتوى على كمية كافية من مخلفات أقراص عباد الشمس المطحون ثم رش النباتات الناتجة بحامض الأسكوربيك بتركيز صفر، ١٠٠، ٢٠٠، ٣٠٠، ٤٠٠ ملليجرام/لتر على إمكانية تحسين النمو والقدرة المحصولية لنباتات البسلة النامية تحت ظروف التربة المستصلحة المتأثرة بالأملاح (حوالى ٥٠٠٠ جزء فى المليون).

وتشير النتائج المتحصل عليها إلى:

- لوحظ تأثيرات إيجابية معنوية لمعاملة البذور بعجينة الكالسيوم وزراعتها فى مرآد تحتوى على كميات كافية من أقراص عباد الشمس المطحون و/أو جميع معاملات حامض الأسكوربيك على كل من صفات النمو ومحصولى القرون والبذور والخضراء ومكوناتها بالإضافة إلى جميع المكونات الكيميائية محل الدراسة بالمقارنة بنباتات الكنترول (الناتجة من بذور غير معاملة بعجينة الكالسيوم وزرعت فى مرآد غير مخصبة بمطحون أقراص عباد الشمس).
- وجد أن النباتات الناتجة من بذور عوملت بعجينة الكالسيوم ثم زرعت فى مرآد تحتوى على مطحون أقراص عباد الشمس أظهرت زيادات معنوية فى صفات النمو (ارتفاع النبات وعدد الأفرع/لبات والسوزن الجاف للمجموع الخضرى للنباتات) ومحصول القرون والخضراء ومكوناته (عدد القرون الخضراء/نبات ووزن القرن ومحصول القرون الخضراء/قدان) وأيضاً محصول البذور الخضراء ومكوناته (عدد البذور الخضراء/قرن ووزن البذرة ومحصول البذور الخضراء/قدان) وكذلك تركيزات جميع المكونات الكيميائية محل الدراسة (الكورفيل الكلى - الكاروتينويدات الكلية - حمض الأسكوربيك - البيروولين الحر - السكريات الكلية الذائبة - الفينولات الكلية - النيتروجين - الفوسفور - اليوناسيوم - الكالسيوم - نسبة الكالسيوم/الصوديوم - الحديد - المنجنيز - الزنك فى المجموع الخضرى للنباتات بالإضافة إلى نسبة النشا ونسبة البروتين مع نقص نسبة السكريات الكلية الذائبة فى البذور الخضراء).
- بالنسبة لمعاملة بحامض الأسكوربيك، فقد وجد أن النباتات التى عوملت برشا بدهة السادة بجميع التركيزات المستخدمة فى الدراسة (١٠٠، ٢٠٠، ٣٠٠، ٤٠٠ ملليجرام/لتر) أظهرت زيادات معنوية فى جميع القياسات المنجزة فى هذا البحث (مثل صفات النمو ومحصولى القرون والخضراء والبذور الخضراء ومكوناتها، وكذلك المكونات الكيميائية محل الدراسة (مع سلوك معاكس بالنسبة للصوديوم فى المجموع الخضرى للنباتات المعاملة وكذلك نسبة السكريات الكلية الذائبة فى البذور الخضراء) بالمقارنة بالنباتات غير المعاملة).
- وجد أن المعاملة التى تم فيها رش النباتات الناتجة من بذور تم تغليفها بعجينة الكالسيوم ثم زراعتها فى مرآد تحتوى على كمية كافية من مطحون أقراص عباد الشمس بحامض الأسكوربيك بتركيز ٣٠٠ ملليجرام/لترهى أفضل معاملة أعطت أفضل النتائج.
- فى ضوء تلك النتائج يمكن إستنتاج أن نتائج هذه الدراسة تلقى الضوء على دور كل من الكالسيوم كمغلف للبذور ومطحون أقراص عباد الشمس كحافظ للماء فى مناطق نمو الجذور بالإضافة إلى دور حامض الأسكوربيك كأحد مضادات الأكسدة (مواد طبيعية وأمنه) فى زيادة تحمل نباتات البسلة للملح. بناء على ذلك فإن إستخدام عجينة الكالسيوم لتغفيف البذرة ثم زراعتها فى مرآد تحتوى على كميات كافية من مطحون أقراص عباد الشمس ثم رش نباتات النسلة 'صنف ماسترى' الناتجة بحامض الأسكوربيك بتركيز ٣٠٠ ملليجرام/لتر لإنتاج نباتات يمكنها التغلب على الظروف البيئية الممنمة حاسمة للتأثيرات السخارية للملحة حتى تركيز ٥٠٠٠ جزء فى المليون فى الأراضي المستصلحة المتأثرة بالأملاح وبالتالي الحصول على محصول إقتصادي من القرون والبذور الخضراء فى ظل ظروف سابقة الذكر.