COMBINED EFFECT OF A POSSIBLE BEST TREATMENT FOR BOTH SOIL AND PLANT ON INCREASING THE SALT TOLERANCE IN SUGAR BEET PLANTS GROWN ON A CALCAREOUS SOIL UNDER SALINITY STRESS

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ABSTRACT

In an endeavour to alleviate the problems of salinity stress, some possible manipulation of soil and plant were evaluated. Two separate experiments were carried out to achieve the main objective of this research. The first was pot experiment, using sand culture technique to estimate the relative salt tolerance of four sugar beet varieties. The plants being treated with a mixture of NaCl and $CaCl_2$ (1:1 w/w) at levels of 1, 50, 100, 150 and 200 m mol_c L^{-1} after the third leaf had emerged. Results showed that Tribel was a relatively salt-tolerant and Ras poly was a relatively salt-sensitive variety.

The second was a field experiment, which carried out at Nubaria Agric. Res. Station in winter season 2004/2005 to study the combined effect of possible best treatments of both soil and plant on enhancing the salt-tolerance in relatively salt-sensitive variety (Ras poly) in calcareous soil under salinity conditions (ECe 10 dS/m). The soil amended with chicken manure treatments (0, 5 and 7.5 m^3/fed., while the plants treated with a combined (arginine and glutamic) amino acids, each in 0, 10, 20 and 30 mg/L, as well as potassium concentrations (0, 0.5, 1.0 and 1.5% K_2O) as foliar spray and/or foliarly applied after 40 and 60^{th} day of sowing. After the 120^{th} day of sowing, fresh and dry weight of both roots and shoots, water content, proline, K and Na contents were determined as well as Na/K ratio was calculated. Root yield, shoot yield, sucrose percentage in roots and gross sugar yield were also determined at harvesting stage.

Generally, results indicated that the application of chicken manure as well as combined (arginine and glutamic) amino acids and potassium to sugar beet plants through foliar spray was associated with an increase in fresh and dry weight, water content, proline and K content. For both roots and shoots after 4 months from sowing. Chicken manure was more effective particularly at 7.5 m^3/fed, opposite trend was observed in Na-content and Na/K ratio. Shoots being more affected. At harvesting, similar trends were observed in root and shoot yields as well as sucrose percentage and gross sugar yield in roots compared with untreated soil and plant treatments.

In fact, increasing levels of proline and potassium in plant tissues appears to function as compatible cytoplasmic solutes in osmotic adjustment. Also, results indicated the ability of salt-sensitive variety of sugar beet plant treated with chicken manure (7.5 m^3/fed) treatment followed by foliar application with combined (arginine and glutamic) amino acids and potassium at rates of 20 mg/L and 1% respectively, to withstand unfavorable effect of salinity stress in calcareous soils.

Key words: Salinity stress, sugar beet, amino acids, potassium, chicken manure, proline, foliar application and calcareous soils

INTRODUCTION

Salinity represents one of the most serious limiting factors for growth and production, inducing morphological, structural and metabolic modifications in higher plants. Growth inhibition due to salt stress may be caused by osmotic effects, ion toxicity, ion imbalance or a combination of these factors. The response of plants to salinity stress differs greatly among various plants. The management of salt affected soils requires a good understanding of crop salinity relations and particularly under field conditions. Sugar beet has become one of the strategic crops in Egypt, an important crop for sugar production and a tolerant plant to salinity (Mass, 1986). Recent studies have shown that dry matter yield of relatively salt- resistant sugar beet plants was less affected by salinity than relatively salt-sensitive ones, where roots are being more affected, (Zein *et al.*, 2002).

Furthermore, tailoring of plants to tolerate salinity stress environments is necessarily needed. This should depend on the development of plant biotechnology research. Until the development had been achieved, the use and modification of some possible treatments of soil and plant should partly increase the crop salt tolerance through alleviating some salinity adversities.

Regarding the role of chicken manure as a possible treatment of soils in avoiding the problem of salinity stress, Amer (1989) stated that application of chicken manure has an effective role in coping salinity stress through improving the status of soil-moisture-plant interrelationship. This may be due to the modification in pore size and shape and consequently improving the soil porosity (Peglial *et al.*, 1987). Also, its addition maintains availability of some micro-nutrients, e.g. Fe, Mn, Zn and Cu (Reda and Amer, 1999), and increase both soil soluble K^+ and Ca^{++} and consequently adjusts soil soluble Na^+/K^+, Na^+/Ca^{++} and Ca^{++}/Mg^{++} ratios, this may be effective in maintaining the membrane function of root cells, against salinity stress (Amer, 1989). Thus, it can be suggested that chicken manure application may avoid the severe imbalance in the essential nutrient ions under relatively high salinity stress.

Considering the addition of some certain amino acids and Potassium through foliar application to enhance the sensitive varieties of plants to salt tolerance. El-Leboudi *et al.* (1997) stated that glutamic acid could be used as an important biochemical marker to enhance plant salt tolerance, through its transformation to proline under salinity stress. Arginine was also reported to be degraded to proline through synthesis of ornosine which may be reversibly converted to glutamic-semialdhyde considered to produce proline under salinity stress (Sudhakar *et al.*, 1993). The tolerant plants were associated with restricted accumulation of both inorganic and organic solutes in their tissues. It is commonly known as "osmotic adjustment" which is believed to reduce the water potential in plant cells. Among these Na, K, proline and free amino acids "compatible solutes" are known to be osmotically active (Glenn *et al.*, 1994 and Abdel-Aziz &Reda, 2000).

The current investigation aims at inducing a further increase in salt tolerance of relatively salt- sensitive variety of sugar beet plant grown on a saline calcareous soil, through a dual treatment of both soil and plant. The soil is treated with chicken manure followed by plant treatment with foliar application of amino acids and potassium.

MATERIALS AND METHODS

To achieve the aforementioned objective of this research, the experimental work was carried out as follows:

Experiment 1:

The purpose of this experiment was to conducted estimate the relative salt tolerance of four sugar beet varieties i.e., Tribel, Maribo Marocpoly, Ras poly and Kawegiga Mono. Sand culture technique was used, which sand passing through a 2 mm sieve being thoroughly washed with HCl and thereafter with distilled water.

Polyethylene pots of 30 cm diameter and an orifice in bottom, to facilitate flushing, were used and each received 8 kg portion of washed dried sand. Five seeds of sugar beet were sown and seedlings were thinned after 15 days, to 2 plants per pot.

The pots were first regularly flushed with nutrient solution of Arnon (1937) until the third leaf emerged, micro elements being involved: later on, the indicated nutrient solution was continued to the applied accompanied with the concerned salts. Pots were later divided into five groups. One was treated with 1 m mol_c ($NaCl+CaCl_2$)/L (1:1 w/w) as a control, and others received 50 m mol_c ($NaCl+CaCl_2$)/L per day to obtain the following saline treatments:50, 100, 150 and 200 m mol_c ($NaCl+CaCl_2$)/L. The experiment was planned in a complete randomized design with having three replicates. Fresh and dry weights of roots and shoots were recorded at 4 months after treated with ($NaCl+ CaCl_2$).

Experiment 2:

A field experiment was carried out in Nubaria Agric. Res Station to study the enhancing of relatively salt sensitive variety of sugar beet (Ras poly) to salinity conditions through treating the soil with chicken manure and plant with amino acids and potassium. Some physical and chemical properties of the experimental soil are shown in Table (1). The soil is highly saline (EC_e 10 dS/m).

The experiment was carried out using spilt- spilt plot design with three replicates. The main plot was divided into three treatments supplanted with application of chicken manure at rates of 0, 5 and 7.5 m^3/fed, mixed with the 30 cm of surface soil during soil preparation. Some characteristics of the used chicken manure are shown in Table (2). The submain plot was divided into four sub-treatments having, the combined (arginine and glutamic) amino acids, each having 0, 10, 20 and 30 mg/L while the sub-subtreatments were potassium treatments at four rates (0, 0.5, 1.0 and 1.5 % K_2O). The amino acids and potassium treatments were added two times as foliar spray after 40 and 60 days from planting. The area of each plot was 12.0 m^2 (5 ridges, 4 m long with 0.60 m width). It was ploughed twice in two ways and received superphosphate (15% P_2O_5) at a rate of 100 kg/fed before the second ploughing.

Table (1): Some physical and chemical properties of the investigated soil.

Soil characteristics	Value
Particle size distribution (%):	
Coarse sand	11.75
Fine sand	37.10
Silt	18.03
Clay	33.12
Textural class	Sandy clay loam
Soil chemical analysis :	
PH(1 :2.5, soil suspension)	8.1
Calcium carbonate (%)	28.8
Organic matter (%)	0.49
Total nitrogen (%)	0.063
Soil paste extract:	
ECe in dS/m (soil paste)	10.40
Ca^{++} (m mol_c L^{-1})	33.40
Mg^{++} (m mol_c L^{-1})	19.60
Na^{+} (m mol_c L^{-1})	45.60
K^{+} (m mol_c L^{-1})	5.23
HCO_3^{-} (m mol_c L^{-1})	4.61
CO_3^{--} (m mol_c L^{-1})	-----
Cl^{-} (m mol_c L^{-1})	66.10
SO_4^{--} (m mol_c L^{-1})	33.12
Available N (mg kg^{-1})	516
Available P (mg kg^{-1})	14.2
Available K (mg kg^{-1})	219

Table (2): Some characteristics of the used chicken manure.

Characteristics	Value
Weight of 1 m^3 (kg)	570
Organic carbon (%)	30.2
Total N (%)	1.61
Total P (%)	0.46
Total K (%)	1.93
PH (1 :5)	7.46
C/N ratio	18.76
Available N (mg kg^{-1})	1887
Available P (mg kg^{-1})	460
Available K (mg kg^{-1})	783

Sugar beet seeds (Ras poly) as relatively salt sensitive variety, were sown at the mid of Nov. (2004) under furrow irrigation system. Nitrogen and potassium fertilizers were added to the soil in two equal doses during the growing period (after 40 and 60 days from sowing) in the form of ammonium sulphate (20.5% N) and potassium sulphate (48% k_2O) at rates of 80 kg N/fed and 50 kg K_2O/fed., respectively. Three seeds were sown in each hill; 20 cm between hills. Plants were thinned to one plant per hill after 40 days from sowing. Representative samples of shoots and roots were taken after 4 months, to record fresh and dry weights of roots and shoots. Plant samples were dried at 70 °C and ground to be then wet digested using H_2SO_4+H_2O_2 mixture as described by Cottenie (1980), the extracts being subjected to determination of sodium and potassium, flame photometrically. In addition, ion balance within plant tissue was calculated as Na/K ratio. Free proline concentration in both roots and shoots was determined using the method of Bates *et al.* (1973).

At harvest (6 months of age), yields of roots and shoots were recorded. In roots, sucrose percentage was determined according to Le Docte (1927) and gross sugar yield (ton/ha) was calculated from root yield (ton/ha) × sucrose%.

RESULTS AND DISCUSSION

1- Evaluation studies for salt tolerance:-

As mentioned in the section of materials and methods, evaluation studies have been performed to select the relatively salt sensitive variety of sugar beet, to salinity developed through use of a mixture of both NaCl and $CaCl_2$ salts applied at different concentrations.

Table (3) indicated that the studied four varieties of sugar beet (Trible, Maribo Marocpoly, Ras poly and Kawegiga Mono) varied appreciably in their relative salt tolerance. Evaluation was performed through growth behaviour as affected by different levels of the applied mixture of NaCl and $CaCl_2$ (1:1 w/w). Generally, the results showed that increasing salinity level (from 1-200 m mol_c/L) consistently decreased the dry matter yield of roots, shoots and whole plants particularly for Ras poly which is considered to be relatively salt-sensitive, shoots being more affected. These results are in agreement with those of Mohamed *et al.* (1995). This variation may be attributed to "physiological drought" and/or through ionic imbalance causing deplation of energy required for metabolism (Rahman *et al.,* 1993).

Variation in responses of the four studied varieties are in agreement with those reported by Zein *et al.* (2002) who showed that roots and shoots dry matter yield of relatively salt sensitive sugar beet plant were more affected by salinity than relatively resistant ones, particularly the dry matter yield of shoots. Such responses were reported also by Subramanian (1979) and El-Sayed (1997) to be mainly due to genetic and biochemical make up of the species as salt tolerance ability is ultimately attributed to genetic and biochemical characteristics.

From the previously mentioned presentation of obtained data, Ras poly was relatively salt-sensitive variety and Tribel was relatively salt-tolerant variety, the adverse effect of salinity on sugar beet growth was more obvious in shoots than in roots. This adverse effect is mainly due to Na^+ toxicity, particularly what concerning effects on metabolic processes "physiological drought".

2- Enhancing of plant salt tolerance:

An approach for evaluating the possibility of enhancing the plant salt tolerance in the relatively salt sensitive variety of sugar beet plants with foliar application of amino acids and potassium, as well as soil application with chicken manure in saline calcareous soil, was

Table (3): Effect of applied salinity levels on dry matter yield (g/plant) of the four sugar beet varieties

Salinity levels (m mol_c L^{-1})	Roots								Shoots								Whole plant							
	V_1		V_2		V_3		V_4		V_1		V_2		V_3		V_4		V_1		V_2		V_3		V_4	
	g/plant	R.P.*	g/plant	R.P.*	g/plant	R.P.*	g/plant	R.P.*	g/plant	R.P.*	g/plant	R.P.*	g/plant	R.P.*	g/plant	R.P.*	g/plant	R.P.*	g/plant	R.P.*	g/plant	R.P.*	g/plant	R.P.*
Control	93.5	100	84.4	100	88.8	100	85.3	100	58.8	100	51.8	100	48.3	100	53.6	100	152.3	100	136.2	100	137.1	100	138.9	100
50	91.6	98	82.7	98	86.6	97	83.6	98	56.4	96	49.2	95	45.9	95	51.5	96	148.0	97	131.2	97	132.5	97	135.1	97
100	89.6	94	79.3	94	82.6	93	78.5	92	54.7	93	46.6	90	44.0	91	49.8	93	144.3	95	125.9	92	126.6	92	128.3	92
150	83.2	89	70.1	83	72.8	82	75.1	88	47.0	80	38.3	74	32.8	68	40.7	76	130.2	85	108.4	80	105.6	77	115.8	83
200	76.7	82	61.6	73	53.3	60	66.5	78	42.9	73	33.7	65	25.6	53	36.4	68	119.6	79	95.3	70	78.9	58	102.9	74

R.P* = (treatment/control)×100

V_1: Tribed V_2 = Maribo Marcopoly V_3 = Ras Poly V_4 = Kawegiga Mono performed through the determination of fresh and dry weights of roots and shoots, water content, proline content, K and Na contents as well as Na/K ratio of the studied plant at 4 months from sowing, as well as roots and shoots yields and roots contents of sucrose and gross sugar yield.

2.1. Fresh and dry weight of roots and shoots:

Tables (4 and 5) showed that increasing the concentration of foliar application with amino acids and potassium, as well as soil application rates of chicken manure, generally, increased fresh and dry weight for roots and shoots as well as their water content of sugar beet plant, chicken manure was more stimulatory effect particularly when combined with foliar application of amino acids and potassium compared with other treatments. These results are particularly in agreement with those of Reda and Amer (1999) who found that relative growth yield of the relatively salt sensitive variety of barley showed some positive response to foliar application of lysine, histidine and arginine amino acids under salinity stress, particularly arginine amino acid. Thus, arginine had a promising effect on enhancing the plant salt tolerance. Abdel-Aziz *et al.* (1987) reported that the highest yield of fresh root of sugar beet plant was attained for plants fertilized with foliar spray with 800 mg L^{-1} K_2O.

Data also showed that foliar application of 30 mg L^{-1} amino acids and 1.5% K_2O improved plant growth and water content compared to lowest (zero for each) treatments, while applying chicken manure at rate of 7.5 m^3/fed together with foliar application 20 mg L^{-1} amino acids and 1% K_2O hardly approached the proper development obtained by 30 mg L^{-1} and 1.5% for amino acids and potassium, respectively, shoots being more affected. This result agreed with Amer (1989) and Reda & Amer (1999) who reported that applying chicken manure followed by foliar application of proline, glutamic and arginine amino acids, at the seedling stage of barley plants shows promising effect of against salinity stress.

Regarding the role of chicken manure in avoiding the problem of salinity stress, it could be stated that the application of chicken manure has an effective role in coping salinity stress through improving the status of soil- moisture-plant interrelationship (Amer, 1989). This may be due to the modification in pore size and shape; and consequently improving the soil porosity (Peglial *et al.*, 1987). Also, its addition

Table (4): Fresh weight, dry weight and water content (g H_2O/ plant and g H_2O/ g dry weight) in roots of the relatively salt sensitive variety of sugar beet as affected by the application of chicken manure, amino acids and potassium under salinity conditions in calcareous soil.

Amino acids levels (meq/L)	Chicken manure rates											
	0.0 m^3/fed				5.0 m^3/fed				7.5 m^3/fed			
	Rate of applied K_2O				Rate of applied K_2O				Rate of applied K_2O			
	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%
	Fresh weight (g/plant)											
0	218	226	240	242	235	252	278	276	249	262	280	284
10	227	239	255	260	244	260	283	287	258	269	295	295
20	241	248	274	271	259	282	293	293	276	294	310	310
30	243	256	275	280	266	283	296	296	281	298	308	310
	Dry weight (g/plant)											
0	56.6	57.9	60.7	60.6	60.5	64.0	68.1	66.7	63.6	66.1	68.2	68.3
10	58.4	60.6	64.0	64.5	62.3	65.1	69.1	69.1	65.1	67.4	71.3	70.2
20	61.1	62.3	66.8	65.7	65.1	68.5	70.2	69.6	67.4	71.3	74.1	73.0
30	61.0	62.3	66.2	66.8	65.7	67.9	70.8	70.2	67.9	71.3	73.6	73.0
	Water content (g H_2O/plant)											
0	161.4	168.1	179.3	181.4	174.5	188.0	209.9	209.3	185.4	195.9	211.8	215.7
10	168.6	178.4	191.0	195.5	181.7	194.9	213.9	217.9	192.9	201.6	223.7	224.8
20	179.9	185.7	207.2	206.8	193.9	213.5	222.8	223.4	208.6	222.7	235.9	237.0
30	182.0	193.7	208.8	213.2	200.3	215.1	225.2	225.8	213.1	226.7	234.4	237.0
	Water content (g H_2O/g dry weight)											
0	2.85	2.85	2.95	2.99	2.88	2.94	3.08	3.14	2.92	2.96	3.11	3.16
10	2.89	2.89	2.95	3.03	2.92	2.99	3.10	3.15	2.96	2.99	3.14	3.20
20	2.94	2.94	3.10	3.12	2.98	3.12	3.17	3.21	3.09	3.12	3.18	3.22
30	2.95	2.95	3.15	3.19	3.05	3.17	3.18	3.22	3.14	3.18	3.19	3.24

Amino acids levels (meq/L)	Chicken manure rates											
	0.0 m^3/fed				5.0 m^3/fed				7.5 m^3/fed			
	Rate of applied K_2O				Rate of applied K_2O				Rate of applied K_2O			
	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%
	Relative increase (%)											
0	0.00	3.67	10.1	11.1	7.80	15.6	27.5	26.6	14.2	20.2	28.4	30.3
10	4.13	9.63	17.0	19.3	12.0	19.3	29.8	31.7	18.3	23.4	35.3	35.3
20	10.6	13.8	25.7	24.3	18.8	29.4	34.4	34.4	26.6	34.9	42.2	42.2
30	11.5	17.4	28.4	22.0	22.0	29.4	35.8	35.8	28.9	36.7	41.3	42.2
	Relative increase (%)											
0	0.00	2.30	7.24	7.10	6.90	13.1	20.3	17.8	12.4	16.8	20.5	20.8
10	3.18	7.10	13.1	14.0	10.1	15.0	22.1	22.1	15.0	19.1	26.0	24.0
20	8.00	10.1	18.0	16.1	15.0	21.0	24.0	23.1	19.1	26.0	31.0	29.0
30	7.80	10.1	17.0	18.0	16.1	20.0	25.1	24.0	20.0	26.0	30.0	29.0
	Relative increase											
0	0.00	4.20	11.1	12.4	8.11	16.5	30.0	29.7	14.9	21.4	31.2	33.6
10	4.50	10.5	18.3	21.1	12.6	20.8	32.5	35.0	19.5	24.9	38.6	39.3
20	11.5	15.1	28.4	27.2	20.1	32.3	38.0	38.4	29.2	38.0	46.2	46.8
30	12.8	20.1	29.4	32.0	24.1	33.3	39.5	39.9	32.0	40.5	45.2	46.8
	Relative increase (%)											
0	0.00	1.75	3.51	4.91	1.05	3.16	8.07	10.2	2.46	3.86	9.12	10.9
10	1.40	3.16	3.51	6.32	8.77	4.91	8.77	10.5	3.86	4.91	10.2	12.3
20	3.16	4.56	8.77	9.47	4.56	9.47	11.2	12.6	8.42	9.47	11.6	13.0
30	3.51	9.12	10.53	11.9	7.02	11.2	11.6	13.0	10.2	11.6	11.9	13.7

Control: untreated soil plants

$$\text{(Relative increase percentage)} = \frac{\text{(Treatment} - \text{control)}}{\text{Control}} \times 100$$

Table (5): Fresh weight, dry weight and water content (g H_2O/ plant and g H_2O/ g dry weight) in shoots of the relatively salt sensitive variety of sugar beet as affected by the application of chicken manure, amino acids and potassium under salinity conditions in calcareous soil.

Amino acids levels (m mol. L^{-1})	Chicken manure rates																							
	0.0 m^3/fed				5.0 m^3/fed				7.5 m^3/fed				0.0 m^3/fed				5.0 m^3/fed				7.5 m^3/fed			
	Rate of applied K_2O				Rate of applied K_2O				Rate of applied K_2O				Rate of applied K_2O				Rate of applied K_2O				Rate of applied K_2O			
	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%
	Fresh weight (g/plant)												Relative increase (%)											
0	170	196	216	220	200	217	234	245	214	235	252	255	0.00	15.3	27.1	29.4	17.6	27.6	37.6	44.1	25.9	38.2	48.2	50.0
10	203	217	234	238	223	236	255	257	240	259	264	266	19.4	27.6	37.6	40.0	31.2	38.8	50.0	51.2	41.2	52.4	55.3	56.5
20	225	239	254	257	245	255	264	266	261	271	277	278	32.4	40.6	49.4	51.2	44.1	50.0	55.3	56.5	53.5	59.4	62.9	63.5
30	228	242	258	258	245	258	266	268	261	274	278	283	34.1	42.4	51.8	51.8	44.1	51.8	56.5	57.6	53.5	61.2	63.5	66.5
	Dry weight (g/plant)												Relative increase (%)											
0	30.3	340	36.7	36.7	35.1	37.0	39.4	39.7	36.4	39.4	41.2	41.2	0.00	12.2	21.1	21.1	15.8	22.1	30.0	31.0	20.1	30.0	36.0	36.0
10	34.8	36.7	39.1	39.4	37.6	39.4	41.5	41.5	39.1	41.8	42.1	42.1	14.9	21.1	29.0	30.0	24.1	30.0	37.0	37.0	29.0	38.0	39.0	39.0
20	37.9	39.1	41.2	41.5	40.1	41.2	42.4	42.4	42.1	43.3	43.9	43.3	25.1	29.0	36.0	37.0	32.3	36.0	39.3	39.3	38.9	42.9	44.9	42.9
30	37.9	39.4	41.5	41.5	39.7	41.5	42.4	42.4	41.8	43.6	43.9	44.1	25.1	30.0	37.0	37.0	31.0	37.0	39.3	39.3	38.0	43.9	44.9	45.5
	Water content (g H_2O/plant)												Relative increase											
0	139.7	162.3	179.3	183.3	164.9	180.0	194.6	205.3	177.6	195.6	210.8	213.8	0.00	16.2	28.3	31.2	18.0	28.8	39.3	47.0	27.1	40.0	50.9	53.0
10	168.2	180.3	194.9	198.6	185.4	196.6	213.5	215.5	200.9	217.2	221.9	223.9	20.4	29.1	39.5	42.2	32.7	40.7	52.8	54.3	43.8	55.5	58.8	60.3
20	187.1	199.9	212.8	215.5	204.9	213.8	221.6	223.6	218.9	227.7	233.1	234.7	33.9	43.1	52.3	54.3	46.7	53.0	58.6	60.1	56.7	63.0	66.9	68.0
30	190.1	202.6	216.5	216.5	205.3	216.5	223.6	225.6	219.2	230.4	234.1	238.9	36.1	45.0	55.0	55.0	47.0	55.0	60.1	61.5	56.9	64.9	97.7	71.0
	Water content (g H_2O/g dry weight)												Relative increase (%)											
0	4.61	4.76	4.89	4.99	4.70	4.86	4.94	5.17	4.88	4.96	5.12	5.19	0.00	3.25	6.07	8.24	1.9.5	5.42	7.16	12.2	5.86	7.59	11.1	12.6
10	4.83	4.91	4.94	5.04	4.93	4.99	5.14	5.19	5.14	5.20	5.27	5.32	4.77	6.51	7.16	9.33	6.94	8.24	11.5	12.6	11.5	12.8	14.8	15.4
20	4.94	5.16	5.17	5.19	5.11	5.19	5.23	5.27	5.20	5.26	5.31	5.42	7.16	11.9	12.2	12.6	10.9	12.6	13.5	14.3	12.8	14.1	15.2	17.6
30	5.02	5.14	5.22	5.22	5.17	5.22	5.27	5.32	5.24	5.28	5.33	5.42	8.89	11.5	13.2	13.2	12.2	13.2	14.3	15.4	13.7	14.5	15.6	17.6

Control: untreated soil plants

$$\text{(Relative increase percentage)} = \frac{\text{(Treatment} - \text{control)}}{\text{Control}} \times 100$$

maintains the availability of some soil nutrients; K^+, Ca^{2+}, Fe^{2+}, Mn^{2+} and Cu^{2+} high, in calcareous soil against salinity stress (Reda and Amer, 1999 and Basyouny *et al.,* 2003). It can be deduced that chicken manure application may avoid the severe imbalance in the essential nutrient ions under salinity stress.

2.2. Proline content:

The gradually increase in the accumulation of proline in salt-tolerance sugar beet variety than salt-sensitive ones, proves the relationship between proline accumulation and salinity tolerance in sugar beet plant (Mohamed *et al.,* 1995), so, proline amino acid was determined in this experiment. Data in Table (6) represent values of proline content in both roots and shoots of relative salt-sensitive variety of sugar beet (Ras poly), after 4 months of sowing, as influenced by different rates of chicken manure application followed by foliar application of both (arginine + glutamic) amino acids and potassium under salinity stress in the calcareous soil. Generally, increasing levels of foliar application treatments as well as the rates of chicken manure, was associated with an increase in proline content compared with untreated treatments. However, proline content in roots was less than in shoots. This is possibly due to the glutamate transformation in shoots to proline amino acid under salinity stress (El-Leboudi *et al.,* 1997). Arginine was also reported to be degraded to proline through synthsis of ornosine which may be reversibly converted to glutamic senoialdehyde considered to produce proline as a result of higher activity of d-pyrroline-5-carboxilic enzyme under salinity stress (Sudhakar *et al.,* 1993).Moreover, Begum and Karmoker (1999) suggested that proline produced in leaf is transported to the root, thereby, helping the plant to regulate the osmotic potential of root cells under salinity stress.

It may be worthy to mention that foliar application with 30 mg L^{-1} and 1.5% of combined amino acids and potassium, respectively, gave slightly higher values of proline content, in comparison to 20 mg L^{-1} and 1%, respectively, combined amino acids treatments were more effective than potassium treatments, particularly in the presence of 7.5 m^3/fed of chicken manure treatment compared with the other treatments. These results agree with those obtained by Reda *et al.* (2003).

Table (6): Proline amino acid, potassium and sodium contents as well as Na/K ratio in both roots and shoots of the relatively salt sensitive variety of sugar beet as affected by the application of chicken manure, amino acids and potassium under salinity conditions in calcareous soil.

Amino acids levels (meq/L)	Chicken manure rates																							
	Roots												Shoots											
	0.0 m^3/fed				5.0 m^3/fed				7.5 m^3/fed				0.0 m^3/fed				5.0 m^3/fed				7.5 m^3/fed			
	Rate of applied K_2O				Rate of applied K_2O				Rate of applied K_2O				Rate of applied K_2O				Rate of applied K_2O				Rate of applied K_2O			
	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%
	Proline (µmol/g F.wt.)												Proline (µmol/g F.wt.)											
0	1.69	1.71	1.73	1.73	1.76	1.79	1.79	1.81	1.83	1.86	1.88	1.89	5.18	5.30	5.29	5.29	5.21	5.33	5.34	5.32	5.35	5.39	5.39	5.41
10	1.72	1.74	1.76	1.77	1.78	1.81	1.83	1.82	1.86	1.88	1.89	1.89	5.79	5.81	5.84	5.86	5.86	5.89	5.93	5.96	5.93	5.99	6.12	6.16
20	1.78	1.80	1.86	1.87	1.84	1.86	1.89	1.89	1.90	1.93	1.96	1.97	5.86	5.90	5.95	5.96	5.93	5.99	6.09	6.12	6.03	6.14	6.29	6.30
30	1.81	1.84	1.86	1.87	18.9	1.89	1.94	1.96	1.95	1.98	1.97	1.98	5.91	5.97	5.99	6.00	5.94	6.10	6.16	6.20	6.17	6.19	6.29	6.30
	Potassium (%)												Potassium (%)											
0	1.55	1.56	1.56	1.54	1.68	1.70	1.78	1.78	1.83	1.86	1.89	1.91	1.68	1.87	1.91	1.92	1.72	1.90	1.95	1.96	1.84	1.90	2.00	2.07
10	1.56	1.57	1.58	1.56	1.69	1.71	1.79	1.78	1.85	1.89	1.91	1.90	1.80	1.90	1.98	1.99	1.85	1.96	2.09	2.11	1.87	1.99	2.15	2.15
20	1.57	1.58	1.59	1.58	1.70	1.72	1.79	1.79	1.86	1.88	1.94	1.93	1.96	1.99	2.10	2.09	1.99	2.15	2.19	2.20	2.10	2.16	2.21	2.23
30	1.55	1.57	1.58	1.59	1.70	1.72	1.79	1.79	1.86	1.89	1.93	1.94	1.99	2.05	2.10	2.10	2.04	2.17	2.18	2.21	2.15	2.19	2.21	2.22
	Sodium (%)												Sodium (%)											
0	3.89	3.83	3.83	3.81	3.71	3.65	3.60	3.61	3.25	3.18	3.11	3.10	2.76	2.72	2.69	2.68	2.70	2.67	2.61	2.58	2.63	2.58	2.51	2.46
10	3.86	3.82	3.82	3.82	3.68	3.61	3.52	3.50	3.23	3.16	3.00	2.94	2.71	2.68	2.66	2.65	2.65	2.60	2.55	2.53	2.60	2.53	2.43	2.40
20	3.88	3.80	3.80	3.81	3.66	3.60	3.50	3.49	3.20	3.14	2.95	2.92	2.69	2.66	2.60	2.61	2.60	2.54	2.50	2.49	2.64	2.48	2.40	2.38
30	3.88	3.80	3.80	3.81	3.66	3.60	3.50	3.50	3.21	3.15	2.96	2.92	2.67	2.66	2.61	2.60	2.57	2.51	2.46	2.46	2.50	2.41	2.37	2.36
	Na/K ratio												Na/K ratio											
0	2.51	2.46	2.46	2.47	2.21	2.15	2.02	2.03	1.78	1.71	1.65	1.62	1.64	1.45	1.41	1.40	1.57	1.41	1.34	1.32	1.43	1.32	1.26	1.19
10	2.47	2.42	2.42	2.45	2.18	2.11	1.97	1.97	1.75	1.72	1.57	1.55	1.51	1.41	1.34	1.33	1.43	1.33	1.22	1.20	1.39	1.27	1.13	1.12
20	2.47	2.39	2.39	2.41	2.15	2.09	1.96	1.95	1.72	1.67	1.52	1.51	1.37	1.34	1.24	1.25	1.31	1.18	1.14	1.13	1.22	1.15	1.09	1.07
30	2.50	2.41	2.41	2.40	2.15	2.09	1.96	1.96	1.73	1.67	1.53	1.51	1.34	1.30	1.24	1.24	1.26	1.16	1.13	1.11	1.16	1.10	1.07	1.06

Control: untreated soil plants

$$\text{(Relative increase percentage)} = \frac{\text{(Treatment} - \text{control)}}{\text{Control}} \times 100$$

2.3. Potassium content:

As known potassium is an essential plant nutrient which plays special roles in membrane transport processes along with establishment for the cell ionic and osmotic equilibria particularly under saline conditions (Clarkson and Hanson, 1980). Accordingly, K-content was thought to be evaluated and shown in Table (6). Data indicated that sprayed the relatively salt sensitive variety of sugar beet plant (Ras poly) with potassium and amino acids amended with chicken manure enhanced the content of K. Whereas increasing the level of each treatment increased K-content in both root and shoots of plants under salinity conditions. These results are in consistent with that of Shaddad (1990) upon spraying different levels of proline, El-Habbasha *et al.* (1996) upon spraying potassium and upon Basyouny *et al.* (2003) using chicken manure.

As expected, response of K-content in roots and shoots of sugar beet plants at 120th day of sowing seemed to give a similar trend to that of proline content, when chicken manure was applied at rate of (7.5 m^3/fed) combined with foliar application at rates of 20 mg L^{-1} and 1% amino acids and potassium, respectively, were hardly approached the proper development obtained by 30 mg L^{-1} and 1.5%. K-content in shoots was better than in roots.

2.3. Sodium content:

The content of sodium in the relatively salt sensitive variety of sugar beet at 120th days of sowing, was affected by different treatments of chicken manure, amino acids and potassium (Table 6).Na-content in both shoots and roots of sugar beet plants was decreased with increasing the levels of chicken manure; amino acids and potassium compared with zero level (untreated soil and plants). Chicken manure at a rate of 7.5 m^3/fed was more pronounced particularly in roots. Also, data showed that foliar application with 20 mg L^{-1} and 1% of amino acids and potassium, respectively, decreased Na-content in plants. However, application of both amino acids and potassium beyond these levels slightly decreased N content particularly in absence of chicken manure application. Such results indicated the ability of plants treated with amino acids and potassium together with organic manure to withstand the unfavorable effect of soil salinity.

Lone and Wynjones (1985) suggested that foliar application of some certain amino acids increased the capacity of salt tolerance in plants, through the exclusion of Na^+ from shoots tissue without apparently affecting the absorption by root, other possibility through the increase of ion compartment or a direct protective effect of the solute.

In calcareous soil under salinity stress, the addition of chicken manure to the soil further increased both soil soluble K^+ and Ca^{2+} and consequently decreased Na^+-absorption by root (Amer, 1989), due to an antagonistic effect between Na^+ and both K^+ or Ca^{2+} ions (Gawish *et al.* 1999). Also, this may be effective in maintaining membrane function of the root cells (Shannon, 1984 and Gorham *et al.,* 1985), or the elongation of plant cell walls involves the orderly creation and breakage of cross-linkages within the pectic fraction. One of the major function of Ca^{2+} is regulate this process, therefore, the maintaining of Ca^{2+} at particular levels are critical on melat ion toxicity under salinity stress (Gawish *et al.,* 1999).

2.4. Na/K ratio:

An approach for evaluating the nutrient balance within plant tissues was thought to be performed through calculating Na/K ratio in both roots and shoots for relatively salt-sensitive plant. Calculated values shown in Table (6) indicated that the concerned ratio was higher (2.51 and 1.64) for roots and shoots respectively, at zero levels of applied chicken manure, amino acids and potassium. Such values being decreased with increasing the levels of each treatment, to be (1.5 and 1.06) at their highest used rates for roots and shoots, respectively. Also, data showed that Na/K ratio was always higher in roots than in shoots of plants, indicating that Na was less absorbed by roots and less translocated to shoots. This finding agrees with that obtained by Li and Liu (1993) who reported that the ratio of Na/K in leaves and roots was lower in salt-tolerant plants than salt-sensitive ones. So, salt tolerance was the results of higher selectivity for K than Na.

Regarding the role of chicken manure in avoiding the problem of salinity stress, it could be stated that the application of chicken manure has an effective role in coping salinity stress through maintaining high availability of K^+ and Ca^{2+}, and consequently adjusted the soil soluble

Na/K, Na/Ca and Ca/Mg ratio, presumably due to maintaining the membrane function of root cells under salinity stress (**Amer, 1989**).

3- Roots and shoots yields as well as sucrose content and gross sugar yield in roots:

The effect of different rates of chicken manure as soil application on increasing the yield, sucrose percentage and gross sugar yield of salt sensitive variety of sugar beet, using four levels for each amino acids and potassium as foliar application was observed. Obtained results recorded in Table (7) showed that the roots yield, shoots yield, sucrose percentage in root and gross sugar yield of the studied plant were promoted by soil and plants treatments separately or combined together compared with the control (untreated soil or plants) treatments. Very low values were attributed to foliar application with zero amino acids and potassium level, particularly without chicken manure treatment (40.1 ton/h, 28.4 ton/h, 12.11% and 4.86 ton/h) for root yield, shoot yield, sucrose percentage and gross sugar yield in roots, respectively. They increased and reached 48.0 ton/h., 37.8 ton/h., 14.31% and 6.87 ton/h for chicken manure at a rate of 7.5 m^3/fed followed by foliar application with 20 mg L^{-1} and 1% for amino acids and potassium respectively. These results agree with those obtained by Shaddad (1990) upon spraying radish shoots with 200 g/m^3 proline amino acid., El-Shazly (2001) upon spraying wheat shoots with 30 mg L^{-1} proline amino acid, Reda and Amer (1999) upon spraying arginine, hestidine and lysine amino acids on barely shoots, under salinity stress, where these amino acids minimized the decreasing rate of relative growth yield of both roots and shoots under salinity conditions, through increasing its capacity of salt tolerance. Also, Abou El-Defan *et al.* (1991) on wheat plants and El-Habasha *et al.* (1996) on pea plants, stated that treating plants with foliar application of potassium resulted in increase in growth yield. Abdel-Aziz *et al.* (1987) reported that the highest yield of fresh root and sucrose content of sugar beet were attained for plant fertilized with foliar spray at rate of 800 mg K L^{-1}. While, Carter (1986) and Zein *et al.* (2002) reported that the reduction in values of sucrose percentage and gross sugar yield for tested sugar beet cultivars under salinity conditions, may be due to increasing Na concentration or decreasing K/Na ratio in root tissues.

Table (7): Root and shoot yields, sucrose content and gross sugar yield of the relatively salt sensitive variety of sugar beet as affected by the application of chicken manure, amino acids and potassium under salinity conditions in calcareous soil.

Chicken manure (m^3/fed)	Amino acids levels (mg/L)	Root yield (ton/h)				Shoot yield (ton/h)				Sucrose (%)				Gross sugar yield (ton/h)			
		Rate of applied K_2O				Rate of applied K_2O				Rate of applied K_2O				Rate of applied K_2O			
		0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%	0.0%	0.5%	1.0%	1.5%
0	0	40.1 (0.00)	42.0 (4.74)	42.7 (6.48)	42.6 (6.23)	28.4 (0.00)	29.9 (5.28)	30.4 (7.04)	30.6 (7.75)	12.11 (0.00)	12.69 (4.79)	12.96 (7.02)	13.04 (7.68)	4.86 (0.00)	5.33 (9.67)	5.53 (13.8)	5.56 (14.4)
	10	42.3 (5.49)	43.1 (7.48)	43.9 (9.48)	44.0 (9.73)	30.6 (7.75)	31.9 (12.3)	33.5 (18.0)	33.5 (18.0)	12.42 (2.56)	12.81 (5.78)	13.13 (8.42)	13.15 (8.59)	5.26 (8.32)	5.52 (13.6)	5.76 (18.5)	5.79 (19.1)
	20	43.7 (8.98)	44.6 (11.2)	45.3 (13.0)	45.2 (12.7)	33.4 (17.6)	34.7 (22.2)	35.0 (23.2)	35.1 (23.6)	12.76 (5.37)	12.89 (6.44)	13.21 (9.08)	13.20 (9.00)	5.58 (14.8)	5.75 (18.3)	5.98 (23.0)	5.97 (22.8)
	30	43.9 (9.48)	44.5 (11.0)	45.3 (13.0)	45.3 (13.0)	33.6 (18.3)	34.8 (22.5)	35.0 (23.2)	35.0 (23.2)	12.79 (5.61)	12.97 (7.10)	13.20 (9.00)	13.21 (9.08)	5.59 (15.0)	5.77 (18.7)	5.98 (23.0)	5.98 (23.0)
5	0	42.8 (6.73)	43.2 (7.73)	43.9 (9.48)	44.1 (10.0)	31.4 (10.6)	32.4 (14.1)	33.3 (17.3)	33.2 (16.9)	12.86 (6.19)	12.99 (7.27)	13.21 (9.08)	13.23 (9.25)	5.50 (13.2)	5.61 (15.4)	5.80 (19.3)	5.83 (20.0)
	10	43.5 (8.48)	44.1 (10.0)	44.9 (12.0)	44.9 (12.0)	33.2 (16.9)	34.3 (20.8)	35.1 (23.6)	35.2 (23.9)	12.94 (6.85)	13.10 (8.18)	13.29 (9.74)	13.30 (9.82)	5.63 (15.8)	5.78 (18.9)	5.97 (22.8)	5.97 (22.8)
	20	44.6 (11.2)	45.2 (12.7)	46.0 (14.7)	45.9 (14.5)	34.6 (21.8)	35.7 (25.7)	36.2 (27.5)	36.0 (26.8)	13.07 (7.93)	13.28 (9.66)	13.41 (10.7)	13.39 (10.6)	5.83 (20.0)	6.00 (23.5)	6.17 (27.0)	6.15 (26.5)
	30	44.6 (11.2)	45.3 (13.0)	46.1 (15.0)	46.0 (14.7)	34.5 (21.5)	35.7 (25.7)	36.3 (27.8)	36.1 (27.1)	13.14 (8.51)	13.26 (9.50)	13.44 (11.0)	13.40 (10.7)	5.86 (20.5)	6.01 (23.7)	6.20 (27.6)	6.16 (26.7)
7.5	0	43.7 (8.98)	44.4 (10.7)	45.8 (14.2)	46.0 (14.7)	32.3 (13.7)	33.6 (18.3)	34.4 (21.1)	34.5 (21.5)	13.45 (11.1)	13.59 (12.2)	13.79 (13.9)	13.76 (13.6)	5.88 (2.10)	6.03 (24.1)	6.32 (30.0)	6.33 (30.2)
	10	44.6 (11.2)	45.5 (13.5)	46.9 (17.0)	46.7 (16.5)	33.9 (19.4)	34.9 (22.9)	35.9 (26.4)	35.8 (26.1)	13.51 (11.60	13.93 (15.0)	14.09 (16.4)	14.00 (15.6)	6.03 (24.1)	6.35 (30.7)	6.61 (36.0)	6.54 (34.6)
	20	45.9 (14.5)	46.6 (16.2)	48.0 (19.7)	47.9 (19.5)	35.0 (23.2)	35.9 (26.4)	37.8 (33.1)	37.5 (32.0)	13.61 (12.4)	14.19 (17.1)	14.31 (18.2)	14.33 (18.3)	6.25 (28.6)	6.61 (36.0)	6.87 (41.4)	6.86 (41.2)
	30	45.8 (14.2)	46.6 (16.2)	48.0 (19.7)	48.0 (19.7)	35.1 (23.6)	36.6 (28.9)	37.8 (33.1)	37.7 (32.7)	13.64 (12.6)	14.21 (17.3)	14.29 (18.0)	14.32 (18.2)	6.23 (28.2)	6.62 (36.2)	6.86 (37.4)	6.87 (41.4)

Control: untreated soil and plant

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التأثير المشترك لأفضل معالجة ممكنة لكل من الأرض والنبات لتحسين صفة التحمل الملحى لنباتات بنجر السكر النامية فى الأرض الجيرية تحت ظروف الملوحة

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فى مسعى جاد لتخفيف مشاكل الملوحة أقيمت بعض المعالجات المتاحة لكل من الأرض والنبات من خلال تجربتين منفصلتين:

التجربة الأولى:-

أجريت تجربة أصص بأستخدام المزارع الرملية بغرض تقييم التحمل الملحى النسبى لأربع أصناف من بنجر السكر مختلفة فى درجة التحمل الملحى (ترييل، ماريبو ماركوبولى، راس بولى، كاوجيجا مونو) حيث عوملت نباتاتها بخليط من أملاح كلوريد الصوديوم وكلوريد الكالسيوم بنسبة ١:١ وزناً بعد ظهور الورقة الثالثة وحتى عمر ٤ شهور من الزراعة وكانت مستويات الملوحة (١، ٥٠، ١٠٠، ١٥٠، ٢٠٠ ملليمكافئ/لتر (ممليمول شحنة/لتر). وفى نهاية التجربة تبين أن الصنف (ترييل) هو الأكثر مقاومة نسبياً والصنف الحساس نسبياً هو (راس بولى).

التجربة الثانية:-

إمتد البحث فى التجربة الثانية باجراء تجربة حقلية بمحطة بحوث النوبارية خلال الموسم الشتوى ٢٠٠٥/٢٠٠٤ تحت ظروف ملوحة التربة (١٠ ديسيسيمنز/م) بغرض رفع صفة التحمل الملحى للصنف الحساس راس بولى والذى تم تقييمه فى التجربة الأولى بمعاملة التربة بإضافة سماد مخلفات الدواجن بثلاث معدلات (صفر، ٥، ٧,٥ م^{3}/فدان) ومعالجة النباتات برشها على عمر ٤٠، ٦٠ يوم من الزراعة بكل من مخلوط الأحماض الأمينية (أرجينين + جلوتاميك) بتركيزات صفر، ١٠، ٢٠، ٣٠ ملليجرام/لتر والبوتاسيوم بتركيزات صفر، ٠,٥، ١,٠، ١,٥%.

وقد تبين من النتائج وبصفة عامة، أن معالجة التربة والنبات بزيادة معدلات سماد الدواجن أو بتركيزات الأحماض الأمينية والبوتاسيوم أدى إلى زيادة الوزن الرطب والجاف لكل من الجذور والمجموع الخضرى، وكذا زيادة محتواهما من الماء الممتص والبرولين والبوتاسيوم. وعلى العكس، فقد إنخفض محتواهما من الصوديوم وكذا نسبة (Na/K) للنباتات عند عمر ١٢٠ يوم من الزراعة. وعند الحصاد زاد محصول الجذور والعروش وكذا زاد محتوى الجذور لكل من السكروز والسكر الخام.

وفى الحقيقة، فأن أفضل المعاملات هى معالجة التربة باضافة سماد الدواجن بمعدل ٧,٥ م^{3}/فدان يعقبه رش النباتات عند عمر ٤٠، ٦٠ يوم من الزراعة بتركيز ٢٠ ملليجرام/لتر من خليط الأحماض الأمينية وتركيز ١% من البوتاسيوم والذى بدوره أدى إلى تاثير مباشر لتجنب مشاكل الملوحة وزيادة تحمل النباتات النامية للملوحة من خلال زيادة تركيزات البرولين والبوتاسيوم فى أنسجة النباتات والتى بدورها تعمل على ضبط الأسموزية للخلايا علاوة على تقليل التأثير السئ للصوديوم من خلال إنخفاض نسبة (Na/K) بخلاياها.

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