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Role of Soil Amendments, Plant Growth Regulators and Amino Acids in Improvement Salt Affected Soils Properties and Wheat Productivity

Amer, A. Kh.
Soils, Water and Environ. Res. Institute, Agric. Res. Center, Giza, Egypt

ABSTRACT

Soil salinity and sodicity are considered two of the most import impediments to agricultural development. Also, agricultural productivities in most of arid and semiarid regions (i.g. Egypt) were threatened by the occurrence of salts. Thus, a field experiment was carried out during the winter season of 2013/2014, in new reclaimed salt affected soil at the Experimental Farm of Sahle El-Hussania Station, Agriculture Research Center, Shrakia Governorate, Egypt., to study the role of soil amendments (organic and inorganic), plant growth regulators (PGR) and amino acids to mitigate the adverse effects of saline soil on growth and productivity of wheat crop. The results can be summarized as: the available macronutrients in soil increased gradually with decreasing the salinity and the sodicity. The raised bed which was treated by the half gypsum requirements, and filled by rice straw gave the highest significantly decrease in the EC, SAR and ESP in the upper layer (0-15 cm) raised bed compared to those filled by sand or hadn't filled. Soil amendments application caused a significant increasing in wheat growth, biological yield (grains and straw) and protein content as the following: gypsum + rice straw > gypsum + sand > gypsum alone. Foliar applications of gebbrelic acid and proline treatments showed a significant increase in growth and yield as individually or with both amendments compared the control. These increases were positively associated with increased concentration levels of gebbrelic acid and proline applications.

Keywords: Salt affected soil, organic amendments, inorganic, plant growth regulator, amino acids and wheat crop

INTRODUCTION

Salinity is one of the major environmental factors in agriculture around the world especially in arid and semiarid regions that negatively affect soil fertility, limits crop growth and productivity and reducing the yield of a wide variety of crops all over the world (Shomeili *et al*., 2011, Fayez and Bazaid 2014). Since high salts content may adversely influence soil physicochemical properties and crop yields, food security could be limited as a consequence (Diacono. and Montemurro, 2015). Also, salinity stress is known to various growth processes including photosynthesis, ion regulation, water relations etc. (Hasegawa, *et al*., 2000). The limits productivity of saline soils may be attributed not only to their salt toxicity or damage caused by excess amounts of soluble salts but also arising inadequacy of organic matter and available mineral nutrients especially N, P, and K. (Abdelbasset Lakhdara, *et al*., 2009). Therefore, salt-affected soils must be reclaimed or develop management practices that maintain satisfactory levels of fertility for sustaining food production.

There are several alternative approaches and techniques used to combat salt stress as well as improve the productivity of salt affected soil, e.g. soil amendments and the plant growth regulators (PGRs). Soil amendments are any substances mixed into soil upper layers to improve the physical properties, such as water retention, permeability, and water infiltration, also supply nutrients. They make changes in a number of ways to promote healthy plant growth and allow water and nutrients to more easily move through the soil (Qadir *et al*., 2001, and Ammari *et al*., 2008). There are two broad categories of soil amendments: 1- organic amendments include sphagnum peat, wood chips, straw, compost, manure, biosolids, sawdust and wood ash,….ect, which increases water infiltration, water-holding capacity, and aggregate stability, (Diacono, and Montemurro, 2015). 2 - Inorganic amendments include vermiculite, perlite, pea gravel and sand,….ect, which applied to improvement and reclamation saline soil to avoid applying the chemicals as soil amendments, and reduce the salt concentration in the soil upper layers, which enhanced the plants growth by leaching the excessive ions released from soil to the deeper layers. (Junbao *et al*., 2010). On the other hand, Plant growth regulators have been reported as one of the seasonal practices in mitigation strategies, which have in general phytohormones (i.g. Gibberellic acid (GA_3)) and osmolytes (i.g. Proline (Pro)). Generally, the seed soaking treatment with plant growth regulators improves the seed germination rate and crop performance under stress conditions, (Ashraf and Foolad, 2007). Gibberellic acid (GA_3) is a phytohormone plays an essential role in promoting growth and elongation of cells. It can be used to alleviate the harmful effects of salinity and restores normal growth. Also it reported to overcome the inhibitory effect of salinity on germination and yield of wheat cultivar. (Chauhan, *et al*., 2009 and Iqbal, *et al*., 2011). Whether, Proline (Pro) is the most widely distributed compatible osmolyte in stressed plants (Hoque *et al*., 2007). Proline application mitigates the reduction of growth and photosynthetic activity under salt stress regulates osmotic potential. Further, it may also play a central role as protein compatible hydrotropic and salinity tolerance (Ashraf and Foolad, 2007). Several scientists reported ameliorative effects of proline in different crops like wheat. Foliar application of proline is an effective approach in minimizing deleterious effects of salinity (Talat *et al*., 2013).

Wheat is an important cereal crop worldwide often confront abiotic stresses such as salinity which are among the most important strength-limiting factors of wheat production particularly in arid and semi-arid areas and it is the staple food for more than 35% of world population (Jing and Chang, 2003, Fercha, *et al*., 2011). The wheat crop has a moderate tolerance to salt stresses (Khan *et al*., 2006).

Because the reclamation, improvement and management of salt-affected soils necessitate complex and expensive technologies, most efforts must be taken for the efficient prevention of these harmful processes. To mitigate the adverse effects of soil salinity on crop yield and quality, the present work was aimed to study the effect of different soil amendments (organic or inorganic), plant growth regulators ((gibberellic acid (GA_3)), and amino acids (proline (Pro)) applications on soil properties and wheat growth, productivity and quality.

MATERIALS AND METHODS

To achieve the aforementioned target, a field experiment was conducted at a newly reclaimed salt affected soil area of Sahle El-Hussania Station, Agriculture Research Center, Shrakia Governorate, Egypt, during a growing winter season of 2013/2014. The general chemical properties of surface soil layer (0–25 cm) were determined according to standard methods after Page *et al.*, (1982) and Klute, (1986), and presented in Table (1).

Table 1. Soil Chemical characteristics and mechanical analysis of surface experimental soil layer (0-25cm).

EC (dS/m)	Cations (meq/l)				Anions (meq/l)		
	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$HCO_3^{=}$	Cl^{-}	$SO_4^{=}$
17.45	16.55	41.34	136.47	3.15	1.01	151.6	44.9
pH (1:2.5)	**soil parameter calculated**			**Mechanical analysis**			
				Particle size Distribution (%)			**Texture class**
	SAR	**ESP**		**Sand**	**Silt**	**Clay**	
8.4	25.37	28.08		17.2	8.7	74.1	**Clay**

The experimental layout was a split plot design for the 15 treatments with three replicates per treatment. The main plots were three different amendments additions, gypsum requirement alone and gypsum requirement with inorganic amendments (sand) or with organic amendments (rice straw) at a rate of $50m^3$ and 4Mg fed^{-1} respectively. The sub main treatments were for the foliar applications of plant growth regulators (gibberellic acid, 25.0 and 50.0 ppm) and amino acids (proline, 50.0 and 100.0 mM L^{-1}), as recommended range in literature respectively, in addition to the control treatment (tape water without gibberellic acid or proline). They used as foliar spray through growth plant stages (i.e. 25 and 50 days after sowing) to improve growth and morphology plant under salinity stress

Experimental area were ploughed twice in two ways for grains bed preparation after received their half the gypsum requirement at a rate of 4 Mg fed^{-1} and superphosphate fertilizer (15.5 % P_2O_5) at a rate of 200 kg fed^{-1}, then addition of soil amendments as main treatments (sand or rice straw) between the two rows at the depth (15-20 cm) which make a raised bed manual according to the described methods after Amer *et al.,* (2011), each main treatment was divided to 15 sub plot treatments (5T. x 3Reb.), each plot area was 10.5 m^2 (3.5 m x 3m) content six rows which make a three raised bed for each plot. Wheat grains (Triticum aestivum, c.v Sakha 93) were soaked in 2% urea solution for 2h before sowing on raised bed to enhance the germination under saline conditions (El Azab, *et al*., 2011). After soaking, the wheat grains at the rates of 70 kg fed^{-1} were cultivated (in 18 November 2013) and all the other usual agricultural practices were followed according to the usual methods adopted for wheat planting in the area of Sahle El-Hussania Station. Where, Nitrogen and Potassium fertilizers were added in two times, i.e., 25 and 50 days after sowing plants in the form of ammonium sulfate (21.5% N) and potassium sulfate (48 % K_2O), at recommended doses (100 units of N fed^{-1} and 24 units of K_2O fed^{-1}, respectively).

Wheat plant samples were collected from each treatment, shoots (at 60 days after sowing plants, tillering stage), grains and straw at harvesting. Plant samples were dried at 65-70 C^0 and digested for macronutrients determinations according to Cottenie, *et al.,* (1982). At harvesting stage, Plant height (cm), 1000 grains weight (g) for all treatments were recorded. Also, biological yield, grain and straw yield were weighed from each plot and related to kg fed^{-1}. Crud protein content (%) in seeds was determined by multiplying the nitrogen percentage by 6.25 according the method described by A.O.A.C., (1984).

Surface soil samples (0 - 15 cm) were collected at tilliring stage and at harvesting to determine available macronutrients; which available N was determined using K_2SO_4 (1%) according to Jackson (1973), and measured according to the modified Kjeldahal method. Also, available P and K were determined by extracting the soil with ammonium bicarbonate- DTPA according to Soltan pour (1985). Chemical analysis of soil samples at harvesting; EC and soluble cations and anions were determined in soil paste extract according to Black *et al.,* (1982).

Sodium adsorption ratio (SAR) was calculated by the following equation:

$$\mathbf{SAR} = \frac{\mathbf{Na}}{\sqrt{(\mathbf{Ca}+\mathbf{Mg})/2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots.(1)$$

Where, Na^{+}, Ca^{+2}, and Mg^{+2} cations in meq/l.

Exchangeable sodium percentage (ESP) was predicted as follows equation:

ESP = 1.95 + 1.03 SAR …….(2) (Rashidi and Seilsepour 2008).

Removal sodium efficiency (RSE) Removal sodium efficiency in percentage of Na removed from soils at end of the experiment was calculated as follows equation:

$$\mathbf{RSE} = \frac{(\mathbf{ESP_i} - \mathbf{ESP_f})}{\mathbf{ESP_i}} \mathbf{\,x\,100} \quad \ldots\ldots\ldots\ldots.(3)$$

Where, ESP_i ; exchangeable sodium percentage before the soil amendments application. ESP_f ; exchangeable sodium percentage after the soil amendments application at the end of the experiment.

Statistical Analyses:

The obtained data were subjected to analyses of variance using MINITAB Statistical Software Program for Windows Release 16, according to Barbara and Brain, (1994). The ANOVA test was used to determine significance of ($p \leq 0.05$) treatment effect and the Least

Significant Difference (L.S.D) test was used to determine significance of the difference between individual means.

RESULTS AND DISCUSSION

Effect of treatments on macronutrients (NPK) content in soil and wheat plant at tillering stage.

The results of the statistical analysis presented in Table (2) showed significantly negative effect for gypsum whether combined with sand or rice straw on available macronutrients content (mg kg^{-1}) in soil at tillereng stage compared to application of gypsum alone. This decreasing in macronutrients was more clearly in the treatment of gypsum combined with rice straw may be due to the consumptive of macronutrients by plants and microorganisms which development with biodegradation process of rice straw. Also, the data in Table (2) showed significantly decreasing in soil content of available macronutrients with foliar application of growth regulator or amino acid. These results may attribute to increasing the plant growth as resulting to growth regulator or amino acid applications, which increase macronutrients uptake. Gibberellic acid treatments showed a relatively greater effect on reducing N, P and K available in soil compared with proline particularly at the higher concentration.

Table 2. Effect of treatments on available macronutrients content in soil (mg kg^{-1}) at tillering stage.

Macronutrints in soil at tillering stage	Treatments (A*R)	foliar application treatments: without (Pro) or (GA3)	Praline (50.0 mM L^{-1})	proline (100.0 mM L^{-1})	gibberellic acid (25.0 ppm)	Gibberellic acid (50.0 ppm)	mean
available N (mg kg^{-1})	gypsum without amendments	58.59	57.67	53.90	55.34	49.93	55.09 a
	with inorganic (sand)	55.80	54.93	51.33	52.70	47.55	52.46 a
	with organic (rice straw)	46.20	45.39	43.35	39.60	36.40	42.19 b
mean		53.53 a	52.66 a	49.53 ab	49.21 ab	44.63 b	…….
LSD at 0.05 level		(A : 4.73) (R : 6.06) (A*R : ns)					
available P (mg kg^{-1})	gypsum without amendments	5.60	5.06	4.70	4.90	4.80	5.01 a
	with inorganic (sand)	5.33	4.82	4.47	4.64	4.57	4.77 a
	with organic (rice straw)	5.33	4.88	4.10	5.02	4.68	4.80 a
mean		5.42 a	4.92 b	4.42 c	4.84 b	4.68 bc	…….
LSD at 0.05 level		(A : ns) (R : 0.35) (A*R : ns)					
available K (mg kg^{-1})	gypsum without amendments	323.47	385.46	299.15	246.10	254.17	301.67 a
	with inorganic (sand)	308.51	366.21	284.96	233.16	241.40	286.85 b
	with organic (rice straw)	219.03	240.22	267.30	245.02	249.64	244.24 c
mean		283.67 a	330.63 a	283.80 ab	241.43 ab	248.40 b	…….
LSD at 0.05 level		(A : 0.63) (R :0. 80) (A*R : 1.39)					

Values are means (n = 3). Values followed by different letters are significantly different, p < 0.05.

On the other hand, data presented in Table (3) showed insignificant differences between soil amendments application on macronutrients percentage in wheat shoots at the tillering stage except N%, which significantly increased at application gypsum combined with rice straw compared with the control (gypsum alone). In contrast, the growth regulator showed significantly positive effects on N% and P% in plant at tillering stage compared to the control (untreated by growth regulator). The proline gave the better level of N% and P% in plant compared to the gibberellic acid at this period of plant age. Generally, under the experimental of treatments, it was observed that, the wheat plants growth doesn't suffering any deficiency in macronutrients, which the levels of determined macronutrients were in the normal range at tillering stage of wheat plant. (3.0 % 0.15 % and 2.0% for NPK respectively according to Campbell, 2002)

Effect of treatments on some soil chemical characteristics after harvesting stage of wheat plants

The beneficial effects of treatments observed in the top raised bed (0-15 cm) of soil in our investigation, where most probably due to the physical action of soil amendments (Sand or Rice straw) that provided channels for infiltrating water, improving the percent pore space, hydraulic conductivity and soluble salts moving particularly Na^+ as consequence for chemical exchange reaction in presence of gypsum. At the end of the experiment, desalinization and desodification curves (Fig. 1) indicate that all the used amendments whether gypsum alone or combined with inorganic or organic amendments showed a pronounced decreased in soil salinity (EC) and sodicity (SAR) in comparison with initial soil (control), these results were in agreement with the findings of Abdel-Fattah, (2012).

Table 3. Effect of treatments on macronutrients concentration (%) in wheat plants at tillering stage.

Item at stage	Studied tillering	Treatments (A*R)	foliar application treatments					mean
			without (Pro) or (GA3)	Praline (50.0 mM L^{-1})	proline (100.0 mM L^{-1})	gibberellic acid (25.0 ppm)	gibberellic acid (50.0 ppm)	
N %		gypsum without amendments	3.84	4.13	4.32	3.86	4.04	4.04 b
		with inorganic (sand)	3.92	4.21	4.41	3.94	4.12	4.12 ab
		with organic (rice straw)	3.93	4.28	4.35	4.33	4.30	4.23 a
mean			3.89 c	4.20 b	4.36 a	4.04 bc	4.15 b	…….
LSD at 0.05 level				(A : 0.135)	(R : 0.173)	(A*R : ns)		
p %		gypsum without amendments	0.29	0.33	0.39	0.39	0.39	0.36 a
		with inorganic (sand)	0.30	0.34	0.40	0.40	0.40	0.37 a
		with organic (rice straw)	0.35	0.39	0.39	0.34	0.37	0.37 a
mean			0.31 c	0.35 b	0.40 a	0.38 ab	0.38 ab	…….
LSD at 0.05 level				(A : ns)	(R : 0.042)	(A*R : ns)		
K %		gypsum without amendments	2.11	1.92	1.60	1.83	1.79	1.85 a
		with inorganic (sand)	2.15	1.96	1.63	1.87	1.82	1.89 a
		with organic (rice straw)	1.55	1.73	1.85	1.89	2.24	1.85 a
mean			1.93 a	1.87 a	1.69 a	1.86 a	1.95 a	…….
LSD at 0.05 level				(A : ns)	(R : ns)	(A*R : 0.311)		

Values are means (n = 3). Values followed by different letters are significantly different, $p < 0.05$.

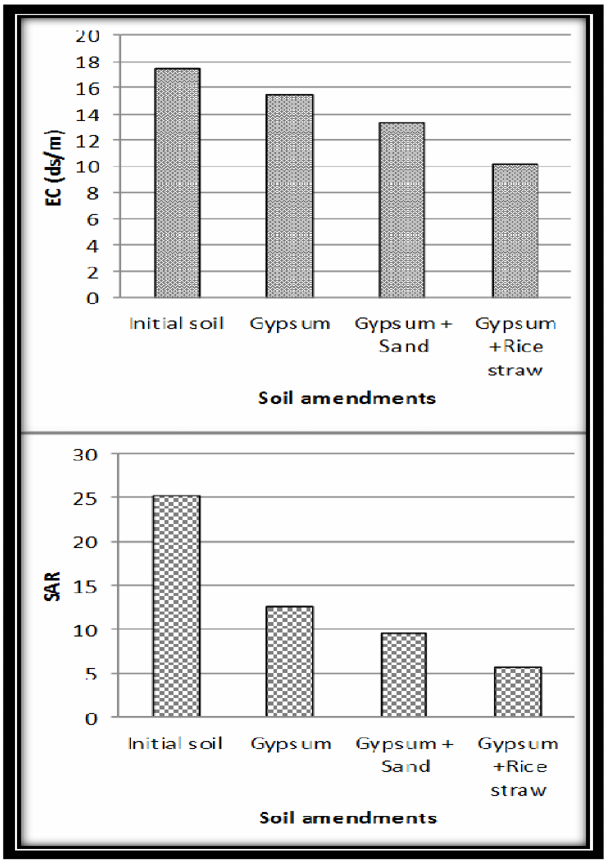

Fig. 1. Effect of soil amendments on soil electrical conductivity (EC) and soil sodium adsorption ratio (SAR) in the topsoil (0-15 cm) of soil raised bed.

Also, the different amendments showed significantly differences among them (Table 4), which the decreases in EC and SAR were as the follows: in case of organic amendments application (Rice straw) > inorganic amendments application (Sand) > gypsum addition alone. Rice straw or sand amendments enhanced reclamation process and caused more decreases in salinity and sodicity may be its capable of loosening the interior of raised bed, which may result in improving the rate of percolation of water and penetration of plant roots. The maximum reduction in salinity (EC) and sodicity (SAR) in soil were obtained with application of the gypsum combined with rice straw, these results may be attributed to ameliorate soil physical properties and water movement which increased dissolution of gypsum in the presence of CO_2 evolved from wheat root respiration and biodegradation process of rice straw, which decreased the precipitation of Ca^{2+} and CO_3^{2-} ions in the $CaCO_3$ form (Sekhon and Bejawa, 1993 and Abd Elrahman, *et al.,* 2012), adequate levels of Ca^{+} cations replace to Na^{+} which removed with the infiltrating water. Finally, soil EC was significantly reduced from 17.45 dS m^{-1} as initial soil (Table 1) to about 15.5, 13.3 and 10.2 dS m^{-1}, with aforementioned soil amendments respectively. In addition, the sodium adsorption ratio (SAR) was significantly reduced by 50.0, 62.2 and 77.1% at using the follows amendments (gypsum alone), (gypsum + sand), and (gypsum + rice straw) respectively, compared to the initial soil (Fig. 1).

Table 4. Effect of treatments on some chemical properties of soil in the end of the experimental (at harvest)

Item Studied in soil at harvesting stage	Treatments (A*R)	foliar application treatments					mean
		without (Pro) or (GA3)	proline (50.0 mM L^{-1})	proline (100.0 mM L^{-1})	gibberellic Acid (25.0 ppm)	gibberellic acid (50.0 ppm)	
EC (dS m^{-1})	gypsum without amendments	15.57	15.28	15.44	15.35	15.42	15.52 a
	with inorganic (sand)	13.43	13.14	13.35	13.19	13.39	13.30 b
	with organic (rice straw)	10.49	10.38	10.04	10.09	10.00	10.20 c
mean		13.16 a	12.94 a	12.94 a	12.88 a	12.94 a	…….
LSD at 0.05 level		(A : 0.35) (R : ns) (A*R : ns)					
SAR	gypsum without amendments	12.87	12.87	12.54	12.74	12.34	12.67 a
	with inorganic (sand)	9.63	9.48	9.81	9.57	9.43	9.58 b
	with organic (rice straw)	5.85	5.83	5.75	5.76	5.74	5.79 c
mean		9.45 a	9.39 a	9.37 a	9.36 a	9.17 a	…….
LSD at 0.05 level		(A :0.25) (R : ns) (A*R : ns)					
ESP	gypsum without amendments	15.21	15.21	14.87	15.08	14.66	15.00 a
	with inorganic (sand)	11.87	11.72	12.06	11.81	11.66	11.82 b
	with organic (rice straw)	7.98	7.95	7.87	7.88	7.86	7.91 c
mean		11.68 a	11.62 a	11.60 a	11.59 a	11.39 a	…….
LSD at 0.05 level		(A : 0.26) (R : ns) (A*R : ns)					
RSE %	gypsum without amendments	45.86	45.84	47.05	46.31	48.26	46.67 c
	with inorganic (sand)	57.73	58.26	57.05	57.94	58.48	57.89 b
	with organic (rice straw)	71.59	71.68	71.98	71.93	72.00	71.83 a
mean		58.39 a	58.60 a	58.70 a	58.73 a	59.58 a	…….
LSD at 0.05 level		(A : 0.92) (R : ns) (A*R : ns)					

Values are means (n = 3). Values followed by different letters are significantly different, $p < 0.05$.

On the other hand, the statistical analyses for data were presented in Table (4) showed that significantly differences between the different soil amendments application for all chemical properties studied as consequence to ameliorate the physical action of soil amendments in raised bed. The EC values were decreased by 13.7 and 33.8% at using the sand and rice straw, respectively compared to that of the control (gypsum alone). Also, in the same condition, the each of SAR and ESP values were reduced by 24.3, 54.3% and 21.1, 47.2% at using the sand and rice straw respectively, while the removal sodium efficiency calculated in percentage (RSE %) significantly increased by 46.67, 57.89 and 71.83% in soil treated by (gypsum alone), (gypsum + sand), and (gypsum + rice straw) respectively, compared to that of the initial soil.

Effect of treatments application on available macronutrients (NPK) in soil after harvesting:

Data in Table (5) showed the effect of different treatments on the residual of available macronutrients in soil at the end of the experiment. The statistical analyses of data revealed that, there are significantly differences between both organic and inorganic amendments combined with gypsum compared to application of gypsum alone on the available amounts of macronutrients. Which, each of macronutrient (N, P or K) amount were significantly decreased by 5% approximately at using sand amendments combined with gypsum, compared to the control (gypsum alone) this resultmay be due to increasing the consumptive of plant. In contrast, the residual NPK in soil amendment by gypsum combined with rice straw were significantly increased by 9.5, 19.9 and 3.5%, respectively with respect to the control. Although increasing the macronutrients uptake by plant as a result to increase the plant growth at this treatment (Gypsum combined with rice straw), it was increased remarkably in soil at the end of the experiment. This finding presumably due to the low concentrations salt in this case which had a stimulation effect on carbon mineralization, biological activities and biodegradation process, they are considered to be direct indicators of the enhancement of soil fertility, (Chandra *et al.,* 2002).

Table 5. Effect of studied treatments on the available macronutrients in soil after the harvest of wheat.

Macronutrients in soil at harvesting stage	Treatments (A*R)	foliar application treatments: without (Pro) or (GA3)	Praline (50.0 mM L^{-1})	proline (100.0 mM L^{-1})	gibberellic acid (25.0 ppm)	gibberellic acid (50.0 ppm)	mean
available N (mg kg^{-1})	gypsum without amendments	52.36	49.36	40.72	40.85	39.95	44.65 b
	with inorganic (sand)	49.87	47.01	38.79	38.91	38.05	42.52 c
	with organic (rice straw)	51.33	50.13	47.71	48.13	47.23	48.91 a
mean		51.19 a	48.83 b	42.41 c	42.63 c	41.74 c	…….
LSD at 0.05 level		(A : 1.68) (R : 2.15) (A*R : ns)					
available P (mg kg^{-1})	gypsum without amendments	4.91	4.55	4.35	4.65	4.35	4.56 b
	with inorganic (sand)	4.68	4.33	4.15	4.43	4.15	4.35 c
	with organic (rice straw)	5.64	5.27	5.21	5.80	5.45	5.47 a
mean		5.07 a	4.71 a	4.57 a	4.96 a	4.65 a	…….
LSD at 0.05 level		(A : 0.31) (R : ns) (A*R : ns)					
available K (mg kg^{-1})	gypsum without amendments	318.65	352.68	318.65	305.29	318.65	322.78 b
	with inorganic (sand)	303.81	329.77	303.81	292.03	303.81	306.65 c
	with organic (rice straw)	274.37	320.29	348.55	400.00	327.26	334.09 a
mean		298.94 d	334.25 a	323.67 b	332.44 a	316.57 c	…….
LSD at 0.05 level		(A : 2.23) (R : 2.86) (A*R : 4.95)					

Values are means (n = 3). Values followed by different letters are significantly different, $p < 0.05$.

Effect of applied treatments on total macronutrients uptake by wheat plant (kg fed^{-1}).

Data in Table (6) show significantly increasing in total NPK uptake as affected by the treatments application whether soil amendments (inorganic or organic) or plant growth regulators and amino acids treatments compared with the control, (gypsum aloe). Also, it was noticed that the different amounts of N and P uptake by plant were insignificant at using the gypsum combined with sand or rice straw application, with respect to decreases the amount uptake from N and P nutrient at using the sand compared to the rice straw amendments, contrarily with K nutrient uptake. Generally, the minimum removal amounts were showed with the addition of gypsum alone, which this treatment hadn't force adequate to decreases the salinity or sodiciy up to acceptable levels. This results in agreement with Kaya *et al.,* (2001 and Tejada *et al*., (2006) who reported that the excess of Na^+ and Cl^- in soil solution inhibited uptake of mineral nutrients, especially Ca^{2+}, K^+, N and P. On the other hand, the removal amounts of N and P to plant at using the highest concentration of gebbrellic acid (50.0 ppm) were more than the highest concentration of proline (100 ML^{-1}). But it was noticed the inverse with the removal amount of K at using the same concentration may be due to the different function of gebbrellic acid and proline in aquatic process in plant tissue, phytohormones and osmolytes respectively.

Table 6. Effect of studied treatments on total macronutrients uptake (kg fed^{-1}) by straw and grains of wheat at harvest.

Total uptake of macronutrients by whole wheat plant (kg fed^{-1})	Treatments (A*R)	foliar application treatments: without (Pro) or (GA3)	proline (50.0 mM L^{-1})	proline (100.0 mM L^{-1})	gibberellic acid (25.0 ppm)	gibberellic acid (50.0 ppm)	mean
Total uptake N	gypsum without amendments	47.08	68.16	77.51	74.76	86.96	70.89 b
	with inorganic (sand)	53.54	77.55	88.20	85.06	98.94	80.66 a
	with organic (rice straw)	57.79	82.09	95.47	90.91	104.47	86.15 a
mean		52.80 d	75.93 c	87.06 b	83.58 b	96.79 a	…….
LSD at 0.05 level		(A : 5.84) (R : 7.48) (A*R : ns)					
Total uptake P	gypsum without amendments	9.13	12.86	15.40	14.70	16.92	13.80 b
	with inorganic (sand)	10.46	14.92	17.87	16.97	19.62	15.97 a
	with organic (rice straw)	9.81	14.98	19.27	18.86	20.86	16.76 a
mean		9.8 d	14.25 c	17.51 ab	16.84 b	19.13 a	…….
LSD at 0.05 level		(A : 1.5) (R : 1.91) (A*R : ns)					
Total uptake K	gypsum without amendments	49.16	61.42	75.39	61.63	59.54	61.43 b
	with inorganic (sand)	57.17	71.39	87.71	71.67	69.23	71.43 a
	with organic (rice straw)	58.01	69.93	56.97	75.68	75.17	67.15 b
mean		54.78 c	67.58 b	73.36 a	69.66 b	67.98 b	…….
LSD at 0.05 level		(A : 6.22) (R : 7.96) (A*R : 13.79)					

Values are means (n = 3). Values followed by different letters are significantly different, $p < 0.05$.

Effect of applied treatments on biological yield and grain quality of wheat plant:

The variances of wheat yield parameters were analyzed and recorded in Table (7), the data revealed that, plant heights, grain yield, straw yield and weight of 1000 grains of wheat plants were significantly increased as a result of gypsum combined with sand or rice straw treatments. This increase reached approximately to10% at using (gypsum combined with sand), but they reached to 9.3, 24.0, 8.2 and 23.1% respectively, at using (gypsum combined with rice straw) compared to the control (gypsum alone). In contrast, soil amendments whether organic or inorganic didn't record any significantly effects on the studied parameters except grains yield and 1000 grains weight. On the other hand, both added growth regulator (gibbrelic acid) or amino acids (proline) had a significantly positive effect on the studied parameters of wheat plant compared the control (without (GA3) or (pro)). In addition to, the highest increasing of plant heights, grain yield, straw yield weight of 1000 grains and crude protein (%) of wheat plants were obtained from using the highest concentration of gibbrelic acid compared to the proline. These results show remarkably accordance with the aforementioned finding. Where, addition of amendments (organic or inorganic) interior of raised bed capable to loosen the root zoon and ameliorate the soil physical action, thus increase water percolation and root penetration. This action followed by ameliorate the chemical properties which in turn promote plants growth, improve general wheat plant vigour, encourages their biological yields and grains quality, particularly with growth regulators treatments.

Table 7. Effect of treatments on plant heights, grains and straw yield, 1000 grains weight and crude protein(%).

Item Studied	Treatments (A*R)	foliar application treatments					mean
		without (Pro) or (GA3)	proline (50.0 mM L^{-1})	Praline (100.0 mM L^{-1})	gibberellic Acid (25.0 ppm)	Gibberellic acid (50.0 ppm)	
plant heights (cm)	gypsum without amendments	55.78	60.48	63.70	57.76	68.34	61.21 b
	with inorganic (sand)	61.29	66.46	70.00	63.47	75.10	67.26 a
	with organic (rice straw)	63.60	64.50	66.13	68.75	71.70	66.94 a
mean		60.22 c	63.81 b	66.61 b	63.32 bc	71.71 a	…….
LSD at 0.05 level				(A : 2.79) (R : 3.57) (A*R : ns)			
Grains Y. (kg fed^{-1})	gypsum without amendments	1571.7	1819.8	1979.3	2020.2	2171.4	1912.5 c
	with inorganic (sand)	1746.3	2022.0	2199.2	2244.7	2412.7	2125.0 b
	with organic (rice straw)	1828.3	2365.4	2607.4	2419.2	2643.2	2372.7 a
mean		1715.4 c	2069.1 b	2261.9 a	2228.0 ab	2409.1 a	…….
LSD at 0.05 level				(A : 150.1) (R : 192.0) (A*R : ns)			
Straw y. (kg fed^{-1})	gypsum without amendments	2470.4	2935.9	3353.0	3237.5	3646.9	3128.7 b
	with inorganic (sand)	2744.9	3262.1	3725.6	3597.2	4052.2	3476.4 a
	with organic (rice straw)	2662.9	3059.8	3597.4	3754.2	3866.2	3388.1 ab
mean		2626.1 d	3085.9 c	3558.7 b	3529.6 b	3855.1 a	…….
LSD at 0.05 level				(A : 216.3) (R : 276.7) (A*R : ns)			
Wt . 1000 grains (g)	gypsum without amendments	21.90	23.07	26.59	24.49	30.56	25.32 c
	with inorganic (sand)	24.33	25.64	29.54	27.21	33.95	28.13 b
	with organic (rice straw)	28.83	30.84	34.55	31.22	30.45	31.18 a
mean		25.02 c	26.52 b	30.23 a	27.64 b	31.65 a	…….
LSD at 0.05 level				(A : 1.31) (R : 1.67) (A*R : 2.89)			
Crude protein (%)	gypsum without amendments	9.97	11.93	12.23	11.86	12.63	11.72 a
	with inorganic (sand)	10.17	12.17	12.47	12.09	12.88	11.96 a
	with organic (rice straw)	10.47	12.53	12.84	12.45	13.26	12.31 a
mean		10.21 c	12.21 b	12.51 ab	12.13 b	12.93 a	…….
LSD at 0.05 level				(A : ns) (R : 0.70) (A*R : ns)			

Values are means (n = 3). Values followed by different letters are significantly different, $p < 0.05$.

CONCLUSION

Based on the aforementioned discussion, soil raised bed which filled by rice straw (low in cost) is a potential candidate for fast and efficient chemical reclamation of saline - sodic soils in a very short time (one season) with adequate amounts of irrigation water, without traditional leaching method application. It is exceedingly important can be used as a sustainable seasonal practice for the saline sodic soil reclamation in countries suffering from water shortage like Egypt. The best chemical properties of soil experiment and the highest yield values were obtained with application of gypsum combined with rice straw because the physical action of rice straw in the first season and probable in the future, it will have important resource of soil fertility. Moreover, the process related to the biodegradation of rice straw may be play an important role in the positive effect in microbial activity and enzymatic activities in soil.

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دور المصلحات الأرضية ومنظمات النمو والأحماض الأمينيه فى تحسين خواص الأراضى المتاثره بالأملاح وإنتاجية محصول القمح

أحمد خليل عامر

معهد بحوث الأراضى والمياة والبيئة ---مركز البحوث الزراعية

تعتبر ملوحه وقلوية التربه إثنين من أهم العوائق التى تعترض التنمية الزراعية كما أن الإنتاج الزراعى فى معظم المناطق الجافة أوشبة الجافة (مثل مصر) مهدد بالتمليح. لذلك أجريت تجربة حقلية خلال الموسم الشتوى 2013-2014 فى أراضى متأثره بالأملاح حديثة الإستزراع بالمزرعة التجريبية لمحطة بحوث الحسينية مركز البحوث الزراعيه بمحافظه الشرقيه مصر. لدراسة دور المصلحات الأرضية (العضويه مثل قش الارز وغير العضويه مثل الرمل) ومنظمات النمو (حمض الجبريلك) والأحماض الأمينية (البرولين) بغرض التخفيف من الأثار السلبية لملوحة التربة على نمو وإنتاجية محصول القمح. ويمكن تلخيص النتائج فيما يلى : المغذيات الكبرى الميسرة فى التربة إزدادت تدريجيا مع إنخفاض الملوحة والقلوية . المصاطب التى تم معاملتها بنصف الموصى به من الجبس والمضاف قش الأرز بداخلها أدت الى إنخفاض عالى المعنوية فى قيم كل من التوصيل الهيدروليكى ونسبة الصوديوم المدمص والنسبه المؤية للصوديوم المتبادل وذلك فى الطبقه العليا من المصطبه (0-15 سم) مقارنه بتلك المصاطب المعامله بالجبس سواء كان مضاف بباطنها الرمل او غيرمضاف. المصلحات الأرضية المستخدمة أحدثت زيادة معنوية فى نمو القمح والمحصول البيولوجى (الحبوب والقش) ومحتوى البروتين بالحبوب على النحو التالى :معامله الجبس مصحوبا بقش الأرز أكبر من معاملة الجبس مع الرمل أكبر من إضافة الجبس بصورة منفردة. إستخدام معاملات الرش بالجبريلين والبرولين أحدثت ذياده معنويه على كل من قياسات النمو والمحصول تحت تأثير رش هذه المعاملات سواء فى صورة فردية أو كانت متحده مع كلا من المصلحات الأرضية مقارنه بالكنترول. هذه الزيادة إرتبطت إيجابيا بذيادة تركيز كلا منهما. أفضل النتائج المتحصل عليها والخاصة بالمحصول كانت فى حالة إستخدام الجبريلين عنه فى حله إستخدام البرولين خاصه فى التركيزات المرتفعة منها.