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MANAGEMENT OF SALINITY PROBLEMS AT SAHL EL-TINA- North SINAI

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ABSTRACT

A filed experiment was carried out on a sandy loam soil at a newly reclaimed area of Sahl El-Tina, Galbana Village No.7, North Sinai, Egypt, during a growing summer season (2009) to study the effect of two techniques for management (Raised beds practice compared with traditional system Furrow row) of saline soil under different rates and forms of N-mineral fertilizers on soil chemical properties, growth, yield and yield component. The applied treatments were two cultural practices (Raised beds and Furrow rows) as well as three solid N-mineral fertilizer forms (*i.e*., Urea**,** Ammonium Nitrate and Ammonium sulfate which added at rates of 75 and 100% of the recommended dose (120 kg N fed^{-1}). Maize (*Zea mays* L., Th. 321 cv.) was undertaken as plant indicator.

The obtained results indicated that the soil chemicals properties were improved under Raised beds conditions compared with traditional system (Furrow row), particularly in the root zone. The pH values were slightly reduced from 8.0 to 7.6 and 7.8. Also the electrical conductivity values (EC) were strongly reduced from 7.3 to 3.4 and 4.2 for Raised beds and Furrow row respectively. More or less similar trend was obtained for the soluble ions with the height reduction up to more than 50% approximately, particular for Cl- and Na+ in the maize root zone under Raised beds system. The role of Raised bed was positive for increase the soil content of available N up to 10.4%, but it was negative on values of available K while decreased up to 12.9% under the same conditions. On the other hand, the available N and K were increased relatively under addition of N forms, while, the rats of nitrogen addition was non-significant. The maize plant parameters such as leaves &stalks, grains nutritional status, grain yields, weight of 100 kernels and crude protein were recorded the best values with Raised beds planting as compared with the traditional practice (Furrow row).

In general, NUE (Nitrogen use efficiency) values below 60% include an increased risk of nitrogen losses and should be avoided in order to protect the environment at N application rates. Also, these values were increased or closed to level of balance in–and output approximately at low N application rates (90 kg.fed^{-1}) under Raised beds practice technology compared with the traditional system (Furrow row), and the best values for NUE were 74.7 % when the ammonium sulfate addition compared with other N forms Thus, the addition rate of N recommended (120 kg.fed^{-1}) for maize production dose not acceptable to saline studied soil.
Keywords: *Raised beds, soaking, management, maize, saline soil and N-mineral,*

INTRODUCTION

A salinity problem exists if salt accumulates in the crop root zone to a concentration that causes a loss in yield. In irrigated areas, these salts often originate from a saline, high water table or from salts in the applied water. Yield reductions occur when the salts accumulate in the root zone to such an extent that the crop is no longer able to extract sufficient water from the salty soil solution, resulting in a water stress for a significant period of time. If water uptake is appreciably reduced, the plant slows its rate of growth (Ayers and Westcot, 1994). Crop yield is best correlated with the average root zone salinity, but for crops irrigated on a daily, or near daily basis (localized or drip irrigation) crop yields are better correlated with the water-uptake weighted root zone salinity (Rhoades, 1982). Excess salts in the root zone hinder plants from withdrawing water from the soil. This lowers the amount of water available to plants, regardless of the amount of water in the root zone. Although the water is not held tighter to the soil, the presence of salt in the soil solution causes plants to exert more energy extracting water from the soil. More energy spent extracting less water causes stress, resulting in reduced growth and yield. (Upson, 2005).

Sahel-El Tina is irrigated from El Salam Canal. Drainage water supplied to El-Salam canal is estimated to be $2x10^9$ $m^3 year^{-1}$. This quantity is harvested from Bahr Hadous, lower and upper Serow drains together and if needed, Frasquer drain. This drainage water is mixed with equal amounts of Nile water used to irrigate 440,000 feddan in the East, North of Sinai Governorate (Ministry of Irrigation and Water Resources, 2002). The EC_{iw} values are more affected by both water source and the period of sampling .Where the recorded values by Shaban and El-Sherife (2007) are 1.54, 1.36, 1.28 and 1.25 dSm^{-1} during alfalfa planting. These values indicated that the irrigation water used classified as moderate saline (Ayers and Westcot 1985). Also, (Kadria El Azab *et al*., 2011) classified this irrigation water as a second class for water salinity (EC_{iw} 0.75 – 3.0 $dS.m^{-1}$) and first one (SAR < 6) for sodicity (C2 S1).

Raised beds farming is a system where the crop zone and the traffic lanes (wheel tracks or furrows) are distinctly and permanently separated. Soil is moved from the traffic lanes (or furrows) and added to the crop zone, slightly raising the surface level of the crop zone. Raised bed technique is an adaptation of the traditional hill and furrow row cropping design. It has been constructed by farmers on each of the three main soil types, and have performed satisfactorily. You will need to carefully assess the suitability of the soil for this technique, because increased levels of management input are required. Self-mulching soils are the most easily managed when using the raised bed system because cracking clay soils regenerate their structure by shrinking and swelling, (Beecher, *et al*., 2003).

Cotching and Dean (2003) studied differences in soil structure, chemistry and biology between raised bed and conventional bed areas in Tasmania's Northern Midlands. They found that areas under raised bed soil management systems for one or two seasons had improved physical properties (greater infiltration, lower bulk density, lower shear strength, and lower penetration resistance). Biological and chemical properties were not significantly different. Raised beds planting technique could help in reducing irrigation requirements of crops and increase crop production in salinity affected areas. This method is appropriate for soils having low permeability, seasonal water logging, salinity and shortage of water supply (Qureshi and Barrett-Lennard, 1998). Raised beds are seedbeds separated by furrows which are aligned with the gradient of the land. They are designed to improve conditions for plant growth by increasing lateral drainage from the beds into the furrows, reducing waterlogging. Forming raised beds reduces the density of the soil and encourages the formation of large pore spaces which improve soil aeration, infiltration and drainage, (McIntosh, *et al*., 2010).

The agronomic practices have not been well documented in the literature. The raised–bed technology has been shown to be particularly valuable on low permeable soils subject to water logging and salinity and in areas short of irrigation water supply (Qureshi & Aslam, 1988), although unsuited to well drain soils. The Raised bed produced a better root environment, reducing water logging and increasing irrigation efficiencies, (Khan, *et al*., 2010). Maize crop especially the hybrid variety needs more water so the farmers are in need of using their limited irrigation water more efficiently to meet their crop water requirements. Thus they prefer to sow their maize crop on raised beds, (Akbar, *et al*., 2007).

Nitrogen use efficiency (NUE) can be defined as the ratio between the amount of fertilizer N applied and the amount of N removed with the harvest. However, different definitions of NUE are used. Even more important than the way of calculation is the interpretation of the results. Examples from field trials show that very high as well as low NUE values represent unsustainable crop production systems and that the interpretation of NUE values requires a qualification scheme, because very high as well as low NUE values represent unsustainable situations. NUE has already gained increasing importance as an agro-environmental indicator, (Johnston & Poulton 2009).

This investigation was conducted to compare the effects tow sowing techniques (Raised beds and Furrow rows),different rates and forms of N mineral fertilizer on the soil chemical properties, growth and yield of maize and reclamation of saline soil to short time (seasonal condition).

MATERIALS AND METHODS

A field experiment was carried out on sandy loam soil at Sahl El-Tina, Gelbana village No 7, North Sinai, Egypt, during a growing summer season (2009). The previous treatments were designed to identify the appropriate of agricultural technique, (Raised beds and Furrow row), N forms, N rates and their interactions on growth, yield and yield components of maize (*Zea mays* L. Th. 321 cv.) under conditions of saline soil. Some physiochemical properties of the 30 cm layer of the soil are presented in Table (1) according to Page *et al*., (1982). The experimental soil was irrigated from El-Salam canal (Nile water + drainage water, 1:1). The chemical properties of irrigation water are shown in Table (2).

Table (1): Some physiochemical properties of the experimental soil before sowing.

O.M (%)	$CaCO_3$ (%)	Available Macro-nutrients ($mg.kg^{-1}$Soil)			Particle size Distribution (%)				Texture
		N	P	K	C.Sand	F.Sand	Silt	Clay	Sandy Loam
0.85	7.59	46.5	6.1	191	5.8	53.5	32.6	8.1	
Depth (cm)	pH (1 : 2.5)	EC ($dS.m^{-1}$)	Soluble Ions (m. $mol.L^{-1}$)						
			Anions				Cations		
			Na^+	K^+	Ca^{++}	Mg^{++}	$HCO_3^=$	Cl^-	$SO_4^=$
0-15	8.2	11.13	53	1.57	44.81	27.94	1.53	54.87	70.92
15-30	7.97	8.83	38.38	4.15	40.75	22.8	3.04	46.5	56.53

Table (2): Some chemical characteristics of El-Salam canal irrigation water.

pH	EC ($dS.m^{-1}$)	Soluble Ions (m mole $.L^{-1}$)								SAR
		$CO_3^=$	HO_3^-	Cl^-	$SO_4^=$	Na^+	K^+	Ca++	Mg^{++}	
8.04	1.66	----	3.83	6.74	5.73	8.16	0.41	3.07	4.29	4.25

The field was well prepared by plowing twice with tractor then addition of organic composted between the two rows which make a raised bed manual, The plot area was 10.5 m^2 (3.5 m x 3m) which three Raised beds or six Furrow row, as follows in [fig. 1].

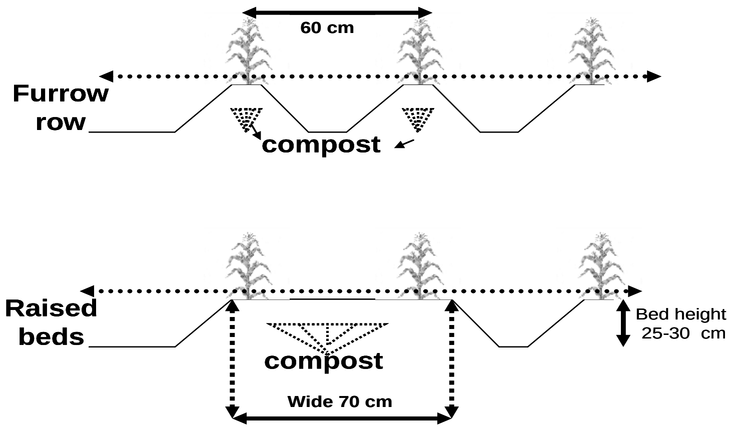

Figure (1): The design of Raised beds and Furrow row practice technique of agriculture

The north-south orientation Raised beds allows for an even exposure of the bed to sunlight. Briefly, this technique consists of seeding 2 rows on the top of Raised beds, 70 cm wide, bed height is normally 25-30 cm. In all treatments, row spacing was 60 cm, distance between plants in the row was

25-30 cm and two seeds were sown.hill^{-1}. In saline conditions, crop germination problems and seedling damage are more likely; hence maize seeds soaked by 2 % Urea for 18h before planting for obviation salt damage and to drought stress injury according to Kadria EL Azab *et al*., (2011).The experimental field was immediately flood irrigated after planting, occasional large irrigation for immerge the bed, each irrigation may be required for leaching of salts. Managing irrigation schedules (amounts and timing) according to calculation of crop water requirements and soil leaching requirement, irrigation was done every 8 days till crop maturity.

All other agronomic operations except those under study were kept normal uniform for all treatments. Where, the experimental soil plots were received local manufacture compost at a rate of 15m^3 fed^{-1}, (It was prepared from the residues of plants farm and its analysis is shown in Table (3).), and 200 kg fed^{-1} Super phosphate (15.5% P_2O_5) on 10 days before planting. Also, 1.0% of potassium sulfate (48% K_2SO_4) was added as foliar sprayed (Zameer khan, *et al*., 2006 and Kadria El Azab *et al*., 2011) in two times, *i.e.,* 25 and 50 days of sowing plants. Nitrogen forms which used were mineral nitrogen fertilizer (urea 46 % N , Ammonium Nitrate, 33.5% N and Ammonium sulfate 21.5% N) were applied in two equal doses at 25and 50 days after sowing as two concentration, 100% and 75% from the recommended dose (120 kg. N fed^{-1}).

Table (3): Chemical analysis of the used compost.

pH (1 : 2.5)	EC (dS m^{-1})	C/N	N	P	K	Fe	Zn
			(%)			(µg g^{-1})	
7.25	5.76	22.5	1.83	0.88	2.23	25.9	28.6

The designed experimental area was laid out in a split-split plot design with three replicates. The main plots were two agricultural techniques (Raised beds and Furrow row), sub plots were three N forms and the sub sub plots were N rates. It was included 12 treatments with three replicates, which were**:**

(1) Agricultural technique:

a) Raised beds.
b) Furrow row.

(2) N- mineral fertilizer forms:

(N.1): Urea - ***$(NH_2)_2CO$*** (46% N)
(N.2): Ammonium Nitrate - ***$(NH_4)_2NO_3$*** (33.0 %N)
(N.2): Ammonium sulfate - ***$(NH_4)_2SO_4$*** (20.6 %N) .

(3) N rates. (From the REC)

a)100 %.
b) 75 %.

At harvest, samples of 6 plants were taken randomly from each experimental plot to measure; plant height (cm), first ear height (cm), stem diameter (cm), ear length (cm), ear diameter (cm), 100- grain weight (g), grain yield (kg fed^{-1}), and leaves and stalks yield (kg fed^{-1}). Also, the samples of maize grains, leaves and stalks were collected from every experimental treatment, oven dried at 70°C, crushed and wet digested using mixture of H_2SO_4 + $HClO_4$ acids to determine nutrient contents in aliquots of the digested solutions, *i.e*., N.P.K.(%) (Ryan *et al*.,1996). Sodium and Potassium were determined by flame photometer (Richard's, 1954).

Samples wetness of the root zone (surface soil layers; 0-15, 15-30 and 30-45 cm) were taken and prepared for chemical analysis; pH, EC and soluble cations and anions were determined in soil paste extract according to Black *et al*., (1982). Available nutrients; N which were determined using K_2SO_4 (1%) according to the method described by 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).

Nitrogen Use Efficiency (NUE) is a term used to indicate the ratio between the amount of fertilizer N removed from the field by the crop and the amount of fertilizer N applied.

$$\textbf{NUE} = (\textbf{N removal with harvest} \div \textbf{mineral N input}) \times \textbf{100}$$

The values percentage for this equation were relatively classified to 4 levels by , Johnston and Poulton (2009) and Brentrup and Palliere (2010) as the following:

1) **Soil mining (> 100 %)** = N removal exceeds N input = declining soil fertility and yield = unsustainable.
2) **Risk of soil mining (90 - 100 %)** = additional N requirement for plant is not met by N input.
3) **Balanced in-and outputs (60 - 90 %)** = N fertilizer input meets total crop demand.
4) **Risk of high N loses (< 60 %)** = N fertilizer input exceeds total crop demand = increased risk of leaching.

The obtained data were exposed to proper statistical analysis of variance (ANOVA) by using Minitab computer program and least significant difference (L.S.D) were calculated at level of 5% (Barbara and Brain, 1994).

RESULTS AND DISCUSSION

Effect of Management practice on soil chemical properties:

Soluble salts that accumulate in soils must be leached below the crop root zone to maintain productivity. Leaching is the basic management tool for controlling salinity. Water is applied in excess of the total amount used by the crop and lost to evaporation. The strategy is to keep the salts in solution and flush them below the root zone. The amount of water needed is referred to as the leaching requirement or the leaching fraction. The results of pH, EC and soluble ions (m.mole L^{-1}) analyzed at 6 different times are given in Table (4), for evaluation the appropriate of agricultural technique, Data showed that pH, were little variation in the two system which decreased from 8.0 to 7.6 and from 8.0 to 7.8 in the root zone for Raised beds and Furrow row respectively, then return for increasing at harvest in all of them to 8.0 or 8.1 approximately. In the other hand, the decreasing in EC values were exceed in any technique especially in the layer of the root zone, which the values were changed from 7.3 to 3.4 and 7.3 to 4.2 for Raised beds and Furrow row respectively, the lowering soil EC through crop sowing may be due to the excess water amount applied with every irrigation to provide the water needed for leaching. However, the little time (8 days) interval between each of irrigation prevents the drying soil and returns the salt to the surface.

Table (4): Effect of management practice (Raised beds or Furrow row) on chemical properties. (Mean values for soil samples).

Agricultural technique and Time of analysis		Depth (cm)	pH (1:2.5)	EC ($dS.m^{-1}$)	Soluble Ions ($m.\ mole.L^{-1}$)						
					Anions				Cations		
					Na^{+}	K^{+}	Ca^{++}	Mg^{++}	$HCO_3^{=}$	Cl^{-}	$SO_4^{=}$
Initial Data (befor planting)		0-15	8.2	8.8	38.4	4.2	40.8	22.8	3.0	46.5	56.5
		15-30	8.0	7.3	30.6	4.9	24.0	24.8	1.7	33.5	49.0
Raised beds	After *	0-15	7.8	6.4	25.8	3.3	29.0	17.7	2.4	31.6	41.9
		15-30	7.6	4.7	19.0	2.5	21.3	13.0	1.8	23.2	30.8
		30-45	7.7	5.6	18.6	3.1	21.5	20.9	1.4	21.8	40.9
	After **	0-15	7.6	5.1	20.4	2.6	22.9	14.0	1.9	24.9	33.1
		15-30	7.8	3.9	12.9	2.4	17.3	11.6	1.5	15.5	27.2
		30-45	7.5	4.4	14.7	2.5	17.0	16.5	1.1	17.2	32.3
	After ***	0-15	7.5	4.9	16.3	3.0	21.9	14.7	1.9	19.6	34.4
		15-30	7.6	3.6	12.0	2.2	16.1	10.8	1.4	14.4	25.3
		30-45	7.4	4.1	13.7	2.3	15.8	15.3	1.0	16.0	30.1
	After ****	0-15	7.3	4.6	19.4	3.2	17.1	15.0	1.2	23.7	29.7
		15-30	7.8	3.4	11.4	2.1	15.3	10.2	1.3	13.7	24.0
		30-45	7.5	3.9	13.0	2.2	15.0	14.6	1.0	15.2	28.5
At Harvest		0-15	7.9	7.5	30.0	3.9	33.7	20.6	2.8	36.7	48.7
		15-30	8.1	5.7	18.9	3.5	25.5	17.0	2.2	22.8	40.0
		30-45	7.8	6.5	21.6	3.6	25.0	24.3	1.7	25.3	47.6
Furrow Row	After *	0-15	8.1	7.8	41.6	3.6	27.9	20.7	2.2	51.7	40.0
		15-30	8.0	5.6	30.0	2.6	20.2	14.9	1.6	37.3	28.9
		30-45	8.1	6.1	25.7	4.1	20.2	20.8	1.5	28.1	41.2
	After **	0-15	7.8	6.2	33.2	2.9	22.3	16.5	1.7	41.3	32.0
		15-30	7.9	4.5	18.0	2.3	20.2	12.4	1.7	22.0	29.2
		30-45	7.9	4.9	20.5	3.3	16.1	16.6	1.2	22.5	32.9
	After ***	0-15	7.6	5.9	31.6	2.8	21.2	15.7	1.6	39.3	30.4
		15-30	7.8	4.4	18.4	3.0	16.2	14.3	1.2	22.6	28.2
		30-45	7.7	4.7	19.5	3.1	15.3	15.8	1.1	21.4	31.3
	After ****	0-15	8.0	5.7	18.9	3.5	25.5	17.0	2.2	22.8	40.0
		15-30	7.9	4.2	17.5	2.9	15.4	13.6	1.1	21.4	26.8
		30-45	7.9	4.4	18.5	3.0	14.6	15.0	1.1	20.3	29.7
At Harvest		0-15	8.1	7.8	41.6	3.6	27.9	20.7	2.2	51.7	40.0
		15-30	8.0	6.9	28.8	4.7	25.4	22.4	1.8	35.3	44.2
		30-45	7.9	6.5	21.6	3.6	25.0	24.3	1.7	25.3	47.6

* = 2^{er} irrigation ** = 4^{er} irrigation *** = 6^{er} irrigation **** = 8^{er} irrigation

Generally, All of the soluble ions data in Table (4) was appeared decreasing up to more than 50% in the root zone approximately through age of plant, especially Na^+ which have negative effect on the plant production (Fipps, 2003). This decreasing were similar in all treatments, but the maximum reduction was noted in the Raised bed practice compared with the Furrow row system, although may be returns to little degree of increasing in the end of experimental due to draying process and may be due to a short period of time (seasonal conditions), whereby leaching was not accomplished. In general, the Raised beds technology has been shown to be particularly valuable on low permeable soils salinity, (Khan, *et al*., 2004 and 2010) and (McIntosh, 2010).

Effect of the studied treatments on soil content of the available N, P and K.

Soil content ($mg.kg^{-1}$) of available N, P and K was statistically non-significant and were similar at harvesting in all the treatments (Table 5 a) this slightly affected by the studied treatments may be to balance nutrients, also the additional doses for P and K in our experimental design were not changed. In the other hand, the individual effects of the different applied treatments (Table 5 b) showed significantly effect on available N and K particularly with both of the Raised bed technique and N-forms.

Table (5 a-b) : Effects of the different applied treatments on available N, P and K in soil surface (0-30 cm) at harvest.

{a}

<table>
<tr><th colspan="3" rowspan="2">Treatments</th><th colspan="3">Available macro-nutrients (mg kg⁻¹ Soil)</th></tr>
<tr><th>N</th><th>P</th><th>K</th></tr>
<tr><td rowspan="6">Raised beds</td><td rowspan="2">Urea</td><td>100%</td><td>87.8</td><td>7.8</td><td>218.8</td></tr>
<tr><td>75%</td><td>84.4</td><td>7.9</td><td>193.1</td></tr>
<tr><td rowspan="2">Ammonium nitrat</td><td>100%</td><td>77.3</td><td>7.0</td><td>172.6</td></tr>
<tr><td>75%</td><td>73.2</td><td>7.3</td><td>192.5</td></tr>
<tr><td rowspan="2">Ammonium sulfate</td><td>100%</td><td>96.0</td><td>6.8</td><td>172.6</td></tr>
<tr><td>75%</td><td>87.3</td><td>6.9</td><td>172.0</td></tr>
<tr><td rowspan="6">Furrow row</td><td rowspan="2">Urea</td><td>100%</td><td>81.7</td><td>7.2</td><td>196.0</td></tr>
<tr><td>75%</td><td>75.6</td><td>6.7</td><td>180.0</td></tr>
<tr><td rowspan="2">Ammonium nitrat</td><td>100%</td><td>73.2</td><td>7.9</td><td>197.8</td></tr>
<tr><td>75%</td><td>68.0</td><td>7.4</td><td>204.2</td></tr>
<tr><td rowspan="2">Ammonium sulfate</td><td>100%</td><td>78.7</td><td>7.6</td><td>243.8</td></tr>
<tr><td>75%</td><td>76.2</td><td>7.8</td><td>266.8</td></tr>
<tr><td colspan="3">LSD at (5%) for A*B*C</td><td>ns</td><td>ns</td><td>ns</td></tr>
</table>

{b}

Treatments		Available macro-nutrients (mg kg^{-1} Soil)		
		N	P	K
Agricultural technique (A)	Raised beds	84.33	7.30	186.94
	Furrow Row	75.55	7.42	214.80
	LSD at 5%	*6.22*	*ns*	*10.06*
N-Forms (B)	Urea	82.34	7.41	197.05
	Ammonium nitrat	72.93	7.40	191.76
	Ammonium sulfate	84.55	7.28	213.80
	LSD at 5%	*7.62*	*ns*	*12.32*
N-Rates (C)	100%	82.46	7.40	200.27
	75%	77.42	7.32	201.47
	LSD at 5%	*ns*	*ns*	*ns*
LSD at (5%)	*A*B*	*ns*	*0.51*	*17.43*
	*A*C*	*ns*	*ns*	*ns*
	*B*C*	*ns*	*ns*	*17.43*
	*A*B*C*	*ns*	*ns*	*ns*

Where, the soil content of available N was increased up to 10.4% whereas, the values of available K was decreased up to 12.9% under Raised bed condition. Also, the available N and K were increased relatively under N form with trend of ammonium sulfate, urea and ammonium nitrate respectively. While the effect of the rates of nitrogen treatments was non-significant.

Recently more of literature studied the physical, biological and chemical properties under raised bed soil management systems, they found that this technology practice improves conditions for plant growth by increasing lateral drainage from the beds into the furrows, reducing waterlogging, reducing the bulk density, lower penetration resistance and encourages the formation of large pore spaces which improve soil aeration, infiltration and drainage, resulting in improved crop growth. (Cotching and Dean, 2003; Peries *et al*., 2004 ; Bakker, 2007 and McIntosh, *et al*., 2010). Thus we suggest that the status of macronutrients strongly related with improvements processes in soil under raised bed practice. Where, our results in (table 5 a-b) appears un positive role for raised beds for increasing available N in soil may be due to improving biological properties particularly with ammonium sulfate compared with furrow row system**.** Data also showed decreasing in the available K soil content may be due to improving physical properties *i.e.*, infiltration and drainage under raised bed practice. So we prefer addition K requirement by foliar in this condition.

Effect of the applied treatments on the nutritional status of maize leaves & stalks and grains :

The data presented in Table (6) showed the effect of the applied treatments individually on the nutritional status of maize leaves & stalks and grains as well as, its statistical analyses. All macronutrients N, P and K content were increased relatively with 15.4, 19.0, 1.9 % and 10.0, 8.3, 12.3 %, for leaves & stalks and grains respectively under Raised bed conditions, with account of the content of N and P nutrients in corn grains more than here content in leaves & stalks under all condition, this is very normal at the end of growing where the maximum of nutrients were translated and accumulated in grains.

Table (6): Individual effects of applied treatments on the content of N, P and K (%) of maize yield components (Mean Values of Individual Factors).

Treatments		Leaves & Stalks				Grains			
		N%	P%	K%	Na %	N%	P%	K%	Na %
Agricultural technique (A)	Raised beds	0.850	0.224	1.293	0.667	1.286	0.387	0.540	0.211
	Furrow Row	0.719	0.182	1.268	0.706	1.157	0.355	0.474	0.213
	LSD at 5%	***0.034***	***0.018***	***ns***	***0.039***	***0.075***	***ns***	***0.055***	***ns***
N-Forms (B)	Urea	0.784	0.214	1.193	0.661	1.223	0.368	0.525	0.196
	Ammonium nitrat	0.763	0.177	1.348	0.714	1.196	0.358	0.506	0.214
	Ammonium sulfate	0.808	0.218	1.300	0.684	1.246	0.387	0.491	0.227
	LSD at 5%	***ns***	***0.022***	***0.074***	***ns***	***ns***	***ns***	***ns***	***0.022***
N-Rates (C)	100%	0.797	0.201	1.291	0.686	1.255	0.370	0.502	0.214
	75%	0.773	0.204	1.269	0.687	1.188	0.372	0.512	0.211
	LSD at 5%	***ns***	***ns***	***ns***	***ns***	***ns***	***ns***	***ns***	***ns***
LSD at (5%)	*A*B*	***ns***	***0.045***	***0.148***	***ns***	***ns***	***0.084***	***ns***	***ns***
	*A*C*	***ns***	***ns***	***ns***	***ns***	***ns***	***ns***	***ns***	***ns***
	*B*C*	***ns***	***0.045***	***ns***	***ns***	***ns***	***0.084***	***0.135***	***ns***
	*A*B*C*	***ns***	***ns***	***ns***	***ns***	***ns***	***ns***	***ns***	***ns***

But the content of K and Na were in the opposite direction may be due to Na is non-translate to plant and poor soil concentration of them (K and Na) by the excess of water irrigation and leaching process. The increasing relatively in content % of K up to 1.9% (non-significant) and up to 12.3% (significant) for leaves &stalks and grains, respectively don't related by its concentration in soil but these different in the values and significantly may be strongly concerned with foliar application of K, so the content is similar approximately in dray weight with agricultural practice, but the clearly improvement in soil parameters under Raised bed conditions have positive effect on the plant health and production which enhanced to translate and accumulation of K in grains.Data also indicate that in Table (6) non-significant effects between N forms on N content for all leaves & stalks and grains, but there are significant effect only to N forms on P and K contents for leaves & stalks. Generally, the N and P content were increased relatively with trend of ammonium sulfate, urea and ammonium nitrate in the same repetition for all leaves & stalks and grains. While the effect of the rates of nitrogen treatments was non-significant.

Effect of applied treatment on either ear parameters, biological yield and grains quality:

Data presented in Table (7) revealed that Raised beds technology was more effective on either maize ear (*i.e*., length and diameter for all plant and ear) or biological yield (*i.e*., grain yields) and grain quality parameters (*i.e*., weight of 100 kernels and crude protein %) as compared with the traditional practice (Furrow row), this positive effect is significantly on all parameters studied where increased to 10.8, 8.7, 9.7, 9.5, 8.8, 21.25, 7.15 and 10.0% respectively, this increasing can be explained on the basis that Raised bed technology were improved most of soil physic-chemical properties and the nutritional status in root zone which are involved directly or indirectly in formation of starch, protein and other biological components through their roles in the respiratory and photosynthesis mechanisms as well as in the activity of various enzymes (Nassar *et al*., 2002). Such positively effects are reflected on soil productivity and returned on increasing the biological nutrients uptake by maize, and then increasing maize grain yield and its quality.Also, Table (7) showed the relative variation for either maize ear as affected by N forms application, these variation may be significant for sum parameters or non-significant with others but the higher values allows when the ammonium sulfate addition, then urea and ammonium nitrate in the same repetition for all parameters studied . While the effect of the rates of nitrogen treatments was non-significant.

Effect of the applied treatments on the efficiency of N fertilizer utilization in maize production :

Table (8) showed the NUE of different mineral fertilizer application (forms and rates) in a short-term field trial with summer maize under Raised beds system. In general, N application rates with NUE values below 60% include an increased risk of nitrogen losses and should be avoided in order to protect the environment. Thus, the addition rate of N recommended (120 $kg.fed^{-1}$) for maize production dose not acceptable in saline soil under experimental conditions may be due to increased risk of leaching. as well as the effect of rates of N fertilizer applied were non –significant on the maize production, Table (7).

Also, The NUE values were increased to level of balance in–and output approximately at low N application rates (90 kg.fed^{-1}) under Raised beds practice technology compared with the traditional system (Furrow row), this situation can be described as a consequence for improving soil physicochemical and biological properties. The NUE values were increased up to 74.7 %, 73.8 % and 63.7 % with using ammonium sulfate, urea and ammonium nitrate respectively. This excess in NUE percentage were maximized when the ammonium sulfate addition compared with other N forms. This is due to the positive effects for anions ammonium and sulfate on soil reclaimed especially at Raised beds practice technology.

Table (7): Individual effects of applied treatments on Maize ear parameters and Yield Components. (Mean Values of Individual Factors).

Treatments		Parameters of Maize growth					Biological Yield (Kg.Fed^{-1})		Maize grain quality parametr	
		Plant Length (cm)	First ear height (cm)	Stem diameter (cm)	Ear length (cm)	Ear diameter (cm)	Grains Y.	Leaves & Stalks Y.	Wt . 100 Kernels (g)	Crude Protein %
Agricultural technique (A)	**Raised beds**	259.6	119.2	3.1	25.4	5.4	2946.7	3122.0	38.9	8.04
	Furrow Row	231.4	108.9	2.8	23.0	4.9	2320.6	2962.3	36.1	7.23
	LSD at 5%	***11.4***	***7.1***	***0.2***	***1.0***	***0.1***	***188.4***	***ns***	***1.62***	***0.47***
N-Forms (B)	**Urea**	240.0	105.9	3.0	23.4	5.0	2706.6	3084.9	34.5	7.64
	Ammonium nitrat	244.4	117.6	2.9	24.4	5.2	2391.2	3017.9	38.4	7.47
	Ammonium sulfate	252.1	118.6	3.1	24.6	5.3	2803.2	3023.6	39.5	7.79
	LSD at 5%	***ns***	***8.7***	***ns***	***ns***	***0.2***	***326.3***	***ns***	***2.8***	ns
N-Rates (C)	**100%**	239.8	113.8	2.8	24.4	5.1	2700.1	3074.0	36.3	7.85
	75%	251.1	114.3	3.2	23.9	5.3	2567.3	3010.3	38.7	7.42
	LSD at 5%	***ns***	***ns***	***0.2***	***ns***	***0.1***	***ns***	***ns***	***2.3***	**ns**
LSD at (5%)	***A*B***	***ns***	***ns***	***0.3***	***ns***	***0.2***	***ns***	***ns***	***ns***	**ns**
	A*C	***ns***	***ns***	***ns***	***1.4***	***ns***	***ns***	***ns***	***2.3***	**ns**
	B*C	***ns***	***ns***	***ns***	***1.7***	***0.2***	***ns***	***ns***	***2.8***	**ns**
	A*B*C	***ns***	***17.4***	***ns***	***ns***	***0.2***	***ns***	***ns***	***ns***	**ns**

Table (8): NUE of different mineral fertilizer application (rates and forms) in a short-term for Raised beds and furrow row practice field with summer maize.

Treatments			N removal with harvest Kg.fed^{-1}(output)		N mineral application rate Kg.fed^{-1} (input)	N use efficiency (NUE) %
			Leaves & Stalks	grains		
Raised beds	Urea	100%	27.8	41.2	120	57.5
		75%	29.3	37.1	90	73.8
	Ammonium nitrat	100%	24.5	35.4	120	49.9
		75%	25.8	31.6	90	63.7
	Ammonium sulfate	100%	25.3	44.5	120	58.1
		75%	26.3	41.0	90	74.7
Furrow Row	Urea	100%	21.4	28.3	120	41.4
		75%	18.8	26.5	90	50.4
	Ammonium nitrat	100%	24.8	25.8	120	42.2
		75%	17.1	23.2	90	44.8
	Ammonium sulfate	100%	23.0	30.2	120	44.3
		75%	23.2	27.6	90	56.4

Thus, it can be concluded that Raised beds practice has more efficiency on improving soil properties and maize productivity compared with the traditional method for planting under saline soils particularly at Sahl El tena. As well as, using ammonium sulfate recorded the best values for all parameters studied compared with the other forms of N fetilizers under these conditions. However, we will need to numbers of studies for evaluation and validation this technology for salinity control.

REFERENCES

Akbar G.; G. Hamilton; Z. Hussain and M. Yasin (2007). Problems and Potentials of permanent raised bed cropping systems in Pakistan. Pakistan Journal of Water Resources, Vol.11:1,11-21.

Ashraf M. and M.R. Foolad (2005). Pre-sowing seed treatment – A shotgun approach to improve germination, plant growth, and crop yield under saline and non-saline conditions. Advances in Agronomy, 88: 223–271

Ayers, R.S. and D.W. Westcot (1985). Water quality for agriculture. FAO Irr gation and Drainage Paper (29) FAO, Rome.

Ayers R.S. and D.W. Westcot (1994). Water quality for agriculture. FAO Irrigation and Drainage Paper 29, Rev. 1 Reprinted 1989, 1994.

Bakker, D. (2007). Soil and surface water management for profitable crops and pastures on waterlogged and saline land : a final report prepared for the Grains Research and Development Corporation, GRDC project number DAW717, Department of Agriculture and Food, Perth.

Barbara, F.R. and L.J. Brain (1994). ''Minitab Hand book''. Duxbury press. An Imprint of Wad Sworth Publish. Comp. Belonont California, U.S.A.

Beecher H.G. ; J.A. Thompson ; D.W. McCaffery and J.S. Muir (2003). Cropping on raised beds in southern NSW, Agfact P1.2.1, (Revised June 2003) www.agric.nsw.gov.au

Black, C.A.; D.D. Evans; L.E. Ensminger; J.L. White and F.E. Clark (1982). Methods of Soil Analysis. Am. Soc. of Agron. Inc. publisher Madison, Wisconsin, USA.

Brentrup F. and C. Palliere (2010). Nitrogen use efficiency as an agro-environmental indicator OECD workshop “Agri-environmental indicators: lessons learned and future directions”, 23-26 March 2010, Leysin, Switzerland.

Cotching, W.E. and G.J. Dean (2003). Soil properties under raised bed farming systems in Tasmania, Proceedings of the 10th Australian Agronomy Conference, Science and Technology: Delivering Results for Agriculture’, Hobart, January 2001.

Fipps, G. (2003). Irrigation water quality standards and salinity management. Fact Sheet B-1667. Texas Cooperative Extension. The Texas A&M University System, College Station, TX.

Jackson, M.L. (1973). "Soil Chemical Analysis." 2nd Ed. Prentice Hall of India Private and L. T. D. , New Delhi, India.

Johnston, A.E. and P.R. Poulton (2009) “Nitrogen in Agriculture: An Overview and Definitions of Nitrogen Use Efficiency”, Proceedings International Fertiliser Society 651, York, UK.

Kadria M. El-Azab ; A. Kh. Amer ; I. A. E. Hegab and T. A. Abou El-Defan (2011). Combating the negative effect of soil salinity stress at Sahl El-Tina area on maize growth and productivity using some fertilization manipulations. Fayoum J. Agric. Res. & Dev.,25:1,107-123.

Khan, M. j. ; M.T. Jan ; A. Ullahkhan ; M. Arif and M. Shafi (2010). Management of saline sodic soils through cultural practices and gypsum. Pak. J. bot., 42: 6, 4143-4155.

Khan, M.J.; N. Muhammad. ; M.J. Khan and I. Adullah (2004). Influence of management practices and amendments on cotton wheat cropping system grown under saline sodic soil conditions at Bannu basin. Proceeding of the 3rd National Drainage Seminar in Peshawar, June 7-8, Pakistan.

Mahatma, M.K.; R. Bhatnagar; R.K. Solanki and G.K. Mittal (2009). Effect of seed soaking treatments on salinity induced antioxidant enzyme activity, lipid perxidation and free amino acids in wheat (*Triticum aestivum* L.) leaves. Indian J. Agric. Biochemistry, 22: 2, 74-79.

McIntosh, K. ; G. White ; Q. Gay ; A. Maughan, and S. Witteveen (2010). Raised bed trial at blackboy creek, near Esperance, salinity and land use impacts series, Report no. SLUI 49, Department of Water, Perth. www.water.wa.gov.au.

Ministry of Irrigation and Water Resources (2002). Survey of Nile System pollution Sources Report no 64.

Nassar, K.E.; A.O. Osman; M.H. El-Kholy; M. Madiha and N. Badran (2002). Effect of seed coating with some micronutrients on faba bean (*Vicia faba L.*).ll. Effect on yield attributes and mineral composition. Egypt. J. Soil Sci., 42:3, 363.

Page, A.L.; R.H. Miller and D.R. Keeney (1982). ''Methods of Soil Analysis''. Part 2: Chemical and Microbiological Properties. Second Edition, Amer Soc. of Agron. Madison, Wisconsin, USA.

Pegah M. D. ; F. Sharif-Zadeh and M. Janmohammadi (2008). Influence of priming techniques on seed germination behavior of maize inbred lines *(zea mays* lARPN) J. Agric. and Biolo. Sci.. 3: 3, MAY 2008 ISSN 1990-6145 ©2006-2008 Asian Research Publishing Network (ARPN). All rights reserved. www.arpnjournals.com.

Peries, R. ; B. Wightman ; C. Bluett and A. Rab (2004). Raised bed cropping in southern Victoria - A snapshot of a productive and sustainable option for waterlogging prone soils, New Directions for a Diverse Planet', Proceedings of the 4th International Crop Science Congress, Brisbane 2004.

Qureshi, R.H. and M. Aslam. 1988. Research on utilization of degraded lands, Sadhoki: 1st Ann.Rep. 1987-88*.* Dept. Soil Sci. Univ. Agric. Faisalabad, Pakistan, 61pp.

Qureshi, R.H. and E.G. Barrett-Lennard (1998). Saline agriculture for irrigated land in Pakistan. A Handbook of Australian Centre for International Agriculture Research Canberra, Australia.

Rhoades J.D. (1982). Reclamation and management of salt-affected soils after drainage. Proc. First Annual Western Provincial Conference on Rationalization of Water and Soil Research and Management, Alberta, Canada. pp. 123–197.

Richard's, L.A. (1954) ''Diagnosis and improvement of saline and alkali soils'', U.S.Dept.Agric, Handbook 60.

Ryan, J.; S. Garabet; K. Harmsen and A. Rashid (1996). A soil and plant Analysis Manual Adapted for the west Asia and North Africa Region. ICARDA, Aleppo, Syria, 140 pp.

Shaban Kh. A. and A.A. El-Sherief (2007). Evaluation of Alfalfa productivity and its response to bio-fertilizer, Mineral Nitrogen and Sulphur under Saline Condition in Newly Reclaimed Area. Egypt. J. Soil. Sci., 47:4, 347-365.

Soltan pour, N. (1985). Use of ammonium bicarbonate- DTPA soil test to evaluate elemental availability and toxicity. Soil Sci. Plant Anal., 16: 3, 323- 338.

Upson, S. (2005). Use these tips to manage hoop house soil salinity, the samuel roberts noble foundation, ardmore, okla. www.noble.org/ag/Horticulture/Salinity/index.html.

Zameer khan M.; s. Muhammad, m. A. Naeem ; E. akhtar and M. khalid (2006). Response of some wheat (*triticum aestivum l.*) Varieties to foliar application of n & k Under rainfed conditions. Pak. J. Bot., 38: 4,1027-1034.

إدارة مشاكل الملوحة بسهل الطينة- شمال سيناء

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أجريت تجربة حقلية في منطقة إستصلاح حديثة ذات تربة طميية رمليه ، بسهل الطينة ، قرية جلبانة رقم 7، شمال سيناء، مصر خلال الموسم الصيفى 2009 لدراسه تاثير اسلوبين لادارة الأراضى الملحية مع معدلات وصور مختلفه من الأسمده النتروجينيه وذلك على الخواص الكيميائيه للتربة ونمو وانتاجية محصول الذرة ومكوناته. حيث شملت المعاملات اثنين من الممارسات الزراعية (المصاطب والخطوط) بالاضافه الى ثلاث صور للأزوت (يوريا 46% نترات الأمونيوم 33.0% - وكبريتات الأمونيوم 20.6%) و بمعدلين (75% و100%) من الجرعة السمادية الموصي بها.

أشارت النتائج إلى تحسن الخواص الكميائيه للأرض تحت ظروف الزراعه فى مصاطب مقارنه بالنظام التقليدى (الزراعه فى خطوط) خصوصا فى منطقه الجذور. حيث انخفضت نسبيا قيم ال pH من 8.0 الى 7.6 و7.8 كما انخفضت بشده قيم التوصيل الهيدرولكى من 7.3 الى 3.4 و 4.2 لكل من المصاطب والخطوط على التوالى .اظهرت الأيونات الذائبه اتجاها مماثلا حيث انخفضت الى اكثر من 50% تقريبا فى منطقه الجذورخصوصا ايونات الكلوريد والصوديوم خلال فتره نمو الذره تحت نظام المصاطب.

علاوة علي ذلك فان اسلوب المصاطب المستخدم يمتلك ايضا تاثيرا اجابيا على محتوى التربه من النتروجين الذي زاد بحوالى 10.4% بينما كان سلبيا على محتوي التربة من البوتاسيوم حيث انخفض بحوالى 12.9% تحت نفس الظروف . على الجانب الأخر فان قيم كل من النتروجين والبوتاسيوم الميسرين ازدادت نسبيا باضافه صور النتروجين وكانت اعلى زياده مع استخدام كبريتات الأمونيوم ثم اليوريا يليها نترات الأمونيوم على التوالى. بينما تأثير معدلات النتروجين المضافه لم يكن معنويا.

تشير النتائج ايضا الى ان القياسات النباتيه للذره ممثله فى الحاله الغذائيه لكل من القش و الحبوب وكذلك صفات النمو(طول النبات وقطر الساق ايضا طول الكوز وقطره) ومحصول الحبوب ووزن ال100 حبه و البروتين % قد سجلت افضل القيم مع نظام الزراعة علي مصاطب مقارنه بالطريقه التقليديه (الزراعه على خطوط).

عموما عند استخدام معدلات من الأسمده الأزوتيه فان القيم الخاصه بكفاءة استعمالها الأقل من 60% تمثل خطوره لفقد النتروجين والتى يجب ان يحد منها وذلك لحمايه البيئه . ايضا هذه القيم قد ارتفعت او اقتربت من مستوى التوازن بين محتوى النتروجين الداخل والخارج عند استعمال المعدل الأقل من التسميد النتروجينى (90كجم/فدان) تحت ظروف الزراعه على المصاطب مقارنه بالزراعه فى خطوط. وكانت افضل القيم 74.7 %عند التسميد بكبريتات الأمونيوم مقارنه بالصور الأخرى وبناء عليه تكون المعلات الموصى بها (120 كجم/فدان)غير مقبوله لانتاج الذرة فى الأراضى الملحية

قام بتحكيم البحث

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