

IMPACTS OF DIFFERENT RATES OF COMPOST, PROLINE-SPRAY AND IRRIGATION ON SOME SOIL PROPERTIES AND SUDAN GRASS GROWN IN SALINE SOIL

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ABSTRACT: *An experiment was conducted during the season of 2017, at South of Sahl El-Hosainiya Research Station, Agricultural Research Center (ARC) Sharkeia Governorate, Egypt. The experimental treatments were: Compost (C) at rates control (C₀), 24 ton. (C₂₄) and 48 ton./ ha. (C₄₈). Irrigation upon 25% available moisture depletion (AMD) (I_{25%}), 50% AMD (I_{50%}) and 75% AMD (I_{75%}). Proline treatments which included spray with 2 mg Proline L⁻¹ (P₁) as well as No-Proline spray (P₀). Whereas, spraying was done at the times 20, 45 and 60 days post-seeding (1200 L/ha.). The cultivated crop was Sudan grass. Two cuts were taken after 60 and 120 days from sowing.*

Obtained results showed that: Soil organic matter increased by 18.4% by (C₄₈). Soil bulk density significantly decreased with the application of compost. Values of total porosity and hydraulic conductivity were significantly increased as a result of compost application. Available N, P and K in the soil at the end of experiment were greater in treatments receiving compost and irrigated upon depletion of 50% available water (I_{50%}). Fresh and dry yield (two cut) were the highest with treatments of irrigation up to 50% depletion of water (I_{50%}), compost at 48 ton/ha.(C_{48ton}) and Proline-spray (P₁).

Key wards: *Compost, Prolene , Irrigation , Clay soil, Sudan grass.*

INTRODUCTION

The recent policy of Egypt tended to increase and improve the arable area to and exploit the resources available.

Improvement of salt affected soils using amendment such as compost could be employed to maintain soil health, reduce pollution and increase agriculture productivity. Irrigated agriculture is vital for Egypt where rain-fed agriculture does not represent any significant part of arable farming. Therefore, maximizing the return obtained from irrigation is very important. Compost has a positive effect on soil fertility and physical properties. It could also increase the irrigation water application efficiency.

Sudan grass are gained increasing importance as nan forage crop in many regions of the world including Egypt. They tolerate adverse conditions such as

salinity, heat, drought, and low soil fertility. Abdel-Moez, *et al.*, 1995, Abdel-Wahab, 1999, Badawi, 2003 and Rehan, *et al.*, 2004 reported that application of organic amendments caused an increasing of soil EC from being about 0.3 to reach as much as about 2 dSm⁻¹, due to the release of soluble salts during their decomposition or due to contents of soluble salts inherent in the amendments. Torres-Tomejil (2008) found that, soil EC was not affected by application of organic amendments. Mekail (1994) treated a sandy soil with organic amendments and obtained an increase in soil organic matter. Moreover, Abdel-Aal *et al.* (2003) and Yaduvanshi (2003) found that the application of organic materials increased organic matter content in the soil. Modaihsh *et al.* (2005), Las Torres-Tomejil (2008) and Ibrahim *et al.* (2011) Patra *et al.* (1992) and El-Naggar (1996)

reported low ammonification and nitrification in saline soils as compared with non-saline soils. Hamidi (1997) reported that low available-N in saline soils is due to decreased mineralization as well as to gaseous-N loss as ammonia. Abou-Baker (2008) applied banana residue compost to a calcareous soil and found that available-N increased in soil. Basyouny et al. (2004) reported that compost increased available-NPK in soil compared with mineral fertilizers. Singer et al. (2004) reported that compost application increased total soil P to 164 mg kg⁻¹ compared with 55 mg kg⁻¹ without compost. Taha (2007) applied sesame straw compost to a sandy soil and observed increases in available NPK after harvesting of two successive crops; the increase was proportional to the application.

Proline is the major amino acid associated with environmental stresses (salinity, extreme temperatures, UV radiation and heavy metals). When exposed to drought or a high salt content in the soil (both leading to water stress),

many plants accumulate high amounts of proline, in some cases several times the sum of all the other amino acids (Ashraf and Foolad 2007). The proteinogenic amino acid-proline functions as an osmolyte, radical scavenger, electron sink, stabilizer of macromolecules and a cell wall component (Matysik et al. 2002).

MATERIALS AND METHODS

The current experimental study was conducted in South of Sahl El-Hosainiya Research Station, Agric. Res. Center (ARC), Sharkeia Governorate, Egypt during summer season of 2017 the experimental soil was saline sodic clay as shown in (Table 1). This investigation was conducted to evaluate the effect of compost and its interaction with treatments of irrigation and proline-spray on some soil characteristics. Also, to study the effects of these treatments on the forage crop (i.e. Sudan grass "*Sudan grasssudanense*" cv Giza 2). The yield of the two cuts of Sudan grass at 60 and 120 days after seeding were be detained for this purpose.

Table 1: Soil properties of the experiment site

Particle size distribution	Values	Chemical analysis	Values
Sand %	15.0	ECdSm ⁻¹ soil past	8.5
Silt %	39.7	pH (1:25 w:v soil water)	8.12
Clay %	45.3	Ca ²⁺ (meq/L)	7.8
Texture class	Heavy Clay	Mg ²⁺ (meq/L)	5.5
		Na ⁺ (meq/L)	67.4
Field capacity (% w/w)	50.2	K ⁺ (meq/L)	1.3
Wilting point (% w/w)	26.3	HCO ₃ ⁻ (meq/L)	2.8
Available water(%w/w)	23.9	Cl ⁻ (meq/L)	71.2
Saturation(% w/v)	81	SO ₄ ²⁻ (meq/L)	8.0
Bulk density(Mg m ⁻³)	1.65	SAR	26
Total porosity%	46.1	Available nutrients (mg kg ⁻¹)	
Hydraulic Conductivity (cm h)	0.44	N	56
CaCO ₃ (g/kg soil)	1.60	P	4.3
Organic matter (g/kg soil)	0.63	K	165

Impacts of different rates of compost, proline-spray and irrigation on some

The experimental design was a factorial split-plot design with three replicates. The main-plots assigned to irrigation treatments (I) and the sub-plots to the treatments of the organic fertilization (C) /proline (P) combinations. The three experimental factors rates were as follows:

- (1) Irrigation "I"; with the three rates of:
- Irrigation depletion up to at 25% of soil available moisture (i.e. short irrigation intervals; I_{25%}).
 - Irrigation depletion up to at 50% (i.e. medium intervals; I_{50%}).
 - Irrigation depletion up to at 75% (i.e. long intervals; I_{75%}).
- (2) Organic fertilization "C"; with the three rates of:
- No compost (control) (C₀)
 - Compost added at 24 ton/ha. (C₂₄).
 - Compost added at 48 ton/ha. (C₄₈).

Their additions were followed by plugging under into the soil (within the 15-cm soil plough layer) before seeding.

- (3) Proline treatment "P"; with the two rates of:
- No proline-spray (spray with water; P₀).
 - Proline-Spray (P₁) with solution of 2 mgL⁻¹ proline in 3 occasions at 500 L/fed. each time. Whereas the spraying were done at 20, 45 and 60 days after sowing.

The main plots (i.e. irrigation treatment) was separated from each

other by 2m belt. The area of the experimental plot was 10.5 m².

All plots received N, P and K as follows: 170 kg N (as ammonium sulphate: 205 g N kg⁻¹) + 24 kg P (as ordinary Ca-superphosphate; 68 g P kg⁻¹) +71 kg K (as K-sulphate; 400g Kkg⁻¹). Application of P and K was done before sowing. Application of N was done in three equal doses (i.e. before sowing, two weeks and five weeks after sowing). Properties of compost and water (used for irrigation) are given in Table (2).

Methods of analysis:

Soil analysis:

Soil particle distribution was done using sodium hexameter-phosphate as a dispersing agent, by the international pipette method according to Piper (1950). Calcium carbonate was done using calcimeter and organic matter by the Walkley and Black method. Also pH (1:2.5 soil water suspensions) and salinity (in paste extract) were measured. Available N (NH₄-N+NO₃-N) was extracted by KCl and determined by the Kjeldahl method. Soil bulk density, total porosity and saturation percent, all these determinations were according to methods cited by Black *et al.* (1965) and USDA (1954). Available P and K were extracted by Ammonium-Bicarbonate-according to Soltanpour (1985). to Black *et al.* 1965).

Table (2): Properties of compost and the water of El-Salam canal.

A: Compost

EC(dS m ⁻¹) 1:10 extract.	pH 1:2.5 susp.	Nutrients			C/N ratio	O.M. (%)	Bulk dens. (g . m ⁻³)	Moisture (%)	Ash (%)	W.H.C (w/w)
		Total (%)	Available (mg/kg)							
		N	P	K						
4.55	6.67	2.73	38.3	286	13.57	49.01	0.455	15.34	54.6	1600

B: Irrigation water

EC (dSm ⁻¹)	pH	Soluble ions (mq _c L ⁻¹)							SAR
		Ca ²⁺	Mg ²⁺	Na ⁺	K ⁺	HCO ₃ ⁻	Cl ⁻	SO ₄ ²⁻	
1.92	7.63	3.55	3.6	11.37	0.37	3.01	12.34	3.55	6.61

Crop yield:

Two cuts as sudan grass were taken from each plot after 60 and 120 days from sowing. Fresh and dry weight (oven dried at 70°C) of plant of plant were determined.

RESULTS AND DISCUSSION

Chemical and physical characteristics of studded soil as well as the responses of both fresh and dry yields of the three harvests of Sudan grass, a forage crop, to evaluate the effect of compost additions, different irrigation rates and proline – application. Discussion will be covering the main individual effects of all the experimental factors, and interaction effects between them, for all the studied parameters.

Effects on some chemical characteristics of the tested saline soil:

Soil Salinity:

Salinity of soil at the end of the experimental trial, expressed as EC (dSm⁻¹), as affected by the experimental factors was showed in Table (3). Increasing the rate of compost addition significantly decrease soil salinity, whereas EC decreased with 17.9% at (C₂₄) and with 22.02% at (C₄₈) relative to (C₀).

The lower of soil salinity with treatments received high rate of compost reflects the role of compost in retaining and maintaining soil moisture, thus reducing soil salinity.

Table (3): Soil salinity (EC, dSm⁻¹ 1:2.5 soil: water suspension) and soil O.M (%), after growing Sudan grass, as affected by the different experimental factors.

Soil O.M (%)			Soil EC (dS/m)			Compost (C) (ton./ha)
Irrigation Rates, % of available moisture depletion (I)						
(I _{75%})	(I _{50%})	(I _{25%})	(I _{75%})	(I _{50%})	(I _{25%})	
Without – proline (P ₀)						
0.63	0.63	0.63	8.00	8.00	8.00	Control (C ₀)
1.53	1.54	1.59	6.77	6.47	6.30	Compost (C ₂₄)
1.79	1.94	1.88	6.43	6.03	6.27	Compost (C ₄₈)
Proline - spray, 2m/L (P ₁)						
0.63	0.63	0.63	7.97	7.97	7.97	Control (C ₀)
1.55	1.58	1.61	6.73	6.37	6.70	Compost (C ₂₄)
1.72	1.93	1.92	6.47	5.93	6.23	Compost (C ₄₈)
LSD at (0.05): I* C *P=ns			LSD at (0.05): I* C *P = ns			

Mean values of the individual effects of the experimental factors.

Soil O.M (%)			Soil EC (dS/m)		
Proline (P)	Irrigation (I)	Compost (C)	Proline (P)	Irrigation (I)	Compost (C) ton/ha
1.351 (P ₀)	1.377 (I _{25%})	0.630 (C ₀)	6.919 (P ₀)	6.921 (I _{25%})	7.985 (C ₀)
1.356 (P ₁)	1.375 (I _{50%})	1.567 (C ₂₄)	6.927 (P ₁)	6.795 (I _{50%})	6.557 (C ₂₄)
	1.308 (I _{75%})	1.863 (C ₄₈)		7.062 (I _{75%})	6.227 (C ₄₈)
LSD at (0.05):			LSD at (0.05):		
P=ns	I= ns	C =0.03	P = ns	I=0.096	C = 0.096

Impacts of different rates of compost, proline-spray and irrigation on some

Treatments of irrigation (I) caused decreasing in EC of soil with 2.14% and 7.19% under (I_{25%}) and (I_{50%}) respectively. Comparing with (I_{75%}) decreased values of soil EC found was of observed with 25% or 50% of available moisture depletion (AMD) reflects the hampering of desalination of the top soil, due to closer between irrigation periods. On the other hand, sprayed plants with prolein didn't significantly affect EC of soil. Generally the decreasing in soil EC was more pronounced with compost addition (C) than with the other experimental factors of (I) or (P).

In general the experimental treatments the interaction effects between the experimental factors, showed non-significant trends with the lowest EC of soil (5.93) under (I₂ P₁ C₄₈) and the highest EC of soil abut (8) under no-compost addition (C₀) regardless the rate of (I) or (P) treatments .

Soil Organic matter content (%):

At the end of experiment, compost addition (C) was the most effective factor comparing with other experimental factors of (I) and (P). Whereas, the addition of compost caused significant increasing in soil organic matter (O.M.) content from 0.63 % (C₀) to 1.57% (C₂₄) and 1.86 (C₄₈) with relative increasing (as % of C₀) of 149 and 195, respectively. On the other hand treatments of irrigation (I) or proline (P) showed non-significant effects on O.M content (%) of soil.

In general, content of soil O.M (%) ranged from 0.63 % under treatment of (I₂₅ C₀ P₀) and 1.94% under the treatment of (I₅₀ C₄₈ P₀).

Available nitrogen, phosphorus and potassium of Soil:

Available values of N, P and K of soil at the end of the experimental trial; expressed as (mg kg⁻¹), as affected by the experimental factors were showed in Table (4).

Available - N:

Compost addition resulted an increasing in available-N the average values were 220 and 293% relative to (C₀) in plots of soil treated with (C₂₄) and (C₄₈) respectively.

Irrigation treatments showed the highest effect on available-N under (I_{75%}) comparing with other irrigation treatments (i.e. I_{25%} and I_{50%}). The favorable effect of (I_{75%}) was the most effective treatment under conditions of no- proline in combination with compost application.

Proline- spray (P₁) showed a decrease on available-N with 9 % relative to (P₀). It is noticed that, available-N in presence of (C₂₄) or (C₄₈) under irrigation with (I_{25%}) or (I_{75%}) showed non-significant changes under Porlien-spray (P₁) comparing with under (P₀).

Generally, available-N of soil as affected with the triple interaction varied considerably according to the applied treatment. Whereas, it's values ranged between 56 mg N kg⁻¹ soil (C₀ under any treatments of I or P) to 278.3 mg N kg⁻¹ in soil of plots treated with (C₄₈ I_{50%} P₀) with an increase of 397 % for the latter over the former treatment.

Available - P:

Compost addition increased available-P with averaging values of 150% and 250%, relative to (C₀), in treatments receiving (C₂₄) and (C₄₈) respectively.

Under irrigation treatments of (I_{25%}) and (I_{75%}), the experimental soil had the similar values of available-P. Moreover, (I_{50%}) showed more available-P with (I_{25%}) or (I_{75%}) with 22%. The favorable effect of (I_{50%}) over (I_{25%} or I_{75%}) occurred only when compost was applied. Such positive effect was greater under (C₄₈) than (C₂₄).

Table (4) :Available--N, P and K (mg kg⁻¹) of soil after growing Sudan grass, as affected by the different experimental factors.

Compost (C) (ton./fed)	Available-N(mg kg ⁻¹)			Available-P(mg kg ⁻¹)			Available-K(mg kg ⁻¹)		
	Irrigation Rates, % of available moisture depletion (I)								
	(I _{25%})	(I _{50%})	(I _{75%})	(I _{25%})	(I _{50%})	(I _{75%})	(I _{25%})	(I _{50%})	(I _{75%})
Without – proline (P ₀)									
Control (C ₀)	56.0	56.0	56.0	4.2	4.2	4.2	165	165	165
Compost (C ₂₄)	168.3	233.0	165.0	10.1	11.5	10.8	361	400	366
Compost (C ₄₈)	204.7	278.3	207.0	14.1	16.5	14.0	372	463	433
Proline - spray , 2m/L (P ₁)									
Control (C ₀)	56.0	56.0	56.0	4.2	4.2	4.2	165	165	165
Compost (C ₂₄)	161.3	176.3	169.7	9.7	10.8	9.6	362	394	361
Compost (C ₄₈)	204.7	219.7	207.7	13.6	15.8	12.6	414	451	429
LSD at (0.05):	9.86			n.s			n.s		
Mean values of the individual effects of the experimental factors.									
Compost (C)	Available-N(mg kg ⁻¹)			Available-P(mg kg ⁻¹)			Available-K(mg kg ⁻¹)		
	Irrigation (I)								
	(I _{25%})	(I _{50%})	(I _{75%})	(I _{25%})	(I _{50%})	(I _{75%})	(I _{25%})	(I _{50%})	(I _{75%})
Control (C ₀)	143	158	158	9	9	10	307	307	321
Compost (C ₂₄)	189	145	145	11	11	9	400	400	323
Compost (C ₄₈)	220	220	220	9	9	9	319	319	
LSD at (0.05):	3.29			0.32			19.02		
4.03	4.03	3.29	0.39	0.39	0.32	19.02	19.02	19.02	n.s

Impacts of different rates of compost, proline-spray and irrigation on some

The spraying of proline (P₁) resulted in lower of soil P-availability by a significant average of 11%. This occurred under all conditions of compost addition and irrigation treatment no significant effect of was observed by either (C) or (I or both on the response to proline.

The available-P varied considerably according to the applied treatments. Values ranged between 4.2 mg P kg⁻¹(C₀ I P) to 16.5 mg P kg⁻¹(C₄₈ I_{50%} P₀) with an increase of 293% due to the latter treatment higher than the former one.

Available - K:

Compost addition resulted in increases in available-K averaging 127 to 158% in treatments receiving (C₂₄) and (C₄₈) respectively, relative to (C₀).

Irrigation treatment (I_{50%}) gave the highest available -K over (I_{75%}) or (I_{25%}). Soils treated with (I_{25%}) or (I_{75%}) recorded the smallest available-k with non-significant interaction between them. The I_{50%} irrigation treatment showed greater value of average available -K (30%) comparing to contents of I_{25%} and I_{75%} treatments respectively. The effect of proline was not significant.

No significant interactions were shown (i.e. effect of irrigation) compost or proline was not interfered by the other factor. But, soil available-K varied according to the applied treatments with values ranging between 165 mg K kg⁻¹(C₀ I P) to 463 mg K kg⁻¹(C₄₈ I_{50%} P₀). The highest treatment showed an increase of 181% over the lowest one.

Experimental factors effects on the previous discussed chemical characteristics:

The highest EC value, under I_{75%} treatment, denote the relatively low soil of soil for moisture content treatment relative to the other two treatments.

On the other hand, low EC of (I_{25%}) and (I_{50%}) reflect a possible greater leaching

of salts from those two treatments relative to (I_{75%}). Decreased in soil salinity by applied compost is due to increased retention of soil moisture.

Increased organic matter and available NPK by compost application are a direct effect of compost and nutrients associated with it (Las Torres-Tomejil, 2008). More nutrients associated with I_{50%} greater than I_{25%} or I_{75%} is an indication of more suitable conditions in soil of that treatment which would accelerate the decomposition of organic matter and maximize nutrients contents, in the soil especially NPK. Sarker *et al.* (1992) found that, the compost provided a substantial modification of physical and chemical properties, which have positive effects on soil fertility. Bulluck *et al.*, (2002) attributed increased availability of nutrients upon adding compost, to an increase of exchange sites of the organic colloids.

Effects on some soil physical characteristics of the tested saline soil:

Some soil physical characteristics of the tested soil at the end of the experimental trial as affected by the experimental factors, such are Soil bulk density (BD), soil total porosity (TP) and soil hydraulic conductivity (HC), will be studied and presented in Table (5).

Soil bulk density (BD):

Bulk density was decreased with compost application. The average increase ranging between 24.7 and 32.9 % due to applying (C₂₄) and (C₄₈) respectively.

Applied treatments caused variation on Soil bulk density (BD), at the end of experiment Bulk density values (g.m⁻³) ranged between 1.11 and 1.72 for (I_{50%} C₄₈ P₁), and (I_{25%} C₀ P₀) and (I_{25%} C₀ P₁) respectively.

Table (5): Soil bulk density, total porosity and hydraulic conductivity of soil after growing Sudan grass, as affected by the different experimental factors.

Compost (C) (ton./fed)	Bulk density (g m ⁻³)		Total porosity (%)		Hydraulic conductivity (cm h ⁻¹)	
	Irrigation Rates, % of available moisture depletion (I)					
	(I _{25%})	(I _{50%})	(I _{75%})	(I _{50%})	(I _{75%})	(I _{75%})
	Without - proline (P ₀)					
Control (C ₀)	1.72	1.66	1.70	45.7	44.0	0.0043
Compost (C ₂₄)	1.29	1.27	1.30	59.7	60.0	0.0155
Compost (C ₄₈)	1.13	1.12	1.16	68.0	69.3	0.0191
	Proline - spray, 2m/L (P ₁)					
Control (C ₀)	1.72	1.69	1.69	46.7	44.0	0.0042
Compost (C ₂₄)	1.26	1.28	1.29	62.7	61.0	0.0156
Compost (C ₄₈)	1.13	1.11	1.17	69.0	70.0	0.0192
LSD at (0.05):	n.s		n.s		n.s	
Mean values of the individual effects of the experimental factors.						
Compost (C)	Bulk density (g m ⁻³)		Total porosity (%)		Hydraulic conductivity (cm h ⁻¹)	
	Irrigation (I)					
	(I _{25%})	(I _{50%})	(I _{75%})	(I _{25%})	(I _{50%})	(I _{75%})
Control (C ₀)	1.70	1.38	1.37	58.63	58.44	0.0130
Compost (C ₂₄)	1.28	1.36	1.37	60.28	59.33	0.0132
Compost (C ₄₈)	1.14	1.39		58.05		0.0128
LSD at (0.05):	n.s		n.s		n.s	
0.01	n.s		n.s		n.s	

Impacts of different rates of compost, proline-spray and irrigation on some

The lowest BD exists with the highest rate of compost application (C_{48}) rate, irrigated by the most suitable irrigation ($I_{50\%}$), and sprayed with proline (P_1) which enhanced growth of plant, all such conditions contributed in improving soil physical condition in the root zone. Irrigation treatment ($I_{50\%}$) showed, in general, slightly lower BD than the other irrigation treatment.

The effect of proline (P) showed non-significant trends with respect to soil bulk density. Therefore, the most effective treatment, which decreased BD, was the addition of organic materials which enhanced soil aggregation and increase the apparent soil volume and consequently decrease bulk density (Gouda, 1984, Las Torres-Tomejil 2008 and Mbah and Onweremadu 2009).

Soil total porosity (TP):

The pattern of response of total porosity (TP) to applied treatments is exactly the same like that of the BD, but with an opposite trend (since increased porosity is another expression of a decreased BD and TP ranged from 44.0% ($I_{75\%}C_0 P_0$) or ($I_{75\%}C_0 P_1$) to 73.7 % ($I_{50\%}C_{48} P_1$). No significant variations of TP values were observed as a result of either irrigation (I) or proline spray (P_0). Compost showed TP increases with average of 36.5 and 56.2 % for (C_{24}) and (C_{48}) application respectively. Such increase is an indicator of soil aggregation and reflect the improvement of soil structure and the increase of porosity. (Las Torres-Tomejil 2008).

Soil hydraulic conductivity (HC):

Hydraulic conductivity at the end of experiment showed variation depending on applied treatment, values ranged between 0.0041 ($I_{50} C_0 P_1$) or ($I_{75} C_0 P_1$) to 0.0197 $cm\ h^{-1}$ ($I_{50} C_{48} P_1$). Irrigation treatments showed non-significant effects. Increased HC by addition

compost is a direct effect of increased porosity caused by manuring. (Hillel, 1982, Aziz, et al. 1999 and Hamouda, et al. 1999).

Overall assessment of the experimental factors effects on the previous discussed physical characteristics:

Compost showed positive effect, of its C_{24} and C_{48} doses, giving progressive increase over the no compost treatment (C_0), with descending order of (: $C_{48} > C_{24} > C_0$.)

The treatment of compost addition at the high rate showed the lowest bulk density and the highest total porosity reflecting the effect of organic matter in improving soil physical properties particularly in heavy clay soil. Mbagwu (1992) showed that the decrease in bulk density of soil due to compost is a direct effect of increased organic matter in soil. Organic amendments promote soil hydraulic activity and build up soil structure of favorable effect to plant growth (Charreau and Nicou, 1971).

The highest positive response to irrigation was associated with $I_{50\%}$, (i.e. irrigation upon 50% available moisture depletion AMD) comparing with I_1 , (i.e. irrigation upon 25% AMD which was the lowest) or with the $I_{75\%}$, i.e. irrigation upon 75% AMD : in an order of $I_2 > I_3 > I_1$. Proline treatment (P_1) showed positive effect relative to the no proline treatment (P_0), in an order of $P_1 > P_0$, under all conditions.

Effect on fresh weight of Sudan grass (1st and 2nd cut):

Fresh weight of 1st cut:

As shown in Table (6), fresh weight varied considerably according to the experimental treatment. Compost addition resulted in increases fresh weight of 21.3 and 36.0 % for C_{24} and

C₄₈ respectively. Whereas, irrigation upon 25% (I_{25%}) gave the lowest yield while the I_{50%} gave the highest; with an order of I_{50%} > I_{75%} > I_{25%}, and average increases were 23.4 % and 8.2 at I_{50%} and I_{75%}, respectively compared to I_{25%}. On the other hand, spraying proline (P₁) gave 9.0% as an average increase.

Generally, fresh weight of 1st cut Sudan grass ranged from 42.1 Mg.ha⁻¹ (I_{25%} C₀ P₀) to 77.5 Mg ha⁻¹ (I_{50%} C₄₈ P₁). Positive effect of compost application, as well as proline - spray, was occurred under all conditions. The interactions were not significant, Also the highest yield given by the medium irrigation of I_{50%} and the lowest given by the wettest one I_{25%} occurred without interaction by compost application or proline - spray (P₁).

Fresh weight of 2nd cut:

The pattern of response was rather similar to that of the first cut with yields varying between 35.1 Mg ha⁻¹ (I_{25%} C₀ P₀) to 69.9 Mg ha⁻¹ (I_{50%} C₄₈ P₁).

Compost addition resulted in increased values of 24.9 and 41.2 % for C₂₄ and C₄₈ respectively. Irrigation treatment I_{50%} gave the highest fresh weight and I_{25%} gave the lowest one with an order of I_{50%} > I_{25%} > I_{75%} with an average increases of 27.6 % and 5.5 by I_{25%} and I_{75%}, respectively I_{25%}. Spraying of proline (P₁) gave an average of 9 % comparing to control.

The interactions effect, of the three experimental factors (i.e. irrigation, compost and proline), was not affected by the status of each other's, (i.e. no interaction effect was found)

Table (6): Fresh weight of 1st and 2nd cut (Mgha⁻¹) of Sudan grass as affected by the different experimental factors.

Compost (C) (ton./ha)	1 st cut (Mgha ⁻¹)			2 nd cut (Mgha ⁻¹)		
	Irrigation Rates, % of available moisture depletion (I)					
	(I _{25%})	(I _{50%})	(I _{75%})	(I _{25%})	(I _{50%})	(I _{75%})
Without - proline (P ₀)						
Control (C ₀)	42.1	47.4	45.6	35.1	42.1	39.1
Compost (C ₂₄)	52.2	65.5	56.7	45.6	58.9	50.1
Compost (C ₄₈)	58.3	74.4	63.3	51.6	66.7	55.6
Proline - spray, 2m/L (P ₁)						
Control (C ₀)	49.2	58.7	52.7	40.5	51.1	45.4
Compost (C ₂₄)	55.5	69.2	59.7	48.0	62.3	51.5
Compost (C ₄₈)	62.3	77.5	66.4	54.2	69.9	60.5
LSD at (0.05): I * C * P = ns				LSD at (0.05): I * C * P = ns		

Mean values of the individual effects of the experimental factors.

1 st cut (Mgha ⁻¹)			2 nd cut (Mgha ⁻¹)				
Compost (C)	Irrigation (I)	Proline (P)	Compost (C)	Irrigation (I)	Proline (P)		
(C ₀)	49.28	(I _{25%}) 53.03	(P ₀) 56.17	(C ₀)	42.22	(I _{25%}) 45.83	(P ₀) 49.42
(C ₂₄)	59.80	(I _{50%}) 65.45	(P ₁) 61.24	(C ₂₄)	52.73	(I _{50%}) 58.50	(P ₁) 53.88
(C ₄₈)	67.03	(I _{75%}) 57.40		(C ₄₈)	59.60	(I _{75%}) 48.34	
LSD at (0.05):			LSD at (0.05):				
C = 1.76	I = 1.76	P = 1.44	C = 1.7	I = 1.7	P = 1.39		

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Effects of experimental treatments on dry weight of Sudan grass (1st and 2nd cut):

Data in Table (7) showed that the dry weight of 1st and 2nd cut affected by deferent experimental treatments.

Dry weight of 1st cut:

Compost gave increases about 27.4 and 47.4 % in treatments receiving (C₂₄) and (C₄₈) respectively. Irrigation treatments showed this order: I_{50%}>I_{75%}>I_{25%}, with average increases of 22.6 and 4.6 % at I_{50%} and I_{75%} respectively compared to I_{25%}. Proline spray (P₁) increased the yield by an average of 9.6%. On the other hand the positive effect of proline was of less magnitude than control treatment of compost such values were 3.4 and 5.7% under treatments of C₂₄ and C₄₈ respectively.

Dry weight varied considerably from 7.7 Mg ha⁻¹ to 15.9 Mg ha⁻¹ (i.e. 106%

increase.) as a result of treatments of (I_{25%} C₀ P₀) and (I_{50%} C₄₈ P₁), respectively.

Dry weight of 2nd cut:

Dry weight was increased with compost application from 34.0 to 52.8 % for C₂₄ and C₄₈ respectively. Irrigation treatments in their effect on dry weight were of the order I_{50%}> I_{75%}> I_{25%}, with average increases of 24.3 and 10.4 % at I₂ and I₃ respectively compared to I₁. Spraying proline (P₁) gave 8.8 % average increase. Such increase was greater under the I_{75%} irrigation (13.2%); also proline was showed greater positive effect under no compost application (22.4%).

The general trend of dry weight varied considerably according to the applied treatments ranging between 6.6 Mg ha⁻¹ (I_{25%} C₀ P₀) to 13.9 Mg ha⁻¹ (I_{50%} C₄₈ P₁); 111% increase.

Table (7): Dry weight of 1st and 2nd cut (Mgha⁻¹) of Sudan grass as affected by the different experimental treatments.

Compost (C) (ton./ha)	1 st cut (Mgha ⁻¹)			2 nd cut (Mgha ⁻¹)		
	Irrigation Rates, % of available moisture depletion (I)					
	(I _{25%})	(I _{50%})	(I _{75%})	(I _{25%})	(I _{50%})	(I _{75%})
Without – proline (P ₀)						
Control (C ₀)	7.7	9.8	7.9	6.6	7.9	7.0
Compost (C ₂₄)	10.7	13.3	11.4	9.4	11.4	10.5
Compost (C ₄₈)	12.8	15.1	12.5	10.7	13.3	11.4
Proline - spray, 2m/L (P ₁)						
Control (C ₀)	9.4	11.6	10.2	7.4	9.8	8.9
Compost (C ₂₄)	11.0	13.8	11.9	9.8	12.1	10.6
Compost (C ₄₈)	13.2	15.9	13.9	11.1	13.9	12.3
LSD at (0.05): I · C · P = ns				LSD at (0.05): I * C * P = ns		

Mean values of the individual effects of the experimental factors.

1 st cut (Mgha ⁻¹)			2 nd cut (Mgha ⁻¹)				
Compost (C)	Irrigation (I)	Proline (P)	Compost (C)	Irrigation (I)	Proline (P)		
(C ₀)	9.43	(I _{25%}) 10.80	(P ₀) 11.24	(C ₀)	7.93	(I _{25%}) 9.17	(P ₀) 9.80
(C ₂₄)	12.01	(I _{50%}) 13.25	(P ₁) 12.32	(C ₂₄)	10.63	(I _{50%}) 11.4	(P ₁) 10.66
(C ₄₈)	13.9	(I _{75%}) 11.30		(C ₄₈)	12.12	(I _{75%}) 10.12	
LSD at (0.05):			LSD at (0.05):				
C = 0.43	I = 0.43	P = 0.35	C = 0.24	I = 0.24	P = 0.20		

Overall assessment of the experimental factors effects on the previous discussed Sudan grass fresh & dry weights at the two cuts:

Overall yield response to applied treatments.

The highest yield of irrigation treatments resulted by applying I_{50%} followed by I_{75%} then I_{25%} with superiority ranging from about 12 to as much as 47 % indicates that the medium irrigation of I_{50%} was most suitable for crop growth. Irrigation treatment of I_{50%} depletion of available moisture renders plants subjected to neither moisture stress nor moisture excess. Allowing plants to face depletion of available water until reaching depleting as much as 75% of available water (the I_{75%} treatment) will cause that the plants sever from high as well soil salinity. Plant facing moisture stress would suffer some decrease in growth.

These results may be due to; irrigation treatment (I_{25%}) must have led to oxygen stress in its rhizosphere (I_{25%}). Nitrogen loss, either by leaching or de-nitrification could have occurred in I_{25%} treatment.

Proline spray alleviated the negative effect of soil salinity and moisture stress particularly under saline conditions (Wahed, et al. 1983).

Applying composts improves the fertility of the clay soils and is reflected by a considerable increase in plant growth (Yaduvanshi (2003). Positive response to compost is a function of increased water retention, field capacity and soil water availability. Organic matter addition incurs addition of active substances such as fulvic and humic acids retain some nutrients, such as Mn and Fe, and preventing them from precipitation, thus allowing them to be available to plants. The extent of availability of such nutrients depends on

the materials and microorganisms (Leithy, et al. 2009 and Gaballa, et al 2009).

Conclusion:

In order to improve the productivity of clay soils, a package of agriculture practices should be applied in order to encounter the adverse effects of soil salinity on crop production. This package includes irrigation intervals to allow suitable aeration and water availability. Also compost and proline spray should be included. Values of soil physical and chemical properties tend to be more appropriate for better Sudan grass production in case of better water management. This issue maximizes the beneficial effects of the compost application or the sprayed proline. Moreover, it furnishes suitable conditions in soil which would accelerate the decomposition of organic matter which results increasing the soil water retention content.

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تأثير استخدام معدلات مختلفة من السماد العضوى ، البرولين و الري على بعض خواص التربة و حشيشة السودان النامية في ارض ملحية.

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الملخص العربى

اقيمت تجربة حقلية فى محطة بحوث سهل الحسينية بمحافظة الشرقية خلال الموسم الزراعى 2017 وهى تجربة عملية تضمنت ثلاث عوامل كالتالى
- الكمبوست (كنترول، 24، 48 طن/هكتار) - معدلات رى (25 و 50 و 75% استنزاف من الرطوبة الميسرة).
- رش البرولين على النبات (بدون رش؛ ورش بالبرولين بمعدل 2 ملليجرام/لتر) تضاف كل 20 ، 45 ، 60 يوم من الزراعة وتم احذ حشيتين بعد 60 ، 120 يوم .
ويهدف البحث لدراسة إمكانية تحسين بعض الخصائص الكيميائية والفيزيائية للتربة الطينية المتأثرة بالأملاح من خلال اضافة السماد العضوى "الكمبوست" وأثر ذلك على تحسين إنتاجية كل من الوزن الرطب والحاف لحشيشة السودان (كمحصول علف) والمنزرع فى هذه الأرض ، نتيجة لرش البرولين على النبات تحت معدلات رى مختلفة بإضافة الكومبست.

ويمكن تلخيص النتائج المتحصل عليها فى ما يلى:

- معاملة التسميد العضوى بمعدل 20 طن للمقدان مع الري 50% من الرطوبة الميسرة ادى الى خفض قيم التوصيل الكهربى سواء ذلك تحت معاملة البرولين او بدونه.
- أوضحت النتائج ان المادة العضوية فى التربة زادت بزيادة معدل التسميد العضوى وكانت افضل النتائج باضافة 48 طن /هكتار .
- حدثت زياده فى قيم النتروجين ، الفوسفور و البوتاسيوم الميسر فى التربة تحت معاملة الري عند استنزاف 50% من الرطوبة الميسرة والتسميد العضوى بمعدل 48 طن/ هكتار.
- انخفاض فى الكثافة الظاهرية للتربة بشكل ملحوظ مع زيادة التسميد العضوي.
- زيادة فى المسامية الكلية ، التوصيل الهيدروليكي نتيجة اضافة التسميد العضوي.
- زيادة المحصول الطازج والجاف لحشيشة السودان النامى فى الاراضى المتأثرة بالاملاح مع وجود معاملة الري عند استنزاف 50% من الرطوبة الميسرة والتسميد العضوى بمعدل 48 طن/هكتار. مع معاملة الرش بالبرولين. وكانت زيادة المحصول فى الوزن الجافة حوالى 24% فى الحشة الاولى مقارنة بالحشة الثانية.

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