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Response of fahl clover to compost rates under irrigation intervals in newly reclaimed saline soils.

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Abstract

A field experiment was conducted on saline clay soil located at the experimental Farm of Sahl- El-Houssinia Agriculture Research Station, El-Sharkia governorate, Egypt, during two winter seasons of 2014/2015 and 2015/2016. These experiments aimed to study the effect of irrigation intervals and compost rates alone or combined on soil fertility and fahl clover productivity and quality under newly reclaimed saline soil conditions. The experimental treatments were arranged in a split plot design with four replicates. The main plots represented the three irrigation intervals (12, 16 and 20 days), whereas the sub-main plots represented compost rates (0, 5, 10, and 15 ton/fad). The results revealed that the effect of irrigation intervals and compost rates were positive on all growth traits of fahl clover and saline soil properties during the two seasons.

Irrigation intervals had a significant effect on growth traits and yield of clover crop and maximum values were obtained with the 12 days irrigation interval. On the contrary, minimum values for the corresponding respective characters were recorded with the 20 days irrigation interval.

The increase of compost rate (5, 10 and 15 ton /fad) gave increases of all growth traits and yield compared with the control. Also, the interaction between irrigation intervals and compost rates was significant on all studied traits and yield. The 12 days interval combined with all compost rates gave the highest values of studied growth traits as well as forage yields. Results showed that the application of compost increased the chemical composition contents of clover plants and soil properties after harvest as well.

Key Words: Irrigation intervals, compost, growth traits, chemical composition.

Introduction

Egyptian clover *Trifolium alexandrinum L.* is the most important winter forage crop in Egypt. It is adapted to a wide range of soil conditions and shows good tolerance to saline and alkaline soils. It is not suitable for acidic or heavy-structured soils.

Soil salinization and drought stress mainly occur in the arid and semiarid regions of Mediterranean area, which are characterized by high evapotranspiration rates and low rainfall. In these areas, the leaching of salts is very low; therefore, salt accumulates in soil surface layers. Since high salts content may adversely influence soil properties and crop yields, food security could be limited as a consequence. Therefore, salt-affected soils must be reclaimed to maintain satisfactory levels of fertility for sustaining food production, **Maringela and Francesco (2015).**

Water is the most important factor limiting horizontal and vertical expansion in the production of different crops. Crop yield and quality are affected by available water in the soil, **El-Nomani *et al,* (2015).** Increasing number of irrigation (irrigation amounts) up to the maximum level increased growth parameters , i.e. plant high, number of branches per plant, leaf area, total plant dry matter, number of flowers, **Abdel-Mawgoud (2006)** . Water stress decreased the availability of moisture in the soil and this consequently decreased the availability of nutrients and intern affected the absorption of minerals, **Hussein and Mahmoud (2013).** El-Salam Canal is one of the national promising projects for reusing drainage water in irrigation. Namely, drainage water from Hadous drain (1.905 B m^3 $year^{-1}$) and El-Serw drain (0.435 B m^3 $year^{-1}$) in a 1:1 mixing ratio with the Nile river water (2.11 B m^3 $year^{-1}$) delivered from Damietta branch **(Shaban 2005).**

Organic matter has several beneficial effects on agricultural fields, such as the slow release of nutrients, soil structure improvement and the protection of soils against erosion. Also, Organic fertilizers are very important for increasing agricultural production, reducing the application rates of chemical fertilizer and hence the prevention of environmental pollution, **Reda (2007).**

Materials and Methods

Two field experiments were conducted at Sahl El-Hussinia Agricultural Research Station, El-Sharkia Governorate, Egypt, in 2014/2015 and 2015/2016 winter seasons. The objectives of these experiments were aimed to study the influence of irrigation intervals and compost rates on some soil chemical properties and productivity and quality of clover variety fahl under saline soil conditions. Some physical and chemical properties of the study soil were determined according to the methods described by **Page *et el,* (1982)** are presented in Table (1).

Table 1. Some physical and chemical properties of the soil used.

Sand (%)			Silt (%)	Clay (%)	Texture		O.M (%)		$CaCO_3$ (%)
24.64			34.90	40.46	Clay		0.53		8.90
Seasons	pH (1:2.5)	EC(dS/m) in soil past	Soluble Cations				Soluble Anions		
			Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	HCO^{-}_3	Cl^{-}	SO^{-2}_4
1st	8.05	9.45	8.92	14.33	70.38	0.87	7.30	60.00	27.20
2nd	8.03	7.29	12.55	17.93	41.35	0.89	5.91	32.90	34.09

Available macronutrients			Available micronutrients		
	N	P	K	Fe	Mn	Zn
1st	36.71	4.40	193	3.73	2.40	0.67
2nd	39.97	4.78	197	3.88	2.46	0.72

All experimental plots were irrigated by El-Salam Canal (Agriculture drainage mixed with Nile water by rate 1:1). Samples of irrigation water were taken in November, January and February for chemical and macro- micronutrients analyses were according to **Page *et al,* (1982).** The mean values of irrigation water analysis average of the two seasons are presented in Table (2).

Table 2. Mean values of chemical and macr- micronutraties of irrigation water used (over two seasons).

Months of taken irrigation water	pH	EC (dS/m)	Cations (meq/l)				Anions (meq/l)			
			Ca^{+2}	Mg^{+2}	Na^{+}	K^{+}	CO^{--}_3	HCO^{-}_3	Cl^{-}	SO^{--}_4
November	7.98	1.75	5.20	2.88	8.67	0.75	nil	2.34	5.66	9.50
January	7.90	1.35	3.75	2.90	6.05	0.80	nil	1.50	3.95	8.05
February	7.89	1.50	3.65	2.75	7.90	0.55	nil	2.45	4.11	8.44

Months of taken irrigation water	Macronutrients (mg/l)		Micronutrients (mg/l)				
	NO_3-N	NH_4-N	P	K	Fe	Mn	Zn
November	12.50	5.40	3.20	9.12	2.19	0.88	1.22
January	14.95	4.20	4.18	10.66	1.50	0.75	1.54
February	10.88	3.75	3.88	8.53	2.25	0.56	1.30

The experimental design was split plot with four replications. The local variety (Fahl) was used. Seeds were broadcasted at the rate of 20 kg fad^{-1}. Sowing date was 25th October in the two seasons. The main plots represented three irrigation intervals were applied after the first irrigation (in the same day of planting).

The number of irrigation times at the three irrigation intervals were as follows:

- 12 days (nine numbers of irrigation times).
- 16 days (six numbers of irrigation times).
- 20 days (five numbers of irrigation times).

According to the recommended doses of water requirement of irrigation for clover variety fahl at Sahl EL- Hussinia region salinity soil (2700 m^3/fad) **Ouda *et al,* (2015),** it, s distributed at number of irrigation times for every different treatments in order to salinity soil needs irrigation frequency to prevent hardening of surface layer and facilitate water continuously and calculate the amount of rain water to be subtracted from the amount of irrigation for every treatment.

The sub plots represented compost rates (0, 5, 10 and 15 ton/fad). Compost was during soil tillage. The compost analysis was done according to the standard methods as described by **Brunner and Wasmer (1978).** Chemical composition of the used compost is shown in Table (4).

All farming processes were carried out before planting. Super phosphate (15.5 % P_2O_5) was applied at a rate of 100 kg fad^{-1} during tillage soil. ammonium nitrate (33.5% N) at the rate of 20 kg/fad was applied on three times 21, 45 and 65 days after planting. Potassium sulphat (48 % K_2O) was applied at rate of 75 kg K_2O fad^{-1} on two equal times 21 and 55 days after planting.

At harvesting after 110 dayes, samples of ten plants from each experimental plot (3x4 m) were taken at random and the following measurements were recorded:

- Plant height (cm), stem diameter, no. of branches/ plant and leaves/ stem ratio.
- Fresh yield (plants of the plot were hand clipped and weighed in kg/plot and
Calculated to ton fad^{-1}).
- Dry yield (Samples of 100gm were dried at 75c^{o} to constant weight and dry matter percentages were estimated. The dry forage yield was calculated by Multiplying fresh forage yield with dry matter percentage).

Table 3. Meteorological data for Sahl EL- Hussinia region (average in two seasons).

Month	Average in two seasons				
	T.max (ºC)	T.min (ºC)	W.S. (m s^{-1})	R.H. (%)	R. F. (mm)
October	35.0	19.8	3.6	73.1	0.0
November	32.2	17.8	3.5	72.2	0.0
December	26.1	14.7	3.0	65.5	100
January	20.4	10.9	3.0	67.7	100
February	18.3	8.5	4.0	68.0	200

Table 4. Chemical analysis of compost used.

Moisture (%)	pH (1:2.5)	EC (dSm-1) 1:10	C/N (%)	N	P	K	Fe	Mn	Zn
							Available micronutrients (mg kg-1)		
25-27	**7.49**	**3.15**	**21.58**	**2.22**	**0.84**	**2.69**	**87.36**	**60.14**	**35.10**

Chemical analysis:

The plant samples were collected from each sub plot, weighed and oven dried at 70°C for 48 hs up to the constant weight, ground and prepared for digestion as described by **Page *et al,* (1982**). A 0.5 g of each oven dried ground plant sample was digested using H_2SO_4, $HCLO_4$ mixture according to the method described by **Chapman and Pratt (1961).**
- N by semi micro Kjeldahl, P by spectrophotometer using stannous chloride reagent,
K by the Flame photometer.
- Fe, Mn and Zn micronutrients were determined in plant digestion using the methods
Described by **Page *et al,* (1982).**
- Total carbohydrates %, fiber were determined in the dry matter of plants, using the method described by **Dubois *et al,* (1956).**
- Protien percentage of plant was calculated by multiplying the nitrogen (%) by the
factor 6.25 **Hymowitz *et al,* (1972).**
- proline concentration was determined from standard curve and calculated
using formula that presented by **Bates *et al*, (1973).**

Statistical analysis:

All data were statistically analyzed by the analysis of variance method according to **Snedcor and Cochran (1989).** Differences among means were tested by L.S.D. at 0.05 level of significance .Bartlett's test was done to test the homogeneity of error variance. The test was not significant for all assessed traits, so, the two season's data were combined.

Results and Discussion

A. Growth traits:

Effect of irrigation intervals:

Data in Table (5) showed that the treatments intervals irrigation at 12 days showed significant superiority over the other irrigation intervals and gave the highest values of plant height, stem diameter, no. of branches and leaves/ stem ratio compared with the other irrigation periods. On the other hand, irrigation at 20 days was significantly inferior and gave the lowest values of studied growth traits.

These results revealed that the frequent irrigation at 12- day is require in case of clay saline soil that would reduce salts from the surface layer of the soil or the layer of root zone. Thus better irrigation management practices are required that would reduce soil salinity and increase growth parameters and yield of plants. The present results revealed clearly that irrigation every 12 and 16 days supplied sufficient soil moisture in fahl root zone which increase the capacity of fahl clover plants in photosynthesis and consequently increased plant height, stem diameter, no. of branches and leaves stem ratio. These results are in agreement with those reported by **El-Noemani *et al,* (2015)** who found that plant height and no. of branches were increased by increasing water application level. **El-Dakroury (2008)** showed that increasing the irrigation treatments from 60 to 100% of ET_0 (Evapotranspiration), significantly increased the growth criteria, *i.e.*, plant height, number of branches, leaves/ stem ratio, dry weight of both stem and total plant.

Table 5. Effect of irrigation intervals and compost rates on growth traits of fahl clover plants.

Treatments	Plant height (cm)			Stem diameter(cm)			No. branches plant^{-1}			Leaves / stem ratio		
	2014/ 2015	2015/ 2016	Comb.	2014/ 2015	2015/ 2016	Comb	2014/ 2015	2015/ 2016	Comb.	2014/ 2015	2015/ 2016	Comb.
Irrigation intervals												
12 days (I_1)	101.5	107.2	104.4	0.44	0.46	0.45	6.68	7.44	7.06	0.76	0.83	0.80
16 days (I_2)	80.99	85.53	83.26	0.41	0.43	0.42	6.56	7.33	6.95	0.58	0.64	0.61
20 days (I_3)	77.91	82.23	80.07	0.37	0.38	0.38	6.31	7.18	6.75	0.57	0.62	0.59
L.S.D 0.05	2.05	2.20	1.96	0.03	0.03	0.02	0.15	0.07	0.18	0.04	0.03	0.02
Compost rates												
(0)T_1	77.2	80.81	79.01	0.37	0.38	0.38	6.34	7.26	6.80	0.58	0.64	0.61
(5)T_2	82.4	88.61	85.51	0.39	0.41	0.40	6.41	7.30	6.95	0.64	0.71	0.68
(10)T_3	91.31	95.01	93.16	0.42	0.44	0.43	6.89	7.34	6.96	0.69	0.75	0.72
(15)T4	96.36	102.1	99.25	0.44	0.47	0.46	6.73	7.38	7.06	0.75	0.83	0.79
L.S.D 0.05	1.94	2.01	1.98	0.04	0.04	0.03	0.16	0.09	0.12	0.05	0.03	0.03
Interaction												
I_1 X T_1	85.01	89.11	87.06	0.39	0.40	0.39	6.43	7.39	6.91	0.60	0.68	0.64
I_1 X T_2	95.20	102.8	99.00	0.43	0.44	0.43	6.51	7.41	6.96	0.75	0.79	0.77
I_1 X T_3	110.6	116.2	113.4	0.46	0.48	0.47	6.80	7.46	7.13	0.80	0.85	0.83
I_1 XT_4	115.4	120.5	117.9	0.49	0.53	0.51	6.96	7.50	7.23	0.92	0.98	0.95
I_2 XT_1	74.14	78.14	76.14	0.36	0.38	0.37	6.38	7.29	6.84	0.54	0.59	0.57
I_2 X T_2	77.52	82.90	80.21	0.38	0.41	0.39	6.40	7.31	6.86	0.58	0.65	0.62
I_2 X T_3	83.12	85.41	84.26	0.43	0.44	0.43	6.62	7.36	6.99	0.59	0.64	0.62
I_2 X T_4	89.20	95.70	92.45	0.45	0.47	0.46	6.84	7.39	7.12	0.62	0.69	0.66
I_3 X T_1	72.45	75.18	73.82	0.33	0.35	0.34	6.20	7.11	6.66	0.50	0.54	0.65
I_3 X T_2	74.5	80.14	77.32	0.35	0.37	0.36	6.33	7.16	6.75	0.55	0.58	0.65
I_3 X T_3	80.20	83.42	81.81	0.37	0.39	0.38	6.35	7.19	6.77	0.60	0.65	0.72
I_3 XT_4	84.50	90.20	8`7.3	0.38	0.40	0.39	6.39	7.25	6.82	0.66	0.71	0.76
L.S.D 0.05	3.05	2.20	1.92	0.04	0.05	0.02	0.05	0.03	0.04	0.03	0.02	0.04

Effect of compost rates:

Data presented in Table (5) showed that the use of compost at rates 0, 5, 10 and 15 ton/fad led to significant increases in plant height, stem diameter, no. of branches and leaves stem ratio in both seasons.

The highest increases of the previous growth traits were obtained by using compost at rate 15 ton/ fad in both seasons. These results could be explained by **Ibrahim and Fadni (2013)** findings, who indicated that the addition of organic fertilizer has an efficient amendment for improving the physical, chemical and nutritional properties of soil and increase crop parameters as well as yield. In other words addition of organic fertilizer led to decrease soil salinity and soil pH and increase the nutrients uptake.

Effect of interaction:

The interaction between compost rates and irrigation intervals on growth traits was significant. The interaction between irrigation at short interval 12 days and compost at rate 15 ton/fad gave the highest values of plant height, stem diameter, no. of branches and leaves stem ratio compared with other treatments. Results indicated clearly that the effect of compost on all studied traits was more pronounced with the 12 days irrigates interval that the other two intervals.

Roey and Jingjing (2015) found that the interaction between organic fertilizer at a rate 10 ton/ha and irrigation every 3 days caused reduction in all plants growth parameters compared with irrigation every 2 days.

B. Fresh and dry yields (ton/ fad):

Data in Table (6) presented the effect of irrigation intervals, compost rates and their interaction on fresh and dry yields of fahl clover.

Effect of irrigation intervals:

The effect of irrigation intervals and compost rates on fresh and dry forage yields of fahl plants was significant. Increasing compost rates and decreasing irrigation intervals increased significantly both fresh and dry forage yields. The relative decrease of mean combined values of fresh and dry yields were 11.56 and 27.21 % and 21.31 and 36.06%for irrigation water intervals 16 and 20 days compared with irrigation intervals 12 days respectively, From these results the increases of fresh and dry yields /fad with the irrigation water (12 days), may be due to the roles of irrigation water applied at adequate quantity for different physiological processes, respiration,

transpiration and activity of enzyme reaction. These results are in agreement by **Mazher *et al,* (2012)** who indicated that fresh and dry weights were gradually increased with decreasing irrigation water intervals.

Table 6. Effect of irrigation intervals and compost rates on fresh and dry yields in fahl clover plants.

Treatments	Fresh yield (ton/fad)			Dry yield (ton/fad)		
	2014/2015	2015/2016	Comb.	2014/2015	2015/2016	Comb.
Irrigation intervals						
12 days (I_1)	13.30	14.03	13.67	1.20	1.25	1.22
16 days (I_2)	11.52	12.67	12.09	0.94	0.99	0.96
20 days (I_3)	9.79	10.11	9.95	0.77	0.80	0.78
L.S.D 0.05	1.05	0.98	1.25	0.15	0.11	0.12
Compost rates						
(0 rate)T_1	8.84	9.33	9.09	0.73	0.76	0.75
(5 rate)T_2	10.65	11.37	11.01	0.81	0.85	0.83
(10 rate)T_3	13.04	13.75	13.39	1.08	1.13	1.11
(15 rate)T_4	13.65	14.62	14.14	1.24	1.29	1.27
L.S.D 0.05	0.91	1.52	1.21	0.02	0.04	0.01
Interaction						
I_1 X T_1	10.28	11.00	10.64	0.85	0.88	0.87
I_1 X T_2	12.88	13.44	13.16	0.95	0.98	0.97
I_1 X T_3	14.90	15.66	15.28	1.42	1.46	1.44
I_1 XT_4	15.23	16.00	15.62	1.56	1.66	1.61
I_2 XT_1	8.32	9.00	8.66	0.70	0.72	0.71
I_2 X T_2	10.20	11.55	10.87	0.79	0.88	0.84
I_2 X T_3	13.56	14.26	13.91	0.98	1.06	1.02
I_2 X T_4	14.00	15.87	14.94	1.27	1.29	1.28
I_3 X T_1	7.93	8.00	7.97	0.65	0.67	0.66
I_3 X T_2	8.88	9.12	9.00	0.68	0.70	0.69
I_3 X T_3	10.66	11.33	10.96	0.84	0.88	0.86
I_3 XT_4	11.72	12.00	11.86	0.89	0.94	0.92
L.S.D 0.05	0.08	0.47	0.30	0.05	0.04	0.04

Effect of compost rates:

Data in Table (6) revealed that both fresh and dry forage yields were significantly affected by compost rates. The highest values of fresh yield 14.62 ton/fad and dry yield 1.29 ton/fad were obtained by the highest rate of compost. This might be related to improvement in physical soil conditions which provide energy for microorganism activity and increase nutrients uptake which consequently led to increase fresh and dry yields **Abbas *et al,* (2013).** The relative increase of the combined values were 21.21, 47.30 and 55.60 % for fresh yield and 10.66, 48.00 and 69.33 % for dry yield as affected by compost rates (5,10 and 15 ton/fad) respectively.

Rashad *et al,* (2011) reported that composts application to soil led to positive effect as it improved the soil properties ameliorated the plant growth and enhanced nutrient's uptake.

Effect of interaction:

Data presented in Table (6) show the interaction effect between irrigation intervals and compost rates were significant on fresh and dry yields. The highest values of fresh and dry yields were 15.62 and 1.61 (ton /fad) were obtained with irrigation every 12 days combined with 15 ton compost. The results showed that irrigation every 12 days combined with compost at different rates had the highest fresh and dry yields of fahl clover compared with irrigation every 16 or 20 days. **Abass *et al,* (2013)** found that the increase of interaction between compost and different irrigation water levels on the fresh and dry yields of clover plants were significant increase by increasing compost and irrigation water intervals.

C. Chemical constituents:

C.1. Macronutraties

Macronutraties in plants of fahl clover as affected by irrigation intervals and compost rates are presented in Table (7).

Effect of irrigation intervals:

Results in Table (7) showed the impact of irrigation intervals gave increase of macronutrient concentration in clover plant as decreased irrigation interval 12 days than 16 or 20 days. Clearly, the irrigation intervals from 12 and 16 days up to 20 days led to increase in N, P and K concentration in clover plants. The irrigation interval every 12 days led to significantly increase and gave highest values

of N, P and K content in both seasons. **Hussein and Mahmoud (2013)** reported that the decrease of N, P and K concentrations in Egyptian clover plant as affected drought stress. **Davis (2007)** suggested that the drought reduces both nutrients uptake by the roots transport from the roots to the shoots, because of restricted transpiration rates and impaired active transport and membrane permeability. Macronutrient deficiencies are very common under salt stress because of high pH **(Zhu *et al,* 2004).**

Effect of Compost rates:

Compost rates affected significantly all traits as shown in Table (7) compared with control. Generally the obtained high in macronutrient concentration in fahl plants may be due to the decreased of soil pH, soil salinity and the increase of the activity microorganisms caused by the action of compost. **Mazher *et al,* (2012)** reported that increasing compost application led to increase of N, P and K concentration in plants, these results may be due to the highest mineralization rate due to increase microbial activity and reduction in soil pH.

Effect of interaction:

Date in Table (7) showed that interaction between irrigation intervals and compost rates on N, P and K concentration were significantly increase with decreased irrigation water interval 12 days and increasing rate of compost. The highest values of N, P, K concentration in fahl plants were recorded with irrigation 12 days combined with 15 ton/fad compared with other treatments. These results are in agreement by **Mazher *et al,* (2012)** who indicated that N, P and K content in plants were increased the interaction between application of Nile compost and irrigation intervals. **Rashad *et al,* (2011)** found that the increasing compost application rate gave enhanced nutrients uptake.

Table 7. Effect of irrigation intervals and compost on macronutrients concentration in clover fahl plants.

Treatments	N (%)			P (%)			K (%)		
	First season	Second season	Comb.	First season	Second season	Comb.	First season	Second season	Comb.
Irrigation intervals									
12 days (I_1)	3.05	3.28	3.17	0.55	0.57	0.56	2.67	2.74	2.71
16 days (I_2)	2.96	3.12	3.04	0.50	0.52	0.51	2.58	2.64	2.61
20 days (I_3)	2.93	3.03	2.98	0.42	0.46	0.44	2.48	2.52	2.50
L.S.D 0.05	0.31	0.43	0.41	0.03	0.03	0.05	0.08	0.10	0.04
Compost rates									
(0 rate)T_1	2.89	2.99	2.94	0.42	0.44	0.43	2.46	2.49	2.48
(5 rate)T_2	2.94	3.12	3.03	0.47	0.49	0.48	2.53	2.59	2.56
(10 rate)T_3	3.02	3.18	3.10	0.52	0.55	0.54	2.60	2.66	2.63
(15 rate)T4	3.06	3.25	3.16	0.56	0.60	0.58	2.71	2.77	2.74
L.S.D 0.05	0.05	0.03	0.05	0.02	0.04	0.02	0.07	0.08	0.05
Interaction									
I_1 X T_1	2.94	3.04	2.99	0.45	0.48	0.465	2.50	2.55	2.53
I_1 X T_2	2.99	3.24	3.12	0.53	0.55	0.54	2.58	2.65	2.62
I_1 X T_3	3.12	3.35	3.24	0.58	0.62	0.60	2.70	2.78	2.74
I_1 XT_4	3.16	3.47	3.32	0.63	0.66	0.645	2.88	2.97	2.93
I_2 XT_1	2.88	2.98	2.93	0.42	0.44	0.43	2.45	2.48	2.47
I_2 X T_2	2.95	3.12	3.04	0.47	0.49	0.48	2.55	2.62	2.59
I_2 X T_3	2.99	3.17	3.08	0.53	0.56	0.55	2.60	2.67	2.64
I_2 X T_4	3.04	3.19	3.12	0.58	0.61	0.59	2.73	2.77	2.75
I_3 X T_1	2.86	2.95	2.91	0.38	0.40	0.39	2.42	2.45	2.44
I_3 X T_2	2.90	3.01	2.96	0.40	0.43	0.42	2.47	2.50	2.49
I_3 X T_3	2.95	3.07	3.01	0.45	0.48	0.47	2.49	2.53	2.51
I_3 XT_4	2.99	3.10	3.05	0.48	0.52	0.50	2.53	2.58	2.56
L.S.D 0.05	0.07	0.05	0.04	0.03	0.04	0.01	0.04	0.03	0.02

C. 2. Carbohydrate, protein, proline and fiber:

Effect of irrigation intervals:

Carbohydrate %, protein % and fiber (kg/fad) content in fahl clover plant were increase with decreasing irrigation water intervals , while the proline (µg/g) content in fahl plant increase with increasing irrigation intervals.

The highest values for carbohydrate %, protein % and fiber (kg/fad) content obtained with irrigation water interval 12 days, while the proline increase with increasing irrigation water intervals 16 and 20

days. The increase of proline content in fahl clover plants due to the accumulating of osmolytes that do not perturb enzyme functions so as to maintain continuous water absorption at the low soil water potential (**Hammad *et al*, 2010)**.

Sallam et al (2014) who indicated that increases of irrigation water led to increase of protein and carbohydrate content. **Al-Suhaibani (2009)** found that the high crude protein and carbohydrate percentage decreased with low water. **Ibrahim *et al,* (2015)** found that the increase value of carbohydrate content in fahl clover plant with increasing irrigation water quantity. Also, the relative decreased of mean values combined with two seasons were 21.43 and 31.02 % for fiber content in fahl plant as affected by irrigation water intervals 16 and 20 days compared with 12 days. **Jiang *et al,* (2012) and Kuchenmeister et al (2013)** reported that the decreased of fiber content in forage legumes reflected to decrease of hemicelluloses content under drought. **Sasani *et al,* (2004)** observed the effect of irrigation intervals on pearl millet had significant effects on total protein; carbohydrates and fiber biomass. **Mazher *et al,* (2012)** indicated that increased of irrigation intervals led to decreased for different physiological processes.

Table 8. Effect of irrigation intervals and compost on fahl Chemical constituents.

Treatments	Carbohydrate %			Protein %			Proline (µg/g f.w.)			Fiber (kg/fad)		
	2014/ 2015	2015/ 2016	Comb.	2014/ 2015	2015/ 2016	Comb	2014/ 2015	2015/ 2016	Comb.	2014/ 2015	2015/ 2016	Comb.
Irrigation intervals												
12 days (I_1)	72.38	73.64	73.01	19.08	20.47	19.78	341	327	334	428.7	430.7	429.7
16 days (I_2)	68.10	68.78	68.44	18.53	19.47	19.00	371	356	363	334.2	340.9	337.6
20 days (I_3)	64.53	65.21	64.87	18.29	18.96	18.63	390	378	384	294.1	298.7	296.4
L.S.D 0.05	2.90	2.14	1.89	0.20	0.42	0.31	4.30	6.18	4.09	5.12	6.18	4.82
Compost rates												
(0 rate)T_1	61.81	62.43	62.12	18.09	18.69	18.39	558	552	555	273.7	284.7	279.2
(5 rate)T_2	68.01	68.67	68.34	18.42	19.52	18.97	470	447	459	321.6	335.4	328.5
(10 rate)T_3	70.81	71.81	71.31	18.88	19.98	19.43	257	245	251	376.5	376.1	376.3
(15 rate)T4	72.71	73.92	73.32	19.15	20.34	19.75	184	172	178	432.9	435.7	434.3
L.S.D 0.05	1.45	1.52	1.14	0.21	0.35	0.29	3.19	4.02	2.54	3.83	3.71	3.16
Interaction												
I_1 X T_1	65.90	66.30	66.1	18.38	19.00	18.69	540	530	535	329.0	340.1	334.6
I_1 X T_2	72.60	73.00	72.80	18.69	20.25	19.47	420	390	405	366.0	377.8	371.9
I_1 X T_3	74.80	76.34	75.57	19.50	20.94	20.22	228	223	226	482.6	485.2	483.9
I_1 XT_4	76.23	78.90	77.56	19.75	21.69	20.72	178	166	172	525.3	531.5	528.4
I_2 XT_1	60.55	61.00	60.78	18.00	18.63	18.32	563	560	561	263.3	278.0	270.7
I_2 X T_2	68.30	69.00	68.65	18.44	19.50	18.97	480	460	470	333.0	300.0	316.5
I_2 X T_3	70.66	72.10	71.38	18.69	19.81	19.25	255	235	245	336.0	328.0	332.0
I_2 X T_4	72.90	73.00	72.95	19.00	19.94	19.47	185	170	178	431.6	430.7	431.2
I_3 X T_1	59.00	60.00	59.5	17.88	18.44	18.16	570	566	568	228.7	236.0	232.4
I_3 X T_2	63.12	64.00	63.56	18.13	18.81	18.47	510	490	500	295.3	298.8	297.1
I_3 X T_3	66.98	67.00	66.99	18.44	19.19	18.82	289	277	283	310.8	315.0	312.9
I_3 XT_4	69.00	69.87	69.44	18.69	19.38	19.04	190	180	185	341.7	345.0	343.4
L.S.D 0.05	1.01	1.00	0.78	0.99	1.00	0.89	4.99	4.08	3.69	5.06	6.06	4.03

Effect of compost rates:

Compost rates affected significantly all traits as shown in Table (8). Compost rates application led to increasing of protein (%), carbohydrate (%), and fiber (kg/fad) contents, while the decreased of proline (µg/g f.w.) content. The applied of compost led to increase of organic matter and the helps to increase the respiration role, the metabolism and increase carbohydrates, protein and fiber content accumulation, **(Mazher *et al,* 2012)**. **Turan *et al,* (2009)** found that the proline accumulation in salt stressed plants is a primary defense response to maintain the osmotic pressure in a cell and its function in plants in salt tolerant and salt sensitive.

Effect of interaction:

Regarding the effect of interaction between the irrigation intervals and compost rates treatments was significant on carbohydrate (%), protein (%), proline (µg/g) and fiber (kg/fad). This significant effect means that the effect of compost was not the same under the three different water intervals. The highest values were obtained from compost rate of 15 ton/fad with 12 days of irrigation intervals.

- **Soil chemical properties:**

Effect of irrigation intervals on soil PH:

Results in Table (9) showed that the soil pH decreased with decreasing irrigation water interval. The effect of irrigation water intervals on soil pH was significant in both seasons. The soil pH of all experimental plots is characterized by slightly to moderately alkaline conditions, where the average pH value was always around 8.00 to 7.93, **FAO (1992).** This decrease soil pH value may be resulted from the oxidation of NO_3 content in irrigation and soil led to increase produced of nitric acid. These is agreement by **Hedia (2014)** found that the increase the amount of applied water led to decreased of soil pH from 8.38 to 7.78. **Abd El-Naby *et al,* (2014)** suggested that the alfalfa clover product the symbiotic N_2 fixation acidified their rhizosphere, causing a considerable H^+ extrusion in the rhizosphere to decrease soil pH.

Effect of compost on soil pH.

Results in Table (9) showed that the application of compost different rates on soil was decreased soil pH with increasing rate of compost applied. In generally, increasing compost rate of application led to decrease soil pH reflected to be due to the active of microorganism, biological activity in particular and organic produced. The mean value of soil pH in two seasons ranged between from (7.95 to 7.87). This may be due to added compost being mostly of activity by microorganisms and product of organic acids. **Shaban *et al,* (2011)** found that the application of organic manure increase microbial activity in the soil, which may increases of the organic matter content due to the active microorganism, biological activity in particular and organic acid produced led to decrease of soil pH.

Effect of Interaction

Data in table (9) showed that interaction between irrigation intervals and compost on soil pH values was significant effect. The results revealed that irrigation intervals every 12 days with combined compost by rate 20 ton /fad had the reduced of soil pH than other treatments. These results are in agreement by **Abdullah (2007)** found that increase of compost rate applied to saline soil led to improving the physical and chemical properties of soil and decreasing soil pH. **Shaban *et al,* (2011)** indicated that applied of compost due to the active microorganism, biological activity and organic acid produced led to decreased of soil pH.

Table 9. Effect of irrigation water intervals and compost different rates on soil pH and soil EC (dSm^{-1}).

Treatments	pH (1:2.5)		Comb.	EC (dSm^{-1})		Comb.
	2014/2015	2015/2016		2014/2015	2015/2016	
	Irrigation intervals					
12 days (I_1)	7.92	7.87	7.89	5.24	4.89	5.07
16 days (I_2)	7.94	7.91	7.93	6.06	5.47	5.77
20 days (I_3)	7.98	7.94	7.96	6.34	5.68	6.01
L.S.D 0.05	0.03	0.02	0.02	0.05	0.03	0.02
Compost rates						
(0 rate)T_1	8.01	7.98	7.99	6.80	6.01	6.41
(5 rate)T_2	7.97	7.93	7.95	6.05	5.70	5.88
(10 rate)T_3	7.91	7.88	7.89	5.60	5.02	5.31
(15 rate)T4	7.89	7.84	7.87	5.06	4.64	4.85
LSD. 0.05	0.03	0.04	0.03	0.02	0.05	0.03
Interaction						
I_1 XT_1	7.98	7.95	7.97	6.48	5.88	6.18
I_1 X T_2	7.95	7.89	7.92	5.41	5.44	5.43
I_1 X T_3	7.88	7.85	7.87	4.93	4.35	4.64
I_1 X T_4	7.85	7.80	7.83	4.12	3.88	4.00
I_2 XT_1	8.01	7.98	7.99	6.94	5.92	6.43
I_2 X T_2	7.97	7.93	7.95	6.18	5.77	5.98
I_2 X T_3	7.90	7.88	7.89	5.72	5.23	5.48
I_2 X T_4	7.88	7.84	7.86	5.39	4.95	5.17
I_3 XT_1	8.03	8.00	8.02	6.98	6.23	6.61
I_3 X T_2	8.00	7.96	7.98	6.55	5.89	6.22
I_3 X T_3	7.96	7.92	7.94	6.15	5.49	5.82
I_3 X T_4	7.93	7.88	7.91	5.66	5.10	5.38
LSD. 0.05	0.04	0.02	0.03	0.03	0.02	0.01

Generally the compost and irrigation intervals were significant decreased in soil pH. The decrease of soil pH reflected to increase of compost rate to fahl clover planting is due to increase nitrogen fixation, increasing organic matter and activity of microorganisms in root zone due to produced organic acid. These results are in agreement by **Hossein-Zadeh *et al,* (2008)** stated that, pH decrease due to increased organic matter, organic and inorganic acids occurs, The most abundant acid is carbonic acid, although acid is a weak acid but it permanent production in soil where root density is high makes dissolve lime in the soil and get out of the soil pH is reduced, under alfalfa planting **Ramezan *et al,* (2013).**

Effect of irrigation intervals on EC:

Data in Table (9) showed that the total soluble salts in soil study as affected by irrigation intervals were decrease with increasing the irrigation periods. This finding is in agreement with that obtained by **Shaban (2005)** reported that using water from El-Salam Canal led to decrease of soil salinity by salts leached out from the soil tented to increase by increasing period irrigation water. This decrease can allow the increase of soil porosity and consequently, the improvement of irrigation water leaching. The minimum of mean value of EC soil was 5.07 dSm^{-1} in the soil treated after 12 days, than other irrigation intervals (16 and 20 days). The increase irrigation periods (16 and 20 days) imposed a more rapid salt accumulation in the root zone, which was ascribed to restriction of the volume of drainage solution.

Effect of compost on EC:

From these data in Table (9), it observed that the total soluble salts decreased as a result of using compost at a rates 20 ton /fad followed by 5 and 10 ton /fad. The EC of soil was slightly enhanced by application compost. These findings are in harmony with those indicated by **Wang *et al,* (2014)** found that a mixture of compost decreased bulk density, EC, and increased total porosity and organic carbon respectively, than the control.

Effect of interaction:

Effect of interaction between irrigation water intervals and compost rates on total soluble salts was decrease by increasing irrigation water periods and high rate of compost. The application compost at different rates led to increase of microorganism's activity, total porosity, and improves soil aggregation and possible leaching salt soil under increase periods of irrigation water. These results are in agreement by **Mariangela and Francesco (2015)** found that the effect of organic fertilizers application on saline soil was improving chemical, physical soil properties and soil remediation in salt affected soil due to their high organic matter content and active biological. This may be due to the positive effect of released active organic acids which enhancing soil aggregation and created conductive prose which led to the excess remove of soluble salts, **Abdullah (2007).**

Macro-micronutrients in soil study after fahl clover harvest.

Effect of irrigation intervals:

Macronutrients, i.e. (N, P and K) available in soil after fahl clover plants over in both seasons were significantly affected by irrigation intervals while the micronutrients availability (Fe, Mn and Zn) content in soil were no significant affect. Data in Tables (10, 11) showed the irrigation every 12 days led to increasing available of macro-micronutrients in soil. The decreased of macro- micronutrients availability in soil due to increasing the irrigation intervals from 16 to 20 days respectively. **Hu *et al,* (2007)** indicated that the drought cause low nutrient availability in soil.

Effect of compost:

Data in Tables (10 &11) showed that the effect of compost rates applied to soil after fahl clover harvest on macronutrients (N, P and K) was significant increase with increasing rate, while the micronutrients (Fe, Mn and Zn) available content was no significant. The highest mean values of N, P, K, Fe, Mn and Zn for soil treated with high rate from compost 15 ton/fad compared with 0, 5 and 10 ton /fad. The relative increase of mean combined two season's values 6.64, 9.75 and 12.35 % for N; 3.70, 16.66 and 19.55 % for P and 2.88, 8.18 and 14.24 % for K availability content in soil as affected by compost at a rates 5, 10 and 15 ton/fad respectively compared with soil treated by 0 ton/fed compost. On the other hand, the relative increase of mean combined two seasons values were 2.07, 3.88 and 5.69 % for Fe; 5.86, 10.16 and 12.50 for Mn and 16.66, 22.22 and 29.16 % for Zn available in soil treated with compost applied at a rates 5, 10 and 15 ton/fad respectively compared control. Also, may be due to the effect of high rate of compost applied to soil reflect to release organic acids , organic substance, enhance soil microbial activity of soil, such as improving activity of soil enzymes and increasing soil microbial biomass leading a reduction in soil pH values and consequently increasing macro-micronutrients available content in soil.

Generally, the results are suggested that the applied the high rates of compost resulted in a increase of N, P, K, Fe, Mn and Zn content in soil. This result may be due to imbalance of nutrients, release of organic acids, organic substances and macro-micronutrients release from compost during decomposition of compost led to decrease soil pH reflected to increase available macro-micronutrients content in soil. **He and Li (2004)** indicated that the application of organic combined with inorganic

fertilizers led to increase the activities of available nutrient content in soil.

Effect of Interaction:

Data in Table (10,11) showed that pronounced increase in soil available macro-micronutrients content i.e. N, P, K Fe, Mn and Zn were achieved as a result of irrigation water intervals 12 and 16 days under applied compost at rates 10 and 15 ton/fad compared with other treatments. This is more related to the residual organic compounds that directly compost led to release more available macro-micronutrients. In addition, the relative increases of these macro-micronutrients in the soil after fahl clover harvest as affected by high rate of compost (15 ton/fad) and decrease irrigation water interval (12 days) compared with other treatments. From the aforementioned results, it could be concluded that N, P, K, Fe, Mn and Zn tend to increase in the studied soils with increasing irrigation period and compost rate. Also, the effect of interaction between irrigation intervals and different rates of compost on macro-micronutrients available in soil was significant increase with decreasing irrigation water interval and increase of rate of compost.

This is due to deceasing in both soil pH and soil salinity. These increases of macro-micronutrients reflect to the accumulation of organic collides and activity of microorganisms led to an increase of available water dissolved organic carbon and a decreased soil pH value and increase of nutrients mobility and bio-availability. **Ibrahim *et al,* (2015)** indicated that the increase irrigation water rate led to increase of available N, P, K, Fe, Mn and Zn in saline soil during fahl clover cultivate. The available of N, P, K, Fe, Mn and Zn content in soil studied depended on the reduced of soil pH as well as the nature of binding's sites on organic and inorganic particle surface.

Table 10. Effect of irrigation water intervals and compost rates on macronutrients available content in soil.

Treatments	N%			P%			K%		
	2014/ 2015	2015/ 2016	Comb.	2014/ 2015	2015/ 2016	Comb.	2014/ 2015	2015/ 2016	Comb.
Irrigation intervals									
12 days (I_1)	42.68	43.63	43.16	5.76	5.95	5.86	221.5	227.5	224.5
16 days (I_2)	41.80	42.08	41.94	5.08	5.45	5.27	203	210.3	206.7
20 days (I_3)	40.97	41.39	41.18	4.83	5.00	4.92	198.8	202.5	200.7
L.S.D 0.05	0.59	0.61	0.45	0.13	0.18	0.11	3.25	3.52	3.15
Compost rates									
(0 rate)T_1	38.29	40.25	39.27	4.79	4.93	4.86	196.0	200.0	198.0
(5 rate)T_2	41.72	42.04	41.88	4.95	5.13	5.04	200.1	207.3	203.7
(10 rate)T_3	43.12	43.07	43.10	5.50	5.84	5.67	210.6	217.7	214.2
(15 rate)T4	44.14	44.10	44.12	5.65	5.97	5.81	223.7	228.7	226.2
LSD.0.05	1.90	1.50	1.24	0.12	0.18	0.09	3.14	4.10	3.20
Interaction									
I_1 XT_1	38.62	40.52	39.57	4.99	5.06	5.03	198	203	200.5
I_1 X T_2	42.18	42.89	42.54	5.20	5.44	5.32	205	213	209.0
I_1 X T_3	44.69	44.89	44.79	6.38	6.59	6.49	229	234	231.5
I_1 X T_4	45.23	46.20	45.72	6.45	6.70	6.58	254	260	257.0
I_2 XT_1	38.24	40.22	39.23	4.78	4.98	4.88	196	199	197.5
I_2 X T_2	41.65	41.77	41.71	4.98	5.04	5.01	199	208	203.5
I_2 X T_3	42.80	42.36	42.58	5.23	5.84	5.54	203	215	209
I_2 X T_4	44.52	43.96	44.24	5.34	5.95	5.65	214	219	216.5
I_3 XT_1	38.00	41.00	39.5	4.59	4.75	4.67	194	198	196
I_3 X T_2	41.33	41.45	41.39	4.68	4.90	4.79	198	201	199.5
I_3 X T_3	41.88	41.96	41.92	4.89	5.10	4.99	200	204	202
I_3 X T_4	42.67	42.15	42.41	5.15	5.26	5.21	203	207	205
LSD. 0.05	0.56	0.71	0.55	0.13	0.12	0.10	3.89	3.59	3.14

Table 11. Effect of irrigation intervals and compost rates on micronutrients available content in soil

Treatments	Fe (mg/kg)			Mn (mg/kg)			Zn(mg/kg)		
	2014/ 2015	2015/ 2016	Comb.	2014/ 2015	2015/ 2016	Comb	2014/ 2015	2015/ 2016	Comb.
Irrigation intervals									
12 days (I_1)	3.99	4.11	4.05	2.79	2.91	2.85	0.85	0.89	0.87
16 days (I_2)	3.91	4.02	3.97	2.71	2.76	2.74	0.82	0.86	0.84
20 days (I_3)	3.81	3.99	3.90	2.64	2.65	2.65	0.80	0.83	0.82
L.S.D 0.05	N.s	N.s	N.s	N.s	N.s	N.s	N.s	N.s	N.s
Compost rates									
(0 rate)T_1	3.78	3.94	**3.86**	2.51	2.61	**2.56**	0.69	0.74	**0.72**
(5 rate)T_2	3.87	4.01	**3.94**	2.67	2.75	**2.71**	0.82	0.85	**0.84**
(10 rate)T_3	3.94	4.08	**4.01**	2.80	2.84	**2.82**	0.86	0.90	**0.88**
(15 rate)T4	4.02	4.13	**4.08**	2.87	2.89	**2.88**	0.91	0.94	**0.93**
L.S.D 0.05	N.s	N.s	N.s	N.s	N.s	N.s	N.s	N.s	N.s
Interaction									
I_1 X T_1	3.80	3.97	3.89	2.55	2.75	2.65	0.72	0.75	0.74
I_1 X T_2	3.97	4.07	4.02	2.75	2.88	2.81	0.84	0.87	0.86
I_1 X T_3	4.04	4.17	4.11	2.89	2.97	2.93	0.89	0.95	0.92
I_1 XT_4	4.13	4.24	4.19	2.99	3.02	3.01	0.94	0.98	0.96
I_2 XT_1	3.78	3.95	3.87	2.50	2.55	2.53	0.69	0.74	0.72
I_2 X T_2	3.85	3.99	3.92	2.66	2.70	2.68	0.82	0.85	0.84
I_2 X T_3	3.96	4.05	4.01	2.80	2.85	2.83	0.85	0.89	0.87
I_2 X T_4	4.03	4.09	4.06	2.86	2.93	2.90	0.90	0.95	0.93
I_3 X T_1	3.75	3.90	3.83	2.48	2.92	2.71	0.67	0.73	0.70
I_3 X T_2	3.78	3.98	3.88	2.60	2.67	2.64	0.80	0.84	0.82
I_3 X T_3	3.83	4.01	3.92	2.71	2.69	2.70	0.83	0.86	0.85
I_3 XT_4	3.89	4.06	3.98	2.76	2.73	2.75	0.88	0.89	0.89
L.S.D 0.05	0.03	0.04	0.03	0.04	0.02	0.04	0.02	0.02	0.01

Conclusion

These results showed that applying irrigation water intervals of 12 days to fahl clover during two seasons under saline soil conditions could be safely practiced, which resulted an increase clover yield and it's quality. Data suggested that the application of compost at rates 5, 10 and 15 ton /fad combined with irrigation water interval 12 days led to improved yield production and quality. Also, data indicated that applied compost different rate or irrigation water decreased intervals were increase of macro-micronutrients available in soil and decreased soil salinity and soil pH during fahl clover cultivate.

In conclusion, the results obtained from this investigation, an irrigation interval 12 days combined with 5, 10 and 15 ton/fad application from compost could be recommended for fahl clover in newly reclaimed saline soil.

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استجابة البرسيم الفحل لمعدلات من الكمبوست تحت فترات الري في الأراضى الملحية المستصلحة الجديدة

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اقيمت تجربتان حقليتان فى محطة البحوث الزراعية بسهل الحسينية –محافظة الشرقية فى موسمين شتوين ٢٠١٤/٢٠١٥ و٢٠١٥ /٢٠١٦ ، وذلك لتقييم فترات الرى ومعدل اضافة الكمبوست على حالة العناصر فى التربة والنبات وانتاجية وجودة البرسيم الفحل تحت ظروف الأراضى الملحية المستصلحة حديثا. كانت المعاملات فترات الرى (١٢ I_1، ١٦ I_2و ٢٠I_3 يوم) بعد رية المحاياة واضافة معدلات من الكمبوست ٠ طن /فدان T_1، ٥ طن/فدان T_2 ، ١٠ طن/فدان T_3 و ١٥ طن/فدان T_4 منفردين او متحدين مع بعض. وكان تقسيم التجربة قطع منشقة مرة واحده.

كانت نتائج التجربة كالتالى :

- ادت زيادة فترات الرى (١٦ و ٢٠) يوم الى تناقص فى طول النبات والوزن الجاف والرطب وانتاجية المحصول عن الفترة ١٢ يوم.
- ادت زيادة معدلات التسميد بالكمبوست ٥ ، ١٠ و ١٥ طن /فدان الى زيادة كل الصفات المحصولية وانتاجية المحصول.
- كان التفاعل بين معدلات التسميد العضوى وفترات الرى له تاثير معنوى على الصفات ومكونات المحصول . حيث اعطى الرى لمده ١٢ يوم مع جميع معدلات اضافة الكمبوست اعلى انتاجية.
- كان لتاثير فترات الرى تاثير معنوى على تركيز العناصر الكبرى النيتروجين– الفوسفور– البوتاسيوم في النبات
- وجد ان اضافة معدلات من الكمبوست وقلة فترات الرى ادي الى زياده الكربوهيدرات – والبروتين – والالياف– وتناقص فى البرولين فى النبات.
- وجد ان فترت الرى ١٢ يوم بعد الزراعة وجميع معدلات اضافة الكمبوست ادى الى زيادة فى جوده محصول البرسيم الفحل.
- فترات الرى (١٢ يوم) ادى الى نقص فى رقم حموضة التربة وملوحة التربة بالمقارنة بالفترات الاخرى (١٦ و ٢٠ يوم)
- ادى اضافة الكمبوست منفرد او متحد مع فترات الرى الى زيادة تيسير عناصر النيتروجين– الفوسفور – البوتاسيوم – الحديد – المنجنيز و الزنك) فى التربة بعد الحصاد.

التوصية: نوصى بفترة الرى ١٢ يوم بعد رية المحاياه والتسميد بالكمبوست وزراعة البرسيم الفحل فى الاراضى الملحية حديثة الأستصلاح.