Salinity Effects of Irrigation Water and Cultivation of Egyptian Clover (*Trifolium alexandrinum,* L.) on Physicochemical Properties of Calcareous Soil

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ABSTRACT

The purpose of this research was to investigate the effect of cultivating Egyptian clover in calcareous soils on the availability of nutrients in the soil when irrigated with water of different quality after harvest. Soil interaction, salinity, cation exchange capacity, organic matter content, macro nutrients (NPK) and micro nutrients iron, zinc, manganese and copper, as well as saturation percentage (SP) as a potential indicator for estimating the field capacity (FC) and wilting point (WP) were measured. The most important results of the study after planting Egyptian clover (*Trifolium alexandrinum,*L.) indicated that the soil properties improved, where the nitrogen, phosphorus and potassium content in the soil irrigated with saline water where (6.55 mg kg-1), (4.41 mg kg-1) and (90.70 mg kg-1), respectively . While the content of soil irrigated with Nile water the three elements were (30.00 mg kg-1), (4.41 mg kg-1), (155.00 mg kg-1), respectively, with a significant decrease in the amount of microelements iron, manganese, zinc and copper. Compared with that irrigated with Nile water.

Key words: Egyptian clover (*Trifolium alexandrinum,*L.); irrigation water quality; calcareous soil; macro- and micro-nutrients.

INTRODUCTION

Egyptian clover is one of the most important green fodder crops in Egypt in the winter season. It is considered a key factor in maintaining the fertility of the soils and improving its physical, chemical and biological properties, as it adds about 130 kg nitrogen/acre at the end of the season (Sammauria and Yadav 2008). It also used as green manure, where one or two cuts are took from it then it plowed into the ground. It characterized by rapid decomposition and transformation into materials suitable for plant nutrition and improving soil properties. It cultivation succeeds in all types of soil that can retain moisture, while it is not well cultivated in lands with a high level of salinity. (Zhang, *et al.*, 2008)

Due to the small area of cultivated land in Egypt, it was necessary to move to the new lands (calcareous - sandy), and these lands suffer from the shortage of irrigation water and its low quality plus the impact of the land on salinity and carbonates with the lack of fertilizers in the appropriate quantity and quality.

In Egypt, irrigated agriculture represents more than 95% of the cropping area, with two crops per year, and uses about of 84% of the water resources (Abd El Hadi *et al.*, 1990). The continuous increase in water demand for agriculture makes the issues of satisfying such demand with limited water very serious. This intensive cropping system depletes the soil in some plant nutrients, which should compensated by fertilizers application (Faizy, 2017)

Salinization is important processes in arid regions, which often reduce crop yields. Salinity is the concentration of soluble mineral salts present in soils on a unit volume or weight basis (Page *et al.*, 1982), Soil salinity can affect nutrient movement to plants, soil properties. In saline soils, pH usually increases with an increase in salinity due to the presence of sodium bicarbonate and carbonates (Gupta *et al.*, 1989). However, Tan (1993) reported that increasing salinity in soil does not necessarily rise in pH. (Agarwal and Ahmad 2010) reported that EC≤8 dS/m) produced the best responses to seed inoculation in Barseem clover. In calcareous soils, statistical studies suggest a strong inverse relationship between the concentration of soluble Ca^{2+} ions and pH (Cresser *et al.*, 1993).

Mahrous *et al*. 1984 indicated that to obtain optimum yield of clover, available soil moisture should maintained between 40-60% depletion of available soil moisture (Zhang *et al*., 2007). El-Bably (2002) also, concluded that the optimum yield of clover significantly increased when three irrigations applied between the cuttings .

In calcareous soil, all crops are responding to N, P, and K fertilizer application. Barseem responded to fertilizer application up to 50 kg N/ha, 100 kg P_2O_5 /ha, 240 kg K_2O/ha under normal irrigation.

Egyptian clover initially withdraws soil nitrogen early in its initial life cycle during its development and Egyptian clover fixes between 115 to 400 kg N/ha in the soil during its growing season (Graves *et al*., 1990).
Therefore, a basal application of N fertilizer recommended at initiating growth stage and

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development of roots and shoots. The efficacy of N fixation is greatly dependent on Rhizobium in Rhizosphere plant activity, soil conditions and the variety of Egyptian clover grown (Radwan *et al*., 2006).

The main targets of this work was to study the effect of sowing of (*Egyptian clover*) in saline calcareous soil on the availability of soil nutrients after harvesting under different water irrigation quality.

MATERIALS AND METHODS

Location of the study area

This study was carried out at Borg El Arab region, it is the northwest coast of Egypt and faraway about 48 km from west Alexandria at latitude 30 ° 45/ and 30 ° 55/ north and at longitude 29 ° 30/ and 29° 50/ east. Its area about 1680 hectares and altitude is 23 m above MSL. See Fig. (1).

This study was conducted at the Burg El Arab area (Sayed Darwish village) during winter seasons of 2016 to 2019 where Egyptian clover (*Trifolium alexandrinum*, L.), the mesqawi cultivar was planted. Soil samples were collected from the experiment implementation sites every 30 cm from soil surface up to 150 cm depth then analyzed were done (Fig .2).

Fig. 1. Location Map of Burg El Arab

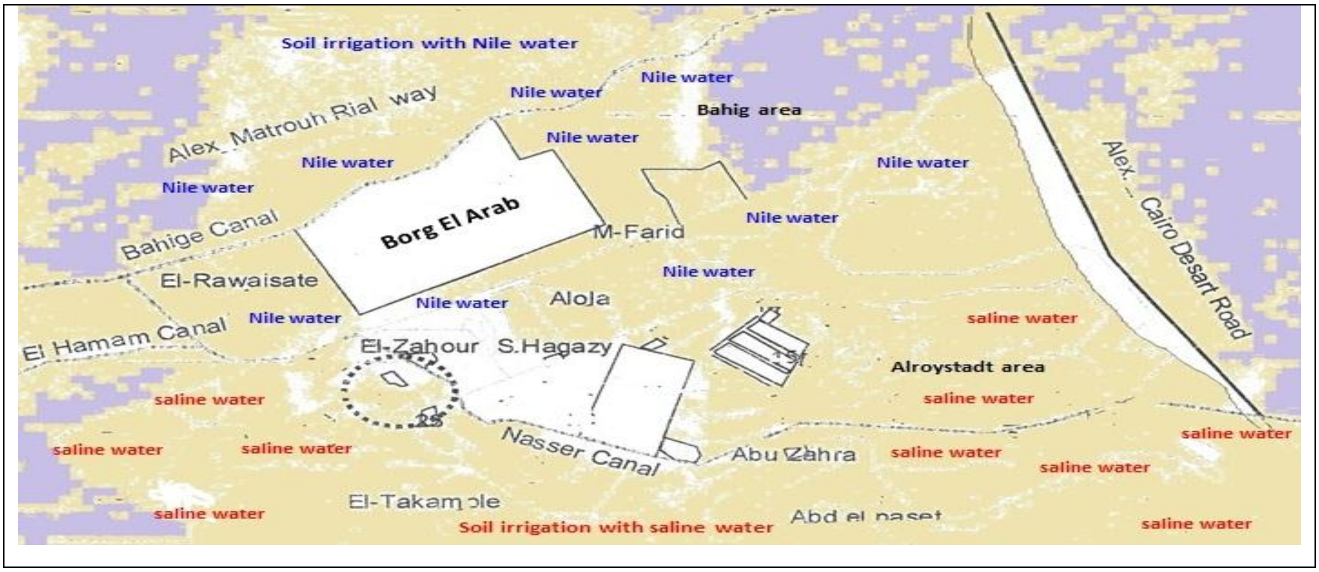

Fig. 2. Key map of the studied area showing location of the samplesSoil analysis

The soil samples of each of the three years before cultivation (2015&2016&2017) and through the three years after cultivation, barseem (2018, 2019 and 2020), collected at four soil depths (0–30, 30–60, 61–95, 96–150 cm). The soil samples, air-dried, ground and passed through a 2 mm plastic sieve and stored for the following soil chemical and physical analysis:

Chemical analysis:

Soluble cations and anions were determined in soil saturation, extracts were determined according to (Page *et al*, 1982) and Sodium Adoption Ratio (SAR) calculated as follows:

$$SAR = Na^{+}/\sqrt{(Ca^{++}+Mg^{++})/2}$$

Where: Na^{+}, Ca^{++} and Mg^{++} refer to their concentrations in meq/l (Donahue *et al*, 1990). Electrical conductivity (EC, dS/m) measured according to (Jackson, 1958) and pH measured according (Jackson, 1958). All the above parameters measured and determined in soil paste extractions. Quality classes defined using salinity and sodium hazard diagram. Cation exchange capacity (CEC) was determined according to (Richards, 1954), and total carbonate content estimated by Collin's calcimeter, (Williams, 1948). Organic matter was determined following Walkley and Black method, (Jackson, 1958), available nitrogen was determined by the micro-kjeldahl method (Black, 1965), available phosphorus was determined according to (Watanabe and Olson 1965) and available potassium was carried out by NH_4OAC method (Black, 1965). In addition, available micronutrients (Fe, Mn, Zn, and Cu) extracted using DTPA (Lindsay and Norvell, 1978) and measured by atomic absorption spectrophotometer, Perkin-Elmer 560.

Physical analysis

The amounts of clay, silt and sand fractions were measured by using the pipette method, as cited by (FAO, 1970), then the soil texture class was defined by plotting the fraction percentages on the texture triangle diagram, (Rebecca, 2004). Field capacity (FC) is the volumetric water content distribution in which the top of the soil profile, becomes fully wetted at the end of infiltration and remains exposed to the subsequent process of drainage without evapotranspiration or rain for 48 h" cultivation of Egyptian clover reduce the field capacity after harvesting (Asgarzadeh *et al*., 2011). The welting point at equilibrium state is the moisture content of the soil samples subjected to 15 bar inside pressure plate extractor. Veihmeyer and Hendrickson (1927, 1931) stated the concept of soil available water (SAW) for plants in its simplest form as the water content available between field capacity (FC) and wilting point (WP). Soil water constant of saturated soil paste, field capacity and welting point measured (Klute 1986).

Water analysis

Water samples collected from different irrigation water sources (irrigation sources (non-saline water from the Nile River from Bahij Canal (mixed saline water (2/3 artesian water and 1/3 Nile river water) during three seasons of (2015, 2016 and 2017 and the following analyses carried out pH of the water samples measured using Beckman's pH meter, (Jackson, 1958). EC (dS/m) measured according to (Jackson, 1958). Soluble cation and anions were determined following methods of (Page *et al*, 1982 and Jackson, 1973). N, P, K and Na were estimated by (Cottenie *et al*. (1982) and (Fe, Mn, Zn, Cu) were determined according to (APHA, AWWA and WPCF, 2015).

Plant analysis

The photosynthetic pigments (Chlorophyll a, Chlorophyll b and carotenoids) were determined using spectrophotometer as recommended method of (Metzner *et al*, 1965). The concentration of pigment fractions can calculate from values of light wavelength (E) as follows:

Chlorophyll a = 10.3 E_{663} – 0.918 E_{644}

Chlorophyll b = 19.7 E_{644} – 3.870E_{663}

Carotenoids (mg/100g dry weight of leaves) = 4.2$E_{452.5}$ - 0.00264Chlorophyll a + 0.426 Chlorophyll b)

Statistical analysis

The data were analyzed using statistical software SAS program (1995). One-way analysis of variance was carried out to compare the means of different treatments and least significant difference at $P < 0.05$ was obtained using Duncan's multiple range test (DMRT) (Duncan, 1955).

RESULTS and DISCUSSION

Physical properties of soil:

Table (1) showed that the texture of the study soil is loamy sand. The average values of saturation percentage (SP), field capacity (FC) and wilting point of soil profile, irrigated with saline water before cultivation were 24.1%, 16.3% and 6.7%, respectively. The total available water was higher (16.6%) in surface layer of the soil (0-30 cm) as shown in Table1. Soil irrigated with Nile water saturation percentage values before (SP) sowing were (31.2%), (24.0%), (16.9 %) and (9.7%), respectively. while field capacity (FC) values of soil irrigated with Nile water were 24.2%, 20.6%,13.4% and 6.7% and wilting point (WP) in the soil irrigated with Nile water (7.0%), (3.5%), (3.5%) and(3.5%), respectively.

Table 1. physical properties of calcareous soil under study before and after sowing of Egyptian clover

irrigation treatments	Particle size distribution (%)				$(SP)_v$*	$(FC)_v$*	$(WP)_v$*	(TAW)v*
	Depth Cm	Sand %	Silt %	Clay %	% 1	% 2	% 3	% 4 = 2-3
Before Cultivation								
Saline water(mixed) (2.93 dSm^{-1})	0-30	89.1	0.7	10.2	28.5	22.4	6.1	16.6
	30-60	89.4	0.8	9.8	25.5	17.3	8.2	9.1
	60-95	88.0	0.8	11.2	22.6	15.2	7.4	7.8
	95-150	81.8	2.0	16.2	19.7	10.3	4.9	5.4
Nile Water (0.98 dS m^{-1})	0-30	89.1	3.4	7.5	31.2	24.2	7.0	17.2
	30-60	87.2	3.0	9.8	24.0	20.6	3.5	17.1
	60-95	86.6	0.4	13.0	16.9	13.4	3.5	9.9
	95-150	92.0	0.4	7.6	9.7	6.7	3.5	3.2
After cultivation								
Saline water (mixed) (2.93 dSm^{-1})	0-30	89.9	1.5	8.6	49.6	46.2	3.5	42.7
	30-60	83.5	0.9	15.6	52.55	44.3	8.3	36.0
	60-95	83.2	3.0	13.8	47.2	41.9	5.4	36.5
	95-150	83.7	2.5	13.8	54.26	44.9	9.3	35.6
Nile Water (0.98 dS m^{-1})	0-30	92.2	0.2	7.6	43.3	38.4	4.9	33.5
	30-60	90.4	0.4	9.2	50.5	42.2	8.3	33.9
	60-95	88.0	0.7	11.3	46.1	42.9	3.2	39.7
	95-150	82.9	0.5	16.6	53.4	49.0	4.4	44.6

SP: saturation percentage, FC: Field capacity, WP: wilting point, Saline water (mixed) = 2/3 Artesian water + 1/3 Nile Water., TAW= total available water, sub v = on volumetric basis

Chemical properties of soil:

Before harvesting there was a lowering in wilting point value in surface layer of soil (0-30 cm) where it reached to 6.1% under saline irrigation water (mixed water, 2.93 dSm^{-1}) treatments while it was (7%) with Nile water (0.98 dS m^{-1}) in the same soil layer (Table2). These results agreed with those reported by (Ragab *et al*., 2008). The values of electric conductivity (ECe) of soil samples in Table (2) indicated that continuous irrigation with Nile water for a long period led to decrease the total soluble salts in the soil and these finding were in harmony with (Sadek and sawy 1989). It observed that cations distribution in soil irrigated with Nile water followed the following order: sodium > calcium+ Magnesium> potassium, while the anions arranged in the order of bicarbonate < sulfate < chloride under irrigated with Nile water. Similar results reported by (Ab El- Naim *et al*, 1987). This behavior can ascribed mainly to the addition of manures as well as fertilizers bearing calcium under cultivation conditions. The similar results obtained by (Yeshaneh, 2015).

The result in Table (2) showed that the pH values of the surface soil layers decreased after cultivation of Egyptian clover in both irrigated soil with saline water and Nile water. This may be due to the presence of calcium carbonate and exchangeable Na^+ (Biswas and Mukherjee, 1987). Data indicated that soils irrigated with Nile water for irrigation appeared lower pH values. Similar results obtained by Mostafa *et al*, (1992). Organic matter values were higher in surface layer (0-30) than in the subsurface layer (30-150) cm.

The percentages of total carbonate ($CaCO_3$ %) in soil layers are depicted in Table (2). The relative wide variation of total carbonate content may be attributed to variation in cycles of deposition or pre- environmental rather than the present conditions which resulted in the formation of calcic horizons. Such allegation confirmed by the presence of considerable amounts of secondary carbonates exceeding more than 5 percent of volume According to (FAO, 1985). Table (2) also showed that the total calcium carbonate of the surface layer (0-30) was 13.3% and 10.7% under saline water and Nile water, respectively. It was almost the same after cultivation. We can concluded that Egyptian clover works to improve the properties of calcareous soils when irrigated with brackish water (mixed). The cultivation of Egyptian clover increased amount of NPK in soil irrigated with Nile water. This matching with the results reported by (Abdelrazek *et al*. 2016). Deficiency in available nitrogen expected especially, in light textured soils with low organic matter content. Moreover, the nitrate nitrogen easily leached from such light texture soils (McCauley *et al*., 2009). As for the available P, the calcareous soil nature of the study soils reflects their improvement in native phosphorus. In addition, the low available P content may be due to the rapid conversion of applied P to insoluble forms of calcium phosphates (Olson and Olson, 1986).

Data presented in Table (2) indicated that CEC values are very low and it reached 5.0 Cmole kg^{-1} in soil irrigated with saline water. This reflects the massive texture of the studied soils as well as the low contribution of organic matter under such conditions (Sadek and Sawy 1989). CEC value was 8.1 Cmole kg^{-1} in the surface layer because of the continuous irrigation with Nile water.

Chemical analysis of irrigation water

Sodium adsorption ratio (SAR) values were 9.37 and 0.76 in mixed water and Nile water, respectively as shown in Table 3. The data, also revealed that soil pH, electrical conductivity (EC) and available macronutrients and micronutrients elements are significantly, affected by water quality.

Table 2. Chemical properties of calcareous soil under study before and after sowing of Egyptian clover

irrigation treatments	Depth, cm	EC, dS/m	pH	Soluble ions, mq/l						OM, %	$CaCO_3$ %	CEC, Cmol/kg
				Cations			Anions					
				Ca++& Mg++	Na^+	K^+	HCO_3^-	Cl^-	$SO_4^=$			
Before Cultivation												
Saline water(mixed)	0-30	4.26	8.76	8.87	38.34	0.70	2.40	34.51	11.00	0.29	13.3	4.5
	30-60	1.55	8.64	3.89	13.95	0.36	2.20	12.56	3.45	0.21	13.5	4.8
	60-95	1.52	8.74	3.39	13.68	0.17	2.30	12.31	2.62	0.01	14.6	4.9
	95-150	1.92	8.82	4.56	17.28	0.44	2.40	15.55	4.32	0.01	15.3	3.9
Nile Water	0-30	8.10	8.61	22.08	60.75	0.67	2.00	54.68	26.82	0.31	10.7	5.7
	30-60	3.55	8.30	11.59	26.63	0.84	0.40	23.96	14.69	0.77	11.4	5.7
	60-95	1.58	8.01	4.83	11.85	0.27	0.60	10.67	5.68	0.21	12.4	5.1
	95-150	1.18	8.04	3.83	8.85	0.18	1.05	7.97	3.84	0.20	12.5	4.8
After Cultivation												
	0-30	4.36	7.85	12.6	34.80	1.75	1.40	31.32	16.43	12.6	10.6	5.9
	30-60	1.45	7.65	4.86	11.60	0.36	2.50	10.44	3.88	4.86	9.2	5.8
Saline	60-95	0.89	8.01	2.75	7.12	0.22	2.00	6.41	1.68	2.75	9.4	5.6
water(mixed)	95-150	0.82	8.30	2.30	6.65	0.35	2.30	5.90	1.01	2.30	8.2	7.5
	0-30	0.76	7.65	1.96	6.08	0.19	2.20	5.47	6.14	1.96	10.6	8.10
	30-60	0.74	7.80	1.92	5.92	0.14	1.70	5.33	6.04	1.92	10.5	6.70
	60-95	1.24	7.91	2.61	9.92	0.17	2.20	8.93	8.70	2.61	9.5	6.40
Nile Water	95-150	0.93	7.82	2.11	7.44	0.14	2.10	6.70	7.22	2.11	8.2	6.60

OM: organic matter, CEC, cation exchange capacity

Table 3. Chemical analysis of irrigation water mixed and Nile water

Irrigation treatments	EC dS m^{-1}	pH	Soluble ions (meq l^{-1}) Ca^{++}+Mg^{++}	Na^{+}	K^{+}	HCO$_3^{-}$	Cl^{-}	SO4^{--}	SAR
Saline water (mixed)	1.52	8.68	4.24	13.68	0.58	2.10	12.31	4.08	9.37
Nile Water	0.81	7.9	4.9	1.19	0.13	2.81	2.91	0.50	0.76
Irrigation treatments	**Available. Macronutrients, (mg l^{-1})**			**Available. Micronutrients, (mg l^{-1})**					
	N	**P**	**K**	**Fe**	**Mn**	**Zn**		**Cu**	
Nile Water	2.00	1.24	90.00	1.23	0.65	0.52		--	
Saline water(mixed)	1.2	0.9	0.50	2.81	0.95	0.90		0.31	
(FAO Guide,1995)				5.0	0.30	2.0		0.2	
L.S.D at 5% level				0.06	0.078	0.106		0.155	

Obtained results (Table 4) indicated that the mean values of available N, P and K of the soil irrigated with saline water (mixed) before cultivation were 8.25, 1.5 and 143.27 mg/kg, respectively. Table 4 also appeared that the average values of available N, P and K of the soil irrigated with Nile water before cultivation were 9.25, 1.6 and 177.75mg/kg, respectively. The increase of N in soil irrigated with river water may due to the increase the activity of nitrifying bacteria (Huang et al. 2016). Similar results obtained by (Hue *et al*, 1988; Tsadilas *et al*, 1995; Gasco *et al*, 2002). The cultivation of (*Egyptian clover)* under the conditions of calcareous soil and irrigation with different quality water resulted in significant differences in the response of plant growth and changes in soil physiochemical properties. These results are matching with Touchton and Boswell, (1975) who reported that the application of saline water (mixed) to soil reduced rate of nitrification in the soil. Therefore, the farmers in Burg El Arab area preferred sowing Barseem in calcareous soil for obtaining good yield and improving soil quality (Mahrous *et al*., 1984). The result in Table 4 illustrated a significant decrease in the amount of Micro elements such as iron, manganese, zinc and copper in soil irrigated with saline water before Egyptian clover sowing in the 0-30 cm soil layer (0.71- 0.65- 0.02 and 0.12 mg kg^{-1}), respectively. However, soil irrigated with Nile water in the same layer showed that contents of the previous elements were (1.07- 1.11- 0.08 and 0.42 $mgkg^{-1}$) respectively. The same result reached by (Abdelrazek *et al*., 2016)

Photosynthetic pigments:

Table 5 showed that the highest level of chlorophyll a recorded in leaves of clover plants irrigated with Nile water and decreased in case of soil irrigated with saline water. In contract chlorophyll b; data appeared converse trend of chlorophyll a level; where the highest level was recorded in plants under saline water irrigation. These results are in harmony with those of (Femandes and, Henriques, 1995; singh and Dubey, 1995). Carotenoids showed a significant difference in its level in case of Nile or saline water irrigated plants Table (5). The increase in photosynthetic pigments of (*Trifolium alexandrium* (Berseem)) leaves in response to soil irrigated with Nile water might be attributed to the accessibility of Mg^{+2} ions and total N required for chlorophyll biosynthesis in the different water irrigates resources compared with Nile water. This matching with (Sheekh, 1993) who observed marked reduction in Mg^{+2} level in the salinized vegetable plants, which is essential for chlorophyll biosynthesis might support the view that heavy metals decreased chlorophyll biosynthesis. Similar conclusion was reported by (Kneer and Zenk, 1992; Eyras *et al*, 1998) in Trifolium alexandrinum (Berseem) plant grown in sandy soil irrigated with saline water.

Table (6) shows the chemical composition of *Egyptian clover* (*Barseem)*. The results in Table (6) showed the percentage ingredients, in the three cuts and the best humidity ranged from (73.35 -86.22 moisture), dry matter (13.78-26.65), raw protein1.91-3.68, and digested protein (1.36-2.90). Metal material (2.00-3.28) and the soluble carbohydrates ranged between (5.94 - 11.53). Data in Table (6) may attributed to the fact that saline water had negative effects on (*Egyptian clover)* growth, which resulted in less exhaustion of nitrogen content in soil. This result is in agreement with those obtained by (Abdelrazek, 2018). Meanwhile, the available nutrients increased after sowing (*Trifolium alexandrinum* ,L.) and decreased significantly in the *Barseem* grown in the saline calcareous soil. These revered that the calcareous soils have a deficient in macronutrients where the available contents are less than 40 mg kg^{-1} for nitrogen, 10 mg kg^{-1} for phosphorous and 200 $mgkg^{-1}$ for potassium (Abdelrazek, 2007). Thus, most of the investigated soils exhibit inadequacy of available macronutrients particularly, in the surface layer.

Table 4. Main available macro and micronutrients in calcareous soil before and after cultivation of Egyptian clover under different quality of irrigation water

Irrigation treatments	Soil depth (cm)	Available Macronutrients mg kg-1			Available Micronutrients mg kg-1			
		N	P	K	Fe	Mn	Zn	Cu
		before Cultivation*						
Saline water (mixed)	0-30	9.00	1.24	120.50	0.71	0.65	0.02	0.12
	30-60	7.00	1.57	130.90	1.02	0.82	0.02	0.11
	60-95	5.00	1.37	170.00	0.40	0.31	0.01	0.13
	95-150	12.00	1.82	176.20	0.90	0.92	0.07	0.92
	Mean	8.25	1.5	143.27	0.758	0.675	0.03	0.32
Nile Water	0-30	10.00	1.78	155. 00	1.07	1.11	0.08	0.42
	30-60	8.00	1.50	210.00	0.05	1.42	0.02	0.31
	60-95	7.50	1.55	160.90	0.19	1.20	0.06	0.32
	95-150	11.50	1.50	160.80	0.90	0.50	0.05	0.31
	Mean	9.25	1.6	177.75	1.535	1.057	0.053	0.34
L.S.D (0.05%)		5.8	2.63	0.31	6.82	0.52	0.24	0.21
		After Cultivation						
Saline water (mixed)	0-30	6.55	4.41	90.70	1.15	3.11	0.08	0.11
	30-60	6.50	6.12	68.40	1.12	1.15	0.09	0.12
	60-95	5.90	6.82	80.70	1.01	1.15	0.08	0.15
	95-150	17.50	6.91	97.50	1.31	0.90	0.07	0.13
	Mean	9.11	6.065	84.325	1.148	1.578	0.08	0.13
Nile Water	0-30	30.00	4.21	155.0	1.31	2.51	0.56	0.52
	30-60	25.00	9.31	114.0	1.21	0.51	0.13	0.14
	60-95	25.50	13.29	180. 90	1.02	0.72	0.10	0.14
	95-150	35.00	13.62	185.90	1.03	0.62	0.10	0.16
	Mean	28.75	10.107	158.95	1.143	1.09	0.245	0.24
L.S.D at 5% level		3.8	1.56	4.5	6.32	3.1	1.21	1.12

*no fertilizer addition

Table 5. Effect of different irrigation water sources on photosynthetic pigment contents in leaves of Egyptian clover

Irrigation treatments	Chlorophyll a (μg/g F. wt)	Chlorophyll b (μg/g F. wt)	Carotenoids (μg/g F. wt)
	After Cultivation		
Nile water	976.51[a]	389.96 [d]	586.55 [a]
Saline water (mixed)	958.88 [d]	484.96 [c]	473.92[b]
L.S.D at 5% level	24.0	46.0	17.8

Table 6. Chemical composition of Egyptian clover

Cut number	Nutritional ingredients in dry matter						
	dry matter	raw protein	Crude fat	soluble carbohydrates	raw fibers	metal material	digested protein
first	13.78	2.12	0.66	5.94	2.39	2.67	1.56
second	14.51	1.91	0.37	6.40	3.83	2.00	1.36
third	26.65	3.68	0.63	11.53	7.50	3.28	2.90

CONCLUSION

It is advice to cultivate Egyptian clover (barseem) as a source of green manure and rich plant residues or other addition of organic matter in new reclaimed calcareous soils for improving its physicochemical properties and increasing its productivity especially, when it irrigated with saline water

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الملخص العربي

تأثير ملوحة مياه الري وزراعة البرسيم المصري على الخواص الفيزيوكيميائية وخصوبة التربة الجيرية

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الغرض من هذه الدراسة هو دراسة تأثير زراعة البرسيم المصري (Egyptian clover) علي التربة الجيرية المتأثرة بالاملاح على اتاحة العناصر الغذائية بالتربةعند الرى بمياه مختلفة الجودة بعد الحصاد. تم قياس تفاعل التربة ، وملوحتها والسعة التبادلية الكاتيونية ، ومحتواها من المادة العضوية ، المغذيات الكبرى (NPK) والصغرى (الحديد والزنك والمنجنيز والنحاس) وكذلك نسبة التشبع (SP) كمؤشر لتقدير السعة الحقلية (FC) ونقطة الذبول (WP) .

وقد اشارات نتائج الدراسة بعد زراعة البرسيم الى تحسين خصائص التربة حيث كان محتوى النيتروجين في التربة المروية بمياه مالحة (٦,٥٥ ملجم كجم ⁻١) ، كمية الفوسفور (٤,٤١ ملجم كجم ⁻١) والزيادة في البوتاسيوم (٩٠,٧٠ملجم كجم⁻١) في نفس التربة ، بينما كان محتوى التربة المروية بمياه النيل من العناصر الثلاثة (٣٠,٠٠ملجم كجم ⁻١) ، (٤,٤١ ملجم كجم⁻١) ،(١٥٥,٠٠ملجم كجم ⁻١) على الترتيب ، مع انخفاض كبير في كمية العناصر الصغرى الحديد ، المنجنيز ، الزنك والنحاس بعد زراعة البرسيم فى الطبقة السطحية في التربة المروية بالمياه المالحة بدرجة أكبر من الري بمياه النيل.

وقد خلصت الدراسة إلى أن البرسيم المصرى يعمل على تحسين خواص التربة الجيرية تحت ظروف الري بمياه مالحة مقارنة بمياه النيل.