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CHEMICAL PROPERTIES AND ELEMENTAL IONS STATUS OF EL- SALAM CANAL IRRIGATION WATER AT SAHL EL-TINA AREA (North Sinai)

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ABSTRACT

The objective of this study was to tracking the annual and seasonal variations in the chemical properties of El-Salam canal water at the area of Sahl El-Tina (north Sinai), during the winter and the summer of the two growing seasons of 2011/2012 and 2012/2013. Chemical and elemental properties analyses were carried out to water samples, which collected along the main source of irrigating crops from El-Salam Canal at Sahl El-Tina area, and their average values were calculated and then The obtained data showed that:

- pH values varied from 7.39 to 7.81 indicating that the irrigation water samples of El- Canal were slightly alkaline. pH mean value was more in the season of 2012/2013 (pH≈ 7.79) than the season of 2011/2012 (pH≈ 7.42). Also pH values were more at summer season than winter season during the season of 2011/2012 and the contrary trend was observed during the season of 2012/2013.
- Electrical conductivity (EC) values of El-Salam Canal water, at Sahl El-Tina area, ranged between 1.63 and 3.77 (dS/m). Their values were 2.70 and 2.12 (dS/m) for the seasons of 2011/2012 and 2012/2013, respectively. During 2011/2012 EC (dS/m) values were more in winter than in summer and the contrary trend was noticed during 2012/2013 growing season.
  The type of irrigation water may be considering medium saline irrigation water and can be used in light textured soils, which have a good drainage systems.
- Soluble ions of Na^+ and Cl^- increased progressively with increasing EC levels in the irrigation water at the growing seasons 2011/2012 and also at the growing seasons 2012/2013.
  As for the annual variations of soluble ions, concentrations of all soluble ions (meq/l) except Mg^{++} and HCO_3^- increased at the season of 2011/2012 than at the seasons of 2012/2013. Seasonal variations during the growing season of 2011/2012 showed that, all concentration (meq/l) of soluble ions increased at winter season than at summer season, except K^+ behaved contrary trend. During 2012/2013, all soluble ions increased at summer season comparing with winter season, except Mg^{++} and HCO_3^- behaved contrary trend.
  These variations can be due to increasing agricultural activities and rainfall, increasing in the leaching processes in some locations and high evaporation, as a result to high temperature.
- Sodium adsorption ratio (SAR), is usually used to evaluate the relatively hazards of Na^+ ion which associated with the irrigation water supply on soil properties. Throughout the season of 2011/2012, SAR was decreased at summer than at winter. While opposite trend was noticed through the growing season of 2012/2013. As for the annual variations in SAR values, data indicated that SAR decreased at 2011/2012 than at 2012/2013.

But in general SAR ranged from 6.15 to 12.52 throughout the two seasons of growth of the current investigation study. These types of water can be used for irrigate

the soils with coarse textured, which have good permeability, because their values ranged 10 > SAR <18.

With respect to the elemental nutrients of El-Salam Canal irrigation water, throughout the two seasons of growth, their concentrations were varied from 2.84 to 5.75 mg/l for N, from 0.80 to 1.49 mg/l for P, from 0.89 to 0.92 mg/l for Fe, from 0.28 to 1.80mg/l for Mn, from 0.56 to 0.97 mg/l for Zn and from 0.03 to 0.09 mg/l for Cu.

The annual variations were represented by the concentrations of 3.07 and 5.28 mg/l for N, 1.15, 1.04 mg/l for P, 0.95 and 0.91 mg/l for Fe, 1.32 and 0.55 mg/l for Mn, 0.73 and 0.83 mg/l for Zn, 0.06 and 0.06 mg/l for Cu at the season of 2011/2012 and the season of 2012/2013, respectively. Their seasonal variations showed that, at summer season of 2011/2012 all the concentrations of N, Fe, Mn, and Cu (mg/l) increased than their corresponding values at winter season. On contrary trend, P and Zn showed decreasing in their concentrations (mg/l) at summer season than their at winter season. While data showed that the at summer season2012/2013, N, P, Fe, and Zn (mg/l) increased than at winter season. On contrary trend, Mn and Cu showed decreasing in their values (mg/l) at summer season than their values at winter season. In general, contents of N and P were considered blow the critical limits. Contents of Fe, Mn and Zn (mg/l) were, also, below the maximum ranges.

Data showed that Pb concentration (mg/l) ranged between 1.38 & 1.35 (mg/l) at 2011/2012 and 1.72 & 1.44 (mg/l) at 2012/2013 during the summer and the winter seasons, respectively.

Cd-contents (mg/l) were ≈ 0.05 (mg/l), with non-effective differences were observed between Cd values either at winter or at summer for the two growth seasons of 2011/2012 and 2012/2013.

Generally, the investigated contents of Pb (mg/l) were below the recommended maximum ranges. While the obtained Cd values can be considered anomalous, and above the recommended maximum limit.

INTRODUCTION

Because of the highest importance of Sinai Peninsula in the socio-economic development of Egypt, the Egyptian government constituted the North Sinai Agriculture Development Project (NSADP) to enhance agricultural and socio- economic development in North Sinai by providing additional water resources, which consisting of Nile water mixed with agriculture drainage water, through El-Salam open canal to increase the possibilities of reclamation and cultivation a lot of new areas in North Sinai. Hussein and Raouf (2002) mentioned that agricultural drainage water collectively forms about $17x\ 10^9\ m^3$ which can be helpful in land reclamation over the next two decades. They continued, of this figure $11x\ 10^9\ m^3$ is the net output into the sea, as $2.5\ x\ 10^9$ and $3.5\ x\ 10^9\ m^3$ / yr are reused pumping from the land residues and drainage network, respectively. Also, DRI(2011) declared that agricultural drainage water in Upper Egypt are discharges back into the River Nile, while the drainage water in Nile Delta is collected through an intensive drainage network and deposed to the sea. About $12\ x\ 10^9\ m^3$ of drainage water are discharged to the sea each year, and only about $4.2\ to\ 4.7\ x\ 10^9\ m^3$ are currently being re-used.

Therefore, the main sector in strategy of socio- economic development of Egypt had been designed for re-use of agricultural drainage water after mixing it with Nile water, to use mainly in socio- economic development in North Sinai through Sinai development projects and El-Salam canal. DRI (1993) stated that, El- Salam canal is one of the national

promising projects involves the re-use of drainage water for North Sinai development projects.

The current work aims at study the seasonal and annual variations in water chemical properties of El-Salam Canal at Sahl El-Tina area in North-Sinai.

MATERIALS AND METHODS

A lot of irrigation water samples were collected along the main source of El-Salam Canal, which used in irrigating the growing crops in the chosen area at Sahl El-Tina district. The abscissas of this area are Latitude 31˚ N. & Longitude 33˚ E., its elevation about 23 m. above the mean sea level. The outer boundaries of this are the feeding irrigation canal from the north and branch of Baloza drain from the south. The land level is slightly above of Lake Manzala and the water table depth varies between 1.12 to 2.20 m.

Throughout the two growing seasons of 2011/2012 and 2012/2013, thirty two different water samples, *i.e.* eight different water samples at in winter and in summer season along the two growth seasons, were collected from different locations in Sahl El-Tina district .

The chemical and elemental analyses of the collected soil samples were carried out and their average values were calculated for discussions. Water samples were analyzed for:

- pH, which measured electronically on a directly water samples, using pH - meter apparatus according to Dewis and Fried (1970).
- EC (Electrical conductivity, dS/m), were measured directly in water samples, using electrode cell of the conductivity meter as stated by Chapman and Pratt (1961).
- Soluble ions (me/l) of Ca^{++}, Mg^{++}, Na^{+}, K^{+}, CO_3^{-} , HCO_3^{-} and Cl^{-} , of water were determined as stated by Chapman and Pratt (1961) as follow:

(1) (Ca^{++}) and (Mg^{++}): were determined by titration with Versenate (EDTA) solution.
(2) (Na^{+}) and (K^{+}): were measured directly in water samples by using Flame photometer device.
(3) (Cl^{-}) : was determined titrimetrically by Silver nitrate ($AgNO_3$) solution.
(4) (CO_3^{2-} & HCO_3^{-}): were determined titrimetrically according to Dewis and Fried (1970) by hydrochloric acid (HCl).
(5) (SO_4^{-} $^{-}$): was calculated by subtracted the sum of (Cl^{-} and HCO_3^{-}, me/l) from the sum of cations (Ca^{2+}, Mg^{2+}, Na^{+} and K^{+}, meq/l). Elemental nutrients: were determined as follows:
(1) Nitrogen: was estimated by using Technicion Auto Analyzer according to Markus *et al* (1982).
(2) Ionic metals of (P, Fe, Mn, Zn, Cu and Pb & Cd): were determined by using plasma 400 According to Soltanpour and Schwab (1985).

RESULTS AND DISCUSSION

Chemical Properties

Data presented in Table (1) and Figures (1–4) showed some chemical properties of El-Salam Canal of irrigation water during the winter and the summer for the growing seasons of 2011/2012 and 2012/2013.

pH values :

The average trend of pH values , as shown in Table (1) , ranged from 7.39 to 7.7.81 indicating that the irrigation water samples of El- Canal were slightly alkaline and in accordance with the results of Sallam et al. (2008) and Agrama and Amer (2012). In this concern, pH tends to be buffered in soil and most crops can be tolerating a slightly alkaline pH.

From data in Table (1) and Fig (1), it can be concluded that, pH mean value was more in the season of 2012/2013 (pH≈ 7.79) than the season of 2011/2012 (pH≈ 7.42). Also, it can be noticed that pH values were more at summer season than winter season during the season of 2011/2012 and the contrary trend were observed during the season of 2012/2013.

Electrical conductivity (EC,dS/m) :

As shown in Table (1), EC of El-Salam Canal irrigation water varied from 1.63 to 3.77 (dS/m) in the investigated area. The mean values were 2.70 and 2.12 (dS/m) for the seasons of 2011/2012 and 2012/2013, respectively. These types of irrigation water may be considering as Kandiah (1990) and Glover (1996) in the class of medium saline irrigation water and can be used in light texture soils, which have good drainage systems, because this water can be used if a moderate amount of leaching occurs and can't be used in soils with restricted drainage.

Table (1): Some chemical properties of El-Salam Canal irrigation water throughout winter and summer of the growing seasons 2011/2013 and 2012/2013.

Properties	2011/2012		2012/2013	
	Winter	Summer	Winter	Summer
pH	7.39	7.44	7.81	7.77
EC (ds/m)	3.77	1.63	2.05	2.19
Soluble Ions (1) Soluble Cations (me/l)				
Ca^{++}	6.97	4.05	4.31	4.55
Mg^{++}	4.31	1.87	4.45	3.96
Na^{+}	26.67	10.32	11.87	13.24
K+	0.56	1.01	0.06	0.31
(2) Soluble Anions (me/l)				
CO_3^{--}	--	--	--	--
HCO_3^{-}	3.22	2.95	5.16	2.86
Cl^{-}	21.18	7.23	10.50	12.86
SO_4^{--}	14.49	7.06	4.56	6.28
Sodium Adsorption Ratio (SAR)				
SAR	12.52	6.58	6.15	6.42

During 2011/2012 and as shown in Fig (1), EC (dS/m) values were more in winter than in summer and the contrary trend was noticed during 2012/2013 growing season.

Soluble Ions (mq/l) :

Generally, data in Table (1) clearly showed that, Na^{+} and Cl^{-} increased progressively with increasing salinity levels in the irrigation water. Whereas, at growing season of 2011/2012 Na^{+} increased from 10.32(me/l) to 26.67(me/l) and Cl^{-} increased from 7.23(me/l) to 21.18(me/l) with increasing EC from 1.63(ds/m) to 3.77 (dS/m), respectively. The same trend was noticed during the growing season of 2012/2013, whereas Na^{+} increased from

11.87(me/l) to 13.24(me/l) and Cl^- increased from 10.50(me/l) to 12.86 (me/l) with increasing EC from 2.05(ds/m) to 2.19 (dS/m), respectively. These findings were coincided with Ahmed (2013).

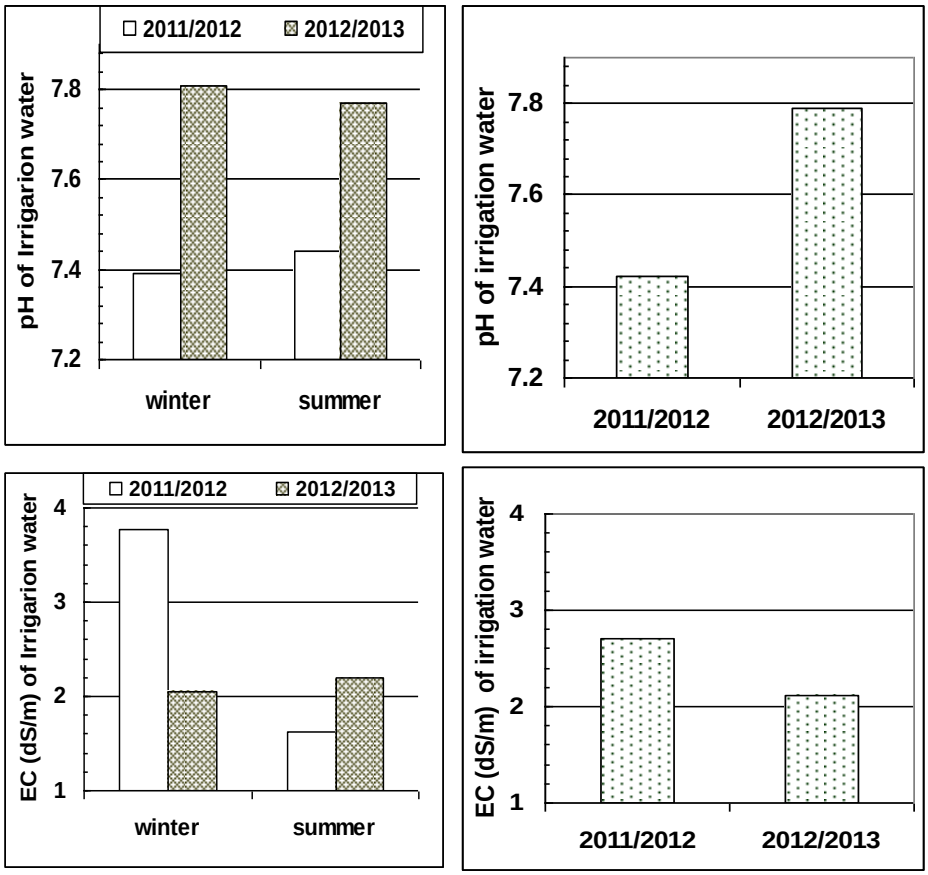

Fig (1): Seasonal and annually variations in pH and EC (dS/m) of El-Salam Canal irrigation water.

On the other hand, the average trends of soluble ions, throughout the two investigation seasons , ranged for Ca^{++} from 4.05 to 6.97 me/l, for Mg^{++} ranged from 1.87 to 4.45 me/l, for Na^+ ranged from10.32 to 26.67 me/l, for K^+ ranged from 0.31 to 1.01me/l, for HCO_3^{--} ranged from 2.86 to 5.16 me/l, for Cl^- ranged from 7.23 to 21.18 me/l and for SO_4^{--} ranged from 4.56 to 14.49 me/l .

As for the annual variations of soluble ions, Table (1) and Figures (2&3), in compare the mean concentrations of soluble ions at the season of 2011/2012 with the same corresponding mean values at the seasons of 2012/2013, decreasing in Ca^{++} was noticed from 5.51 to 4.43 me/l, in Na^+ from 18.50 to 12.50 me/l, in K^+ from 0.79 to 0.19 me/l, Cl^- from 14.21 to 11.68 me/l and in SO_4^{--} from 10.78 to 5.42 me/l. While increasing in Mg^{++} were noticed from 3.09 to 4.21 me/l and in HCO_3^{--} from 3.09 to 4.01 me/l.

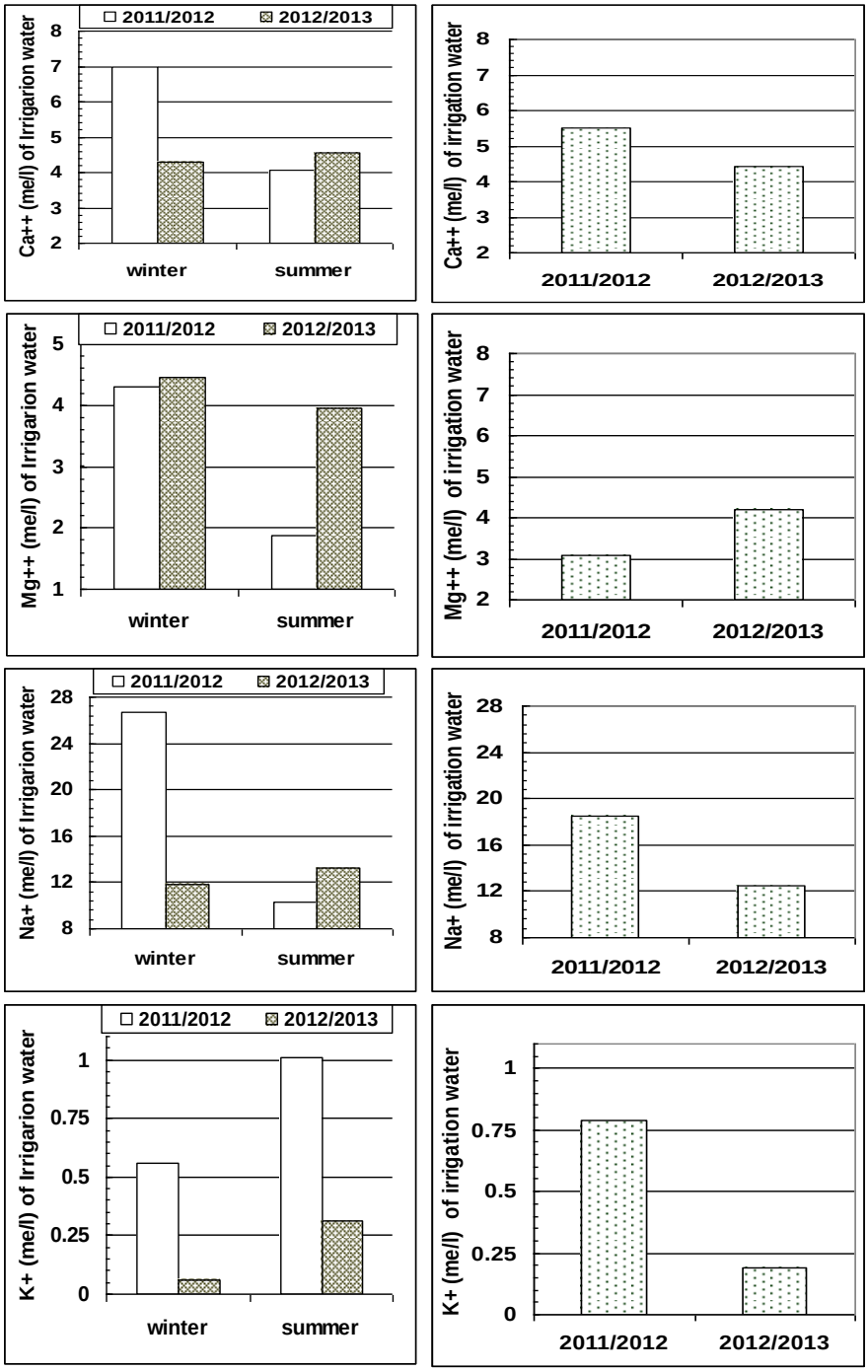

Fig (2): Seasonal and annually variations in soluble cations of Ca^{++}, Mg^{++}, K^{+} and Na^{+} (me/l) of El-Salam Canal irrigation water.

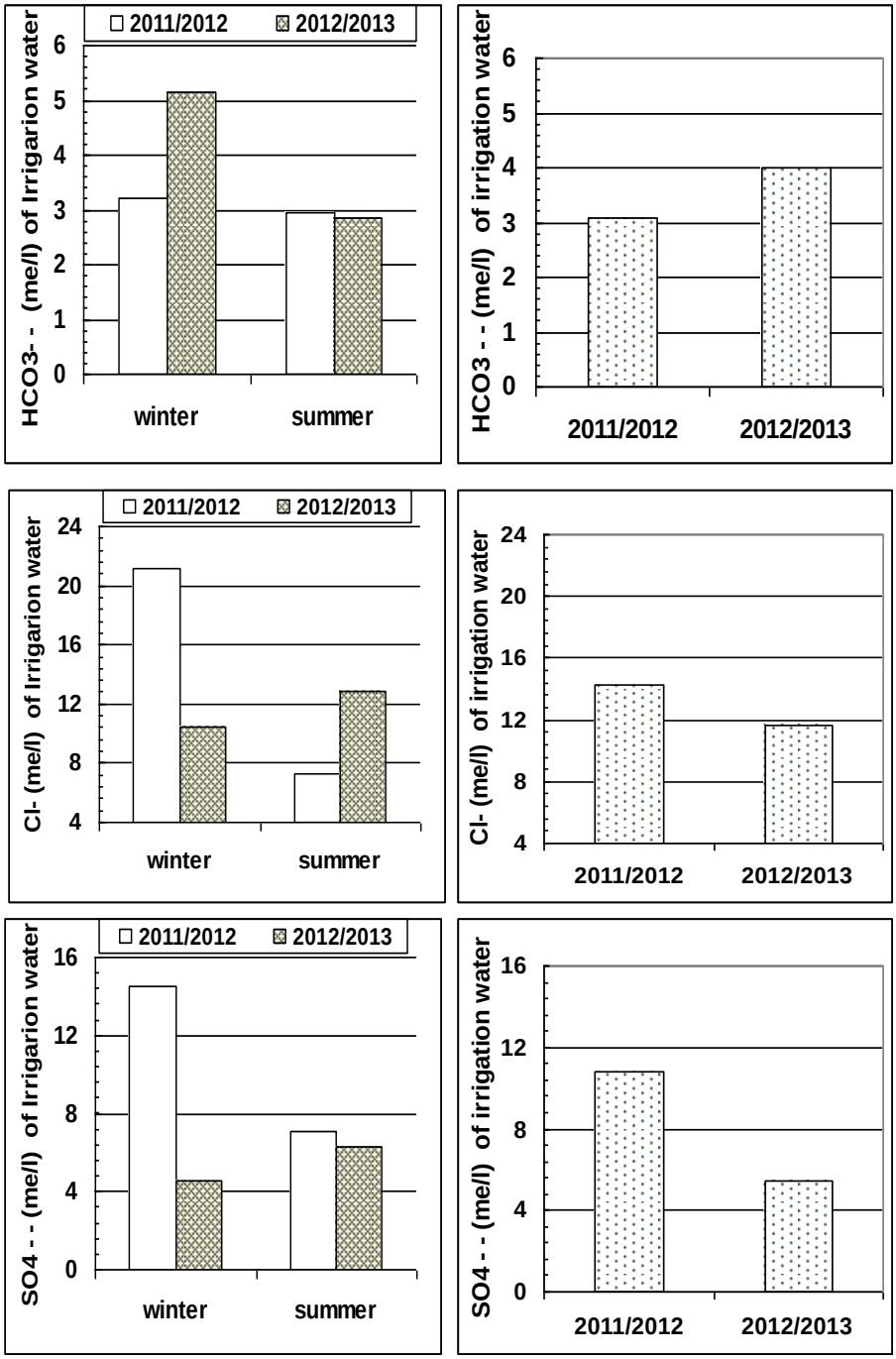

Fig (3): Seasonal and annually variations in the soluble anions of HCO_3^-, Cl^- and SO_4^{--} (me/l) of El-Salam Canal irrigation.

Seasonal variations of soluble ions data, which tabulated in Table (1), and Figures (2&3), declared that at 2011/2012 all soluble ions increased at winter season in comparing with summer season, except K^+ behaved contrary trend. Whereas, these soluble ions (mg/l) recorded 6.97 and 4.05 for Ca^{++}, 4.31 and 1.87 for Mg^{++}, 26.67 and 10.32 for Na^+, 0.56 and 1.01 for K^+ ,3.22 and 2.65 for HCO_3^- , 21.18 and 7.23 for Cl^- and 14.49 and 7.06 for SO_4^{--} at winter and at summer , respectively.

During 2012/2013, the same table and Figures showed that, all soluble ions increased at summer season comparing with winter season, except Mg^{++} and HCO_3^- behaved contrary trend. Whereas, these soluble ions (mg/l) recorded 4.55 and 4.31 for Ca^{++}, 3.69 and 4.45 for Mg^{++}, 13.24 and 11.87 for Na^+, 0.31 and 0.06 for K^+ ,2.86 and 5.16 for HCO_3^- , 12.86 and 10.50 for Cl^- and 6.28 and 4.56 for SO_4^{--} at summer and at winter , respectively.

Sodium Adsorption Ratio (SAR):

Sodium adsorption ratio (SAR) is usually used to evaluating the relatively hazards effect of Na^+ ion, which associated with the irrigation water supply, on soil properties.

Data in Table (1) and Fig (4) indicated generally that, SAR ranged from 6.15 to 12.52 along the two seasons of growth. Throughout the season of 2011/2012, SAR was equal to 6.58 at summer and increased to 12.52 at winter. While opposite trend was noticed through the growing season of 2012/2013, whereas SAR increased from 6.15 at winter to 6.42 at summer.

As for the annual variations in SAR values, data indicated that SAR decreased from 9.55 in 2011/2012 to 6.29 in 2012/2013.

These types of water can be used for irrigating coarse textured soil with a good permeability, because their 10 < SAR <18 as stated by Glover (1996).

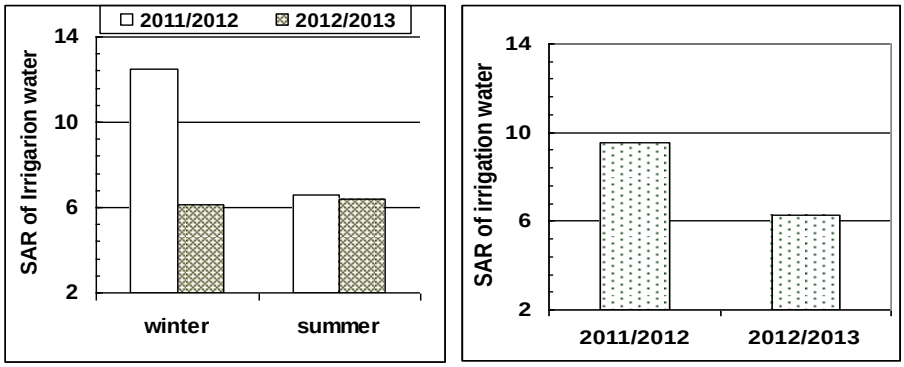

Fig (4): Seasonal and annually variations in SAR of El-Salam Canal irrigation water.

Variations in chemical properties:

Generally, the previous discussion showed differences in chemical properties of El-Salam Canal irrigation water among the two growth seasons of 2011/2012 and 2012/2013 and among the two seasons of winter and summer. These variations can be attributed to many reasons such as increasing agricultural activities and rainfall, which cause dilution of EC and chemical components in the used irrigation water. Increasing the leaching

processes in some locations and high evaporation, as a result to high temperature, also can be increased EC and chemical components of the used irrigation water (El-Kholy et al. 2004).

Elemental Ions (mg/l)

Table (2) and Figures (5 & 6) showed some element ions (mg/l) status of El-Salam Canal irrigation water during the winter and summer growing seasons of 2011/2012 and 2012/2013.

Throughout the two seasons of growth and under the circumstances of the district under investigation, data in Table (2) and Fig's (5&6) showed the status of some elemental nutrients in El-Salam Canal irrigation water.

Table (2) : Some elements concentrations (mg/l) of El-Salam Canal irrigation water of throughout winter and summer for the growing seasons of 2011/2013 and 2012/2013.

Elements	2011/2012		2012/2013	
	Winter	Summer	Winter	Summer
Elemental Ions (mg/l)				
N	2.84	3.30	4.80	5.75
P	1.49	0.81	0.80	1.28
Fe	0.89	0.92	0.90	0.92
Mn	0.84	1.80	0.82	0.28
Zn	0.90	0.56	0.69	0.97
Cu	0.03	0.09	0.06	0.05
Pb	1.35	1.38	1.44	1.72
Cd	0.05	0.04	0.05	0.05

Nutrients status:

These nutrients were varied from 2.84 to 5.75 mg/l for N, from 0.80 to 1.49 mg/l for P, from 0.89 to 0.92 mg/l for Fe, from 0.28 to 1.80mg/l for Mn, from 0.56 to 0.97 mg/l for Zn and from 0.03 to 0.09 mg/l for Cu.

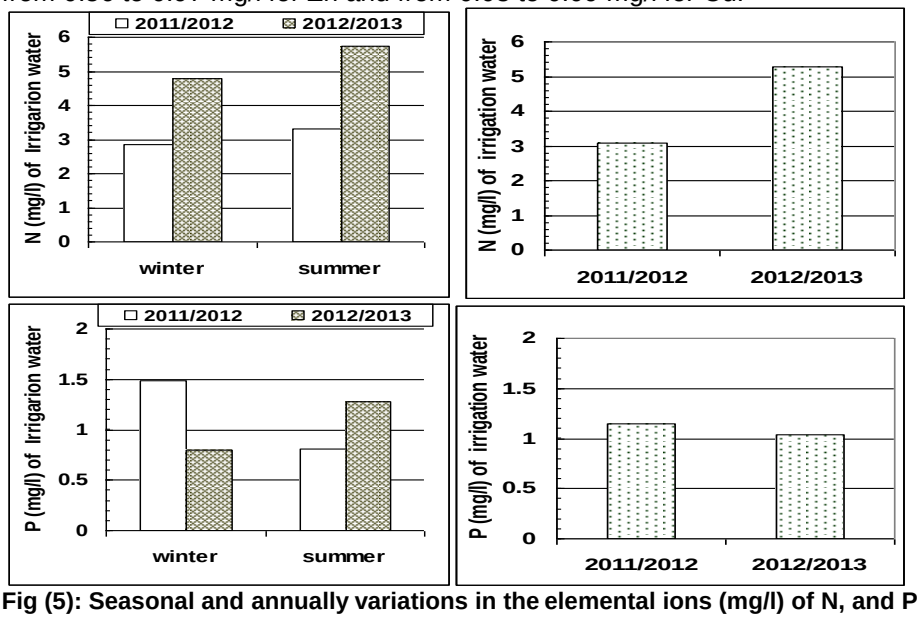

Fig (5): Seasonal and annually variations in the elemental ions (mg/l) of N, and P of El-Salam Canal irrigation water.

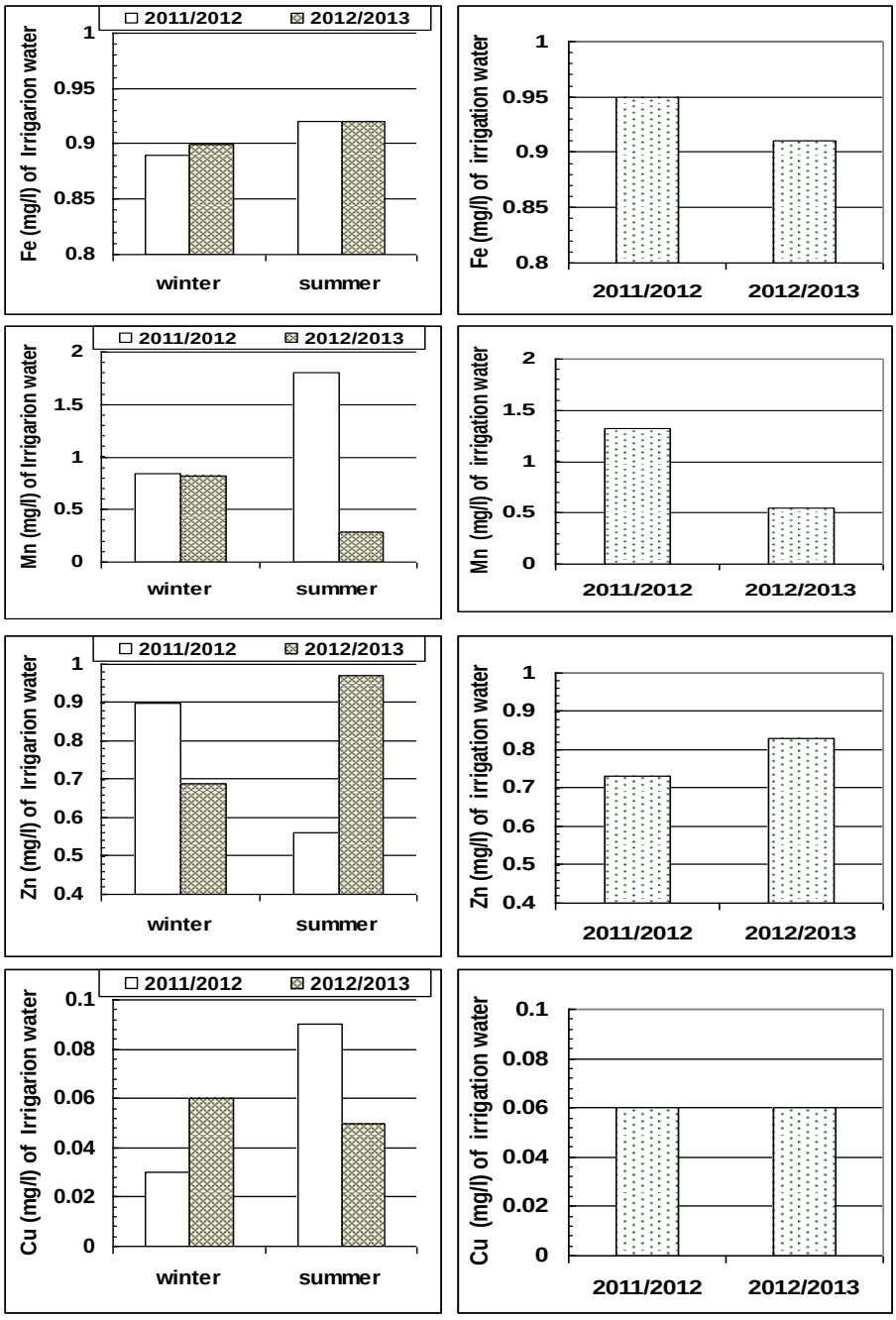

Fig (6): Seasonal and annually variations in the elemental ions (mg/l) of Fe, Mn, Zn and Cu of El-Salam Canal irrigation water.

On the other hand, their mean concentrations, which represented the annual variations were 3.07 and 5.28 mg/l for N, 1.15, 1.04 mg/l for P, 0.95 and 0.91 mg/l for Fe, 1.32 and 0.55 mg/l for Mn, 0.73 and 0.83 mg/l for Zn, 0.06 and 0.06 mg/l for Cu at the season of 2011/2012 and the season of 2012/2013, respectively.

With other meaning the general average of these nutrient concentrations (mg/l) along the period of this investigations work were 4.18, 1.10, 0.91, 0.94, 0.78 and 0.06 for N, P, Fe , Mn , Zn and Cu.

Data of Table (2) and Figures (5) and (6) showed the seasonal variations during 2011/2012, whereas at summer season that N, Fe, Mn, and Cu (mg/l) increased than their values at winter season.

On contrary trend, P and Zn showed decreasing in their values (mg/l) at summer season than their values at winter season. Whereas, their values (mg/l) at summer season were: N (3.30) , Fe (0.92) , Mn (1.80) , Cu (0.09) , P (0.81) and Zn (0.56) and their values at winter were : N (2.48) , Fe (0.89) , Mn (0.48) , Cu (0.03) , P (1.49) and Zn (0.90).

With respect to the seasonal variations during 2012/2013, data showed that at summer season N, P, Fe, and Zn (mg/l) increased than their values at winter season. On contrary trend, Mn and Cu showed decreasing in their values (mg/l) at summer season than their values at winter season. Whereas, their values (mg/l) at summer season were: N (5.75) , P (1.28) , Fe (0.92) , Zn (0.97) , Mn (0.28) , Cu (0.05) and their values at winter were : N (4.80) , P (0.80) , Fe (0.90) , Zn (0.69) , Mn (0.82) , Cu (0.06).

Extending El-Salam Canal to the semi-and arid desert of north Sinai, certainly represent a good attraction factor for human activities, which included agricultural practices and activities. Thus residual of mineral fertilizers, used during agricultural practices, percolates after irrigation processes to agricultural drains and represent the main source for nutrients exist in water of El-Salam Canal after mixing with the water of agricultural drains.

The recorded data in Table (2) for N and P - concentrations (mg/l) were in coincided with FAO (1985), Shaban (1998), Mostafa (2001) and Sallam et al. (2008). As stated by Somaya et al. (2002) these contents of N and P be considered blow the critical limits. The investigated contents of Fe, Mn and Zn (mg/l) in Table (2) were, also, below the maximum ranges as reported by FAO (1992).

Heavy metals:

Data in Table (2) and Fig (7) showed that Pb concentration (mg/l) was ranged from 1.35 to 1.72 throughout the investigated seasons. Pb- mean concentrations were 1.37 at 2011/2012 and 1.58 at 2012/2013. Pb-concentrations recorded 1.38 & 1.35 (mg/l) at 2011/2012 and 1.72 & 1.44 (mg/l) at 2012/2013 during summer and winter seasons, respectively. Generally, the investigated contents were below the recommended maximum ranges of FAO (1992).

Also data of Table (2) and Fig (7) showed that, Cd-contents (mg/l) were ≈ 0.05 (mg/l). Non-effective differences were observed between Cd values neither at winter nor at summer for the two growth seasons of 2011/2012 and 2012/2013. The obtained Cd values can be considered

anomalous, and above the recommended maximum limit stated by FAO (1992).

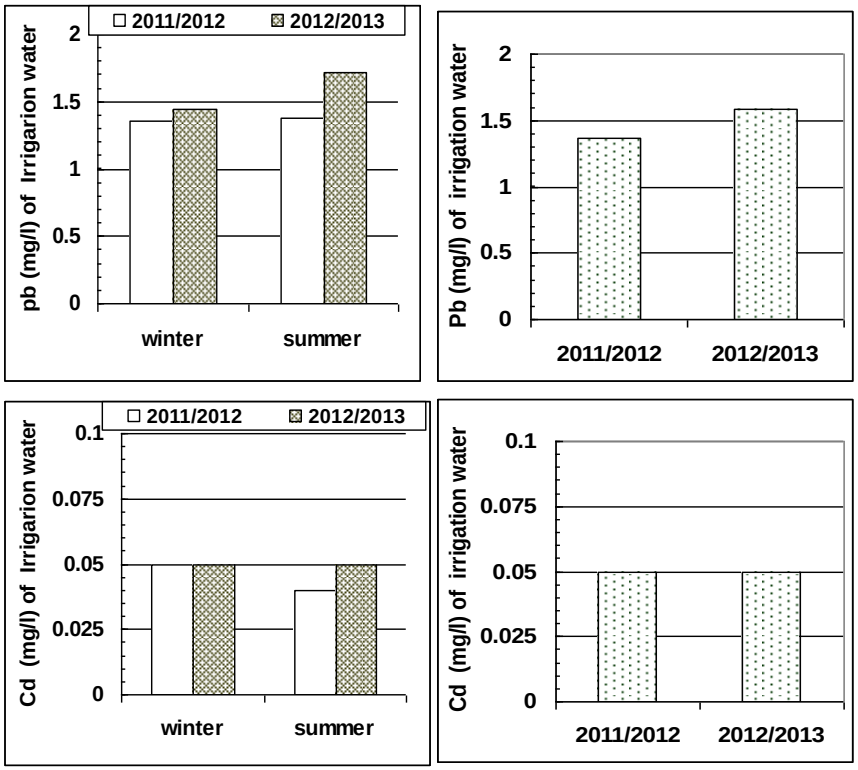

Fig (7): Seasonal and annually variations in the elemental ions (mg/l) of Pb and Cd of El-Salam Canal irrigation water.

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الصفات الكيمائية وحالة الأيونات المعدنيه لمياه رى ترعة السلام فى منطقة سهل الطينه (شمال سيناء)

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يهدف موضوع هذا البحث إلى دراسة التغييرات الموسمية والسنوية خلال صيف وشتاء العاميين المتتاليين 2011 / 2012 و 2012/ 2013 م فى الصفات الكيميائية وحالة الأيونات المعدنية فى مياه الرى لترعه السلام والتى تستخدم لرى الزراعات فى منطقة سهل الطينة بشمال سيناء. وتدل النتائج المتحصل عليها على :

تراوحت قيم درجة حموضة مياه ترعة السلام (pH) خلال فترة البحث بصفة عامة مابين 7.39 و 7.81 ممايدل على أنها مياه ذو قلوية بسيطة . وكانت قيم (pH) التربة تقارب 7.79 خلال عام 2011/ 2012 وتقارب 7.42 خلال عام 2012/ 2013 . وأظهرت النتائج زيادة قيم (pH) فى الصيف خلال عام 20111/ 2012 بينما كانت قيمها خلال عام 2013/2012 اعلى فى الشتاء . وعموما فهذه القلوية البسيطة لـ (pH) ترعة السلام تستطيع أن تتحملها معظم الزراعات.

تراوحت قيم درجة التوصيل الكهربى (EC) لمياه ترعة السلام خلال فترة البحث بصفة عامة مابين 1.63 و 3.77 ديسيمنز/م . وأظهرت النتائج زيادة قيم (EC) فى الشتاء خلال عام 20111/ 2012 بينما كانت قيمها خلال عام 2013/2012 اعلى فى الصيف . وهذه المياه بصفة عامة يمكن إستخدامها للرى فى الأراضى الخشنة القوام ذات نظم الصرف الجيدة .

لوحظ حدوث زيادة متدرجة واضحة فى كل من تركيز أيونات الصوديوم والكلوريد الذائبان فى مياه ترعة السلام بزيادة درجة التوصيل الكهربى (EC) للمياه وذلك خلال كل من عامى البحث.

فيما يتعلق بالتغييرات السنوية ، لوحظ زيادة فى تركيز كل الأيونات الذائبة ، فيما عدا أيونات المغنسيوم والبيكربونات ، فى موسم 2011/ 2012 عن موسم 2012/ 2013م

أما التغييرات الموسمية فى تركيزات الأيونات الذائبة ، فخلال عام 2012/2011 لوحظ زيادة فى تركيز كل الأيونات(ملليمكافىء/ لتر) ، فيماعدا أيونات البوتاسيوم ، فى الشتاء عن الصيف ... وخلال عام 2012/ 2013 لوحظ زيادة فى تركيز كل الأيونات(ملليمكافىء/ لتر) ، فيماعدا أيونات البيكربونات والمغنسيوم ، فى الصيف عن الشتاء.

وهذه التغيرات فى تركيز الأيونات الذائبة يمكن أن يرجع إلى عدة اسباب كزيادة النشاط الزراعى وسقوط الأمطار وزيادة عمليات الغسيل من الأراضى الزراعية وكذلك قد ترجع لزيادة البخر كنتيجة لزيادة درجات الحرارة.

نسبة الصوديوم المحتمل إدمصاصها من محلول التربة بواسط التربه (SAR) تستخدم لتقييم الأضرار المتوقع حدوثها لخواص التربه المرويه بهذه المياه مما بها من أيونات الصوديوم ذائبه

والـ SAR كانت قيمها المتحصل عليها خلال عام 2011/ 2012 أقل من تلك المتحصل عليها خلال عام 2012/ 2013 ... والـ SAR كانت قيمها المتحصل عليها خلال عام 2011/ 2012 أقل فى الصيف عن الشتاء ، بينما لوحظ العكس خلال عام 2012/ 2013 .

وبصفة عامة فإن قيم الـ (SAR) لمياه رى ترعة السلام تتراوح من 6.15 إلى 12.25 وهى نوعية يمكن إستخدامها بأمان فى رى الأرضى خشنة القوام لأنها أقل من 18.

فيما يتعلق بالأيونات المعدنية فى مياه الرى لترعة السلام والتغييرات السنوية فيها ، لوحظ زيادة الأيونات المعدنية لكل من الفوسفور والحديد والمنجنيز بينما قلت تركيزات كل من الأيونات المعدنية لكل من النتروجين والزنك ولم يحدث تغيير ملحوظ لأيونات النحاس وذلك خلال موسم 2012/2011 مقارنة بموسم 2013/2012 .

وبالنسبة للتغيرات الموسمية فقد لوحظ فى خلال عام 2012/2011 أن كل الأيونات المعدنية فيما عدا الفوسفور والزنك زادت فى الصيف عن الشتاء... بينما فى خلال عام 2013/2012 فإن أيونات النتروجين والفوسفور والحديد والزنك زادت فى الصيف عن الشتاء فى حين كل من أيونات المنجنيز والنحاس قلت فى الصيف عن الشتاء.

وبصفة عامة فإن تركيز كل من الأيونات المعدنية المدروسة كانت كلها أقل من الحدود القصوى (الحرجه).

وقد أظهرت النتائج أن متوسط تركيز عنصر الرصاص فى مياه الرى لترعة السلام خلال عامى الدراسة كان يتروح من 1.38 : 1.35 (ملليجرام / لتر) خلال عام 2011/ 2012 و 1.72 : 1.44(ملليجرام / لتر) خلال عام 2013/2011 أثناء فصلى الصيف والشتاء على التوالى . ولكن لم يلاحظ تغييرات مؤثرة فى محتوى مياه ترعة السلام من عنصر الكادميوم . وعموما فإن تركيز الكادميوم (تحت ظروف الدراسة) كان أكبر من الحدود المسموح بها.

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