Al-Qadisiyah Journal of Agriculture Sciences (QJAS)- Vol.8 NO.2 (2018)
ISSN Print (2077-5822) ISSN Online (2618-1479)

The EffectofThermodynemic ParametersontheRlationship Between Exchangeable Sodium Percentageand Sodium Adsorption Ratioin Saline Soilof Iraq Central.

Safa Mahdi AbdulKadium
College of Agriculture/ University of AL-Qasim Green

Submission Track
Received : 12/11/2017
Final Revision :12/12/2017
Keywords
saline soil Thermodynamic, exchangeable sodium percentage, sodium adsorption ratio.
Corresponding
Ahmed89mahdi@yahoo.com

Abstract
The study was conducted to determine the relationship between the exchangeable sodium percentage ESP and sodium adsorption ratio SAR in the soil solution. Some saline affected soils were selected at the locations Yosifya, Muwayliha, Imam, Eychreesh, Mahaweel, Ejbalah, Abe-Ghragg, Kifil, Elseneya and Eldagharaah. Using thermodynamic criteria to recalculate throught description quantitative concepts rather than analytical.The results indicate that the values of SAR range from 0.96 - 26.80 (cmol $Kg^{-1})^{0.5}$ of the studied sites and this ratio increased when taking into account free ions 3.52 - 32.7 (cmol $Kg^{-1})^{0.5}$. The ESP Calculated laboratory was (2.0 - 9.0 %) and all of these were less than ESP % according to laboratory salinity accounts, and generally show increase in the values of the proportion of ESP with increased SAR according to the approved indicators. The probability of these soils turning into sodic is unlikely to decrease pH and HCO_3^{-1} values and increase concentrations of calcium and magnesium ions.
The statistical results indicated that in order to predict soil ESP based on soil SAR the linear regression model for predicting soil ESP from SAR. ESP=1.95+1.05SAR with R^2=0.92 can be recommended.

Introduction:

Saline-affected soils are characterized by varying morphological and physiochemical characteristics depending on the ecosystems they form. Anions affect the behavior and adsorption of soil solution catIons. Due to importance of the dynamic cation movement in the soil solution, the interaction between anions and cations has a role in soil and water management (1). Therefore, recent studies have resorted to the use of thermodynamic concepts in the quantitative description of chemical phenomena as ionic forces played an effective role in the speed of release and adsorption for the ions (2).

Two different criteria are recognized in literature as indicates of salinity.These are the Exchangeable Sodium Percentage (ESP) indicator is the best expression of sodium risk in soil, which reflects the saturation of exchange sites of sodium soils(3).

$$ESP = \frac{Exchangeable\ Na}{CEC} \times 100$$

and the sodium adsorption ratio (SAR), which expresses the accumulation of sodium ion in soil solution relative to calcium and magnesium ions.

$$SAR = \frac{Na}{\sqrt{\frac{Ca+Mg}{2}}}$$

(4) noted that increasing the sodium content leads to the clinging of minutes and the breakdown of their structure. The measurement of exchangeable cations concentrations in saline soil remains problem.In this situation,relationships among exchangeable sodium percentage(ESP) and sodium adsorption ration (SAR) it may be more appropriate and economical. Many of the approximate relationships between SAR and ESP have been derived, including the American salinity laboratory .

ESP = [100 (- 0.0126 + 0.01475 SAR) / 1 + (- 0.0126 + 0.01475 SAR).

The use of such relationships was important because of the difficulty of estimating ESP in addition to the efforts and time to perform laboratory analyzes. (5) noted a fundamental problem in the relationship between ESP and SAR because of the difference in the differential coefficient of ion exchange reactions in saline-affected soils as they differed according to ionic power.(6),this suggested a model for the relationship between ESP and SAR.(7) noted that the increase in ionic strength leads to the preference of Ca^{+2}ion due to the pressure of the double spreading layer and the calcium movement.

Because of the importance of the thermodynamic parameters in the ESP and SAR section, which are considered in terms of efficiency rather than analytical focus, ESP and SAR have been recalculated and the experimental relationship was established before and after the calculation of these criteria.

Materials and methods:

Soil samples (0-30) cm were collected from different sites representing some of the saline soils in central Iraq (Yusufiya, Muleha, Imam, Ajrash, Mahaweel, Jiblah, AbiGaraq, Kefal, Sunni andDaghara). The samples were aerosolized and then grinded and passed from a 2 mm diameter sieve. Chemical analyzes was performed for the saturated paste extract.ECe,pH,(Na^{+}, Mg^{+2}, Ca^{+2}, SO_4^{-2}, HCO_3^{-}) ions (8). The exchangeable ions according to (9)Na^{+}, Mg^{+2}, Ca^{+2} ions in the ionic force method.

The thermodynamic values were calculated according to (10) which is based on the concentration, nature and density of ions.

$$I = \frac{1}{2}\sum c_i z_i^2$$

whereas:-

I=ionic strength

Ci=concentration ($mols^{-1}$)

Zi=ion charge

Efficiency coefficient according to the equation Debye - Hockel extended equation (11)

$$\text{Log } x = \frac{AZi^2\sqrt{I}}{1+BD\sqrt{I}}$$

Whereas:

Log x:activity coefficent

A:aconstant=0.509 for aqueous solution

Zi^2:ion charge

I:ionic strength

B: 0.328 at $25C^0$

D:ion size

Since the ion pairs with SO_4^{-2} were extensive with multivalent cations but slight with univalent (12). These parameters were calculated as the output of the(13) program and was based on the concentration of free ions and not the analytical concentration. Therefore, SAR was recalculated based on these new concentrations which took into consideration the ionpairs.

Result and discussion:

The data in table I Indicated that there are obvious differences in the salt concentration and ionic composition of the soil samples

Table 1. Shows the results of the chemical analysis of the saturated paste extract.

Location	ECe dSm^{-1}	pH	Ca^{+2}	Mg^{+2}	Na^{+}	SO_4^{-2}	HCO_3^{-}	CEC $(cmol\ Kg^{-1})^{0.5}$
			MmL^{-1}					
Yosifya	4.3	7.4	10.2	6.4	12.1	16.1	2.05	20.39
Muwayliha	22.3	7.6	41.0	83.0	65.0	30.0	1.99	28.0

Al-Qadisiyah Journal of Agriculture Sciences (QJAS)- Vol.8 NO.2 (2018)
ISSN Print (2077-5822) ISSN Online (2618-1479)

Imam	8.2	7.5	16.5	13.1	31.0	30.0	1.4	29.42
Eychreesh	32.6	7.8	45.0	40.0	66.0	25.1	1.12	38.65
Mahaweel	9.5	7.5	20.5	10.1	41.5	33.7	2.15	23.86
Ejbalah	7.0	7.5	14.4	10.5	29.7	22.7	2.3	24.50
Abe-Ghragg	8.3	7.4	8.3	5.3	17.3	26.3	2.4	20.4
Kifil	17.8	7.8	13.4	19.0	150.0	15.2	2.6	23.0
Elseneya	6.2	7.5	14.1	11.2	52.0	35.2	2.3	18.70
Eldagharaah	15.5	7.6	19.0	19.5	100.0	24.6	2.8	20.38

It is noted that the studied soils are between (11.3 and 23.6)dSm-¹, so the probability of them being turned into sodic soils is not possible because of the absence of $CO_3^{-2}$and, the reduction of the $HCO_3^-$and pH ratio for the indicators adopted for the sodic soil, and the most important,soil content high concentration of calcium and magnesium.

Table 2 shows the values of free Ions obtained from the outputs of the ion pair program. These are generally observed to be less than the analytical concentration. This is due to the ion pairs, which are the highest values inmultivalent ions, especially calcium ions, magnesium, and high sulfate according to the principle of ion pars (12).

Table 2. Main free ions in the saturated extract of mM L $^{-1}$

Location	Ca^{+2}	Mg^{+2}	Na^{+}	SO_4^{-2}	HCO_3^{-}
Yosifya	6.79	4.49	11.80	10.99	1.90
Muwayliha	32.39	30.23	64.26	13.82	1.57
Imam	10.94	8.93	30.43	15.53	1.36
Eychreesh	34.91	31.26	65.96	14.97	0.87
Mahaweel	14.72	7.16	40.84	13.78	2.24
Ejbalah	4.90	6.87	29.08	17.34	2.10
Abe-Ghragg	5.51	3.68	17.01	10.89	2.26
Kifil	7.24	12.95	146.97	23.02	2.38
Elseneya	9.00	7.46	24.50	15.95	2.10
Eldagharaah	10.93	12.62	97.67	85.54	2.52

The soil ESP-cal values were compared with the soil ESP values determined by laboratory tests are shownin Table 3

Table 3. Chemical properties used in evaluating soil ESP-SAR model

Location	SAR	SAR-FI	ESP	ESP-Cal
Yosifya	2.96	3.52	2.00	3.00
Muwayliha	7.32	7.90	3.10	8.70
Imam	5.70	6.91	4.68	6.67
Eychreesh	7.26	8.11	3.50	3.73
Mahaweel	7.54	8.80	4.67	8.99
Ejbalah	5.94	7.45	3.64	8.59
Abe-Ghragg	4.67	5.66	4.83	5.32
Kifil	12.00	19.12	7.30	14.08
Elseneya	5.00	6.88	4.37	5.67
Eldagharaah	16.12	22.48	9.05	18.38

Al-Qadisiyah Journal of Agriculture Sciences (QJAS)- Vol.8 NO.2 (2018)
ISSN Print (2077-5822)   ISSN Online (2618-1479)

The SAR values ranged between (2.96 - 26.80) cmol Kg-[1]for the studied sites while they were between (3.52 - 32.7)cmol Kg-[1]for the sites of Yosifya and Kifilafter taking into account free ions calculated according to the thermodynamic concepts.

The calculated ESP values ranged between(2.0 - 9.0)%, whereas these values and all sites are less than those obtained according to the US Salinity Laboratory calculations ranging between (3.0 - 27.67)%.

Linear regression model based on sodium Adsorption Ratio was used to predict soil Exchangeable Sodium Percentage ESP-Cal.=0.2595+1.1505(SAR) with R^2=0.938.Therefore,the soil ESP-SAR Model can provide an easy, economical method to estimate soil ESP (Fig 1).

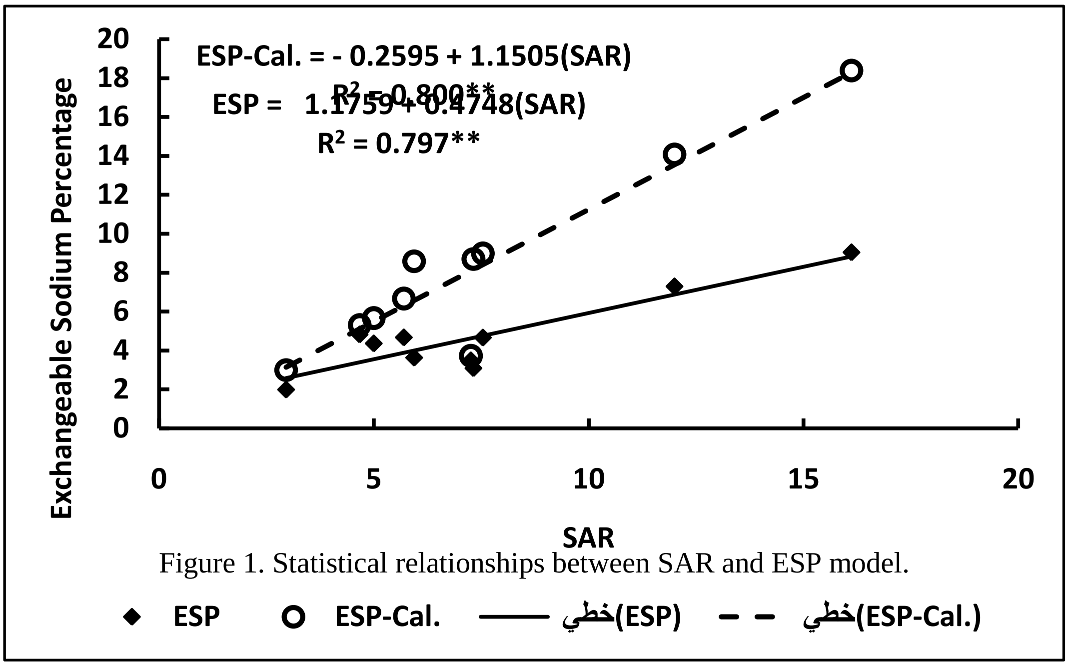
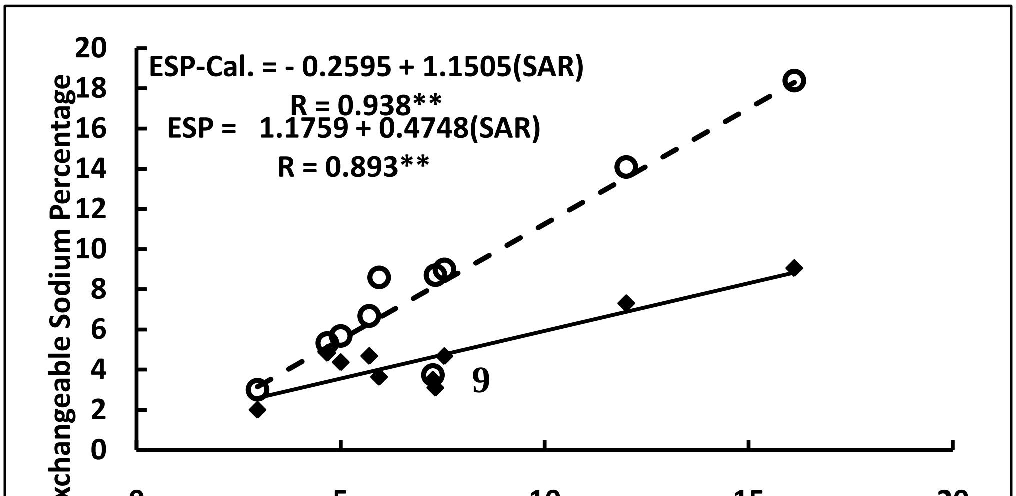


Figure 1. Statistical relationships between SAR and ESP model.



Al-Qadisiyah Journal of Agriculture Sciences (QJAS)- Vol.8 NO.2 (2018)
ISSN Print (2077-5822)   ISSN Online (2618-1479)

References:

1-Ragab,A. A. M , F. A.Hellal and M .Abd El-Hady. (2002). Water salinity impacts on some soil properties and nutrients uptake by Wheat plant and calcareous soil, Austr. J. Basic and Appl. Sci. 2(2): 225-233.

2-Abdulkadum, S.M. (2016). Ionic strength and activity in some soils Affected by salinity. Euphrates J. Agric. Sci. 3th Agric. Conference: 220-224.

3-Quirk J. P. (2001). The significance of the threshold and turpidity concentrations in relation to sodicity and microstructure. Austr. J. soil Res. 39:1185-1217.

4-Hoffman, G. J. (2010).Water quality eriteria for irrigation. EC.782. University of Nebraska, Lincoln Extension.

5-Endo,T. S.; Yamamoto,T. Honna and A. E. Eneji. (2002). Sodium calcium exchange selectivity as in fluenced by clay minerals and composition. Soil Sci.167(2): 117-125.

6-Rashidi, M. and M. Seilse pour. (2008). Modeling of soil exchangeable sodium percentage based on soil sodium adsorption ratio. ARPN J. Agri. Bio. Sci. 3(4): 22-26.

7-Ali, A. H. and M. M. Yassen. (2017). Role of some properties of Basrah soils on the relation ship between exchange able sodium Percentage (ESP) andsodium adsorption ratio (SAM). Iraqi J. Agri. Res. 22 : 67-80.

8-Page, A. L.; R. H. Miller and D. R. Keeney. (1982). Methodsds of soils analysispart 2: Chemical and microbiological properties. Agron series NO.9Amer. Soc. Agron.Soil Sci. Soc. Am. Inc. Madison, USA.

9-John Ryan, G. A and A. Al-Rashid. (2003).International center for agricultural research in the dry areas (ICARDA)Aleppo. Syria. National agricultural research center (NARC) Islamabad.Pakistan.

10-Wolt, H. D. (1988). Solution chemistry appliction to environmental Sci.and agric.John Wiley and sons.Inc.Newyork.

11-Sposito , G. (2008). The chemistry of soils, second edition, Oxford Uni.press.

12-Adams, F. (1971). Jonic concentration and activities. Soil sci. Amer. Proc. 35: 42.

13-Abed, M. A. (2002). Program to calculation pairs using Excel 79 and compeer it with Adams,1971 and Wolt,1988 program Al-Buhooth Al-Tachanya. 15 J. 103.

تاثير المعلمات الحرارية على العلاقة بين نسبة الصوديوم ومعدل امتزاز الصوديوم في التربة الملحية في العراق

صفا مهدي عبد الكاظم
كلية الزراعة / جامعة القاسم الخضراء

الخلاصة

اجريتالدراسةلتحديدالعلاقةبيننسبةالصوديومESPونسبةامتزازالصوديومSARفيمحلولالتربة.
وقدتماختياربعضأنواعالتربةالملحيةالمتأثرةفيمواقعيوسيفياوالمويليحةوالإماموشريشومحاويلوإقبالهوأبيغراغوكيفلواللسينيةوالضبارة.
باستخدامعايير الديناميكاالحراريةلإعادةحسابالمفاهيمالكميةالوصفيةبدلاًمنالتحليلية.
تشير النتائجإلىأنقيمSARتتراوحمن 0.96 إلى 26.80 (cmol Kg-¹) ° •
5منالمواقعالمدروسةوهذهالنسبةتزدادعندالأخذبعينالاعتبارالأيوناتالحرة 3.52 - 32.7 (5 • ° Kg-¹) cmol.

Al-Qadisiyah Journal of Agriculture Sciences (QJAS)- Vol.8 NO.2 (2018)
ISSN Print (2077-5822)   ISSN Online (2618-1479)

كانالمختبر المحسوب9.0 - 2.0) ESP ٪) وكلهذهكانتأقلمن ESP ٪ وفقالحساباتالملوحةالمختبرية،وتظهر عموماز يادةفيقيمنسبةESPمعز يادةSARوفقاللمؤشر اتالمعتمدة. ومنغير المحتملأنيؤدياحتماليةتحولهذهالتربةإلىسوديكإلىخفضقيمالأسالهيدروجينيو HCO_3^{-1}وزيادةتركيز اتأيوناتالكالسيوموالمغنيسيوم. وأشارتالنتائجالإحصائيةإلىأنهمنأجلالتنبؤبالتربةESPالمبنيةعلىالتربةSARنموذجالانحدار الخطيللتنبؤبالتربةESPمنSAR. يمكنالتوصيةباستخدام$ESP = 1.95 + 1.05SAR$مع$R^2 = 0.92$.

الكلمات المفتاحية : التربةالمالحةالحرارية،نسبةالصوديومالقابلةللصرف،نسبةامتصاصالصوديوم.