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Effect of *Cladophora crispate* Extract on Potassium Release from soil

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Abstract: Two soil samples were selected based on the difference in particle size distribution, included fine texture (clay loam) and coarse texture (sandy). Laboratory experiment was conducted by treating both the two samples by four concentrations of *Cladophora crispate* extract (0,1,2,3 g/l) to evaluate the ability to release soluble and exchangeable potassium. The tested soil samples varied in soluble and exchangeable potassium content which ranged between (0.2-1.12) and (0.1-0.79) Meq/l for fine texture and coarse texture, respectively and greater amount for released potassium was in the concentration of 3g/l for fine which was higher in fine than coarse texture. The results showed linear increment in potassium phases (soluble, exchangeable and available) with the increase of algae extract concentration

Keywords: Available potassium , *Cladophora crispate*, algae extract , soil texture

Iraqi soils characterize by high store of potassium content but is unavailable because its retention between layers of clay minerals such as mica and smectite (Alzubaidi 2003) . The soil texture is important factor effecting on potassium availability (Anderson et al 2007). Fixation of potassium is major problems in Iraqi soils and that lead farmers to apply high quantities of potassium fertilizers to covering plant need from this macroelement but this undesired way because the risks of soil pollution and salinization (Aderhold et al 1996, Murphy et al 2005). The new trend of clean agriculture in the world requires reduce the use of potassium fertilizers by evolving technology which make the K available from soil to the crops (Safinaz and Ragaa 2013). Release of fixed K (unavailable) to the exchangeable and soluble forms(available) occurs when the amount of exchangeable and soluble K are reduced by plant uptake, leaching and perhaps by rises in microbial activities (Sparks 2000). Algae extract has been reported as a beneficial treatment as a soil conditioners which improve nutrients availability and this can reflect on the plant through increase of growth, yield and productivity (Norrie and Keathley 2006). Algae extract mixture consisted of wide range of active compounds including (organic acids amino acids, vitamins, hormones and enzymes) can react with minerals and rocks (Al-shakankerya 2014). The present study aimed to illustrate the role of different concentrations of algae extract on fixed potassium release from soil minerals in to the soil solution.

MATERIALS AND METHODS

Study area: The study was conducted at Misan University, Misan province/Ammarah city ,Iraq (N 31026- 56.62= - 310 27- 7.328= latitudes, E 470 43- 14.138=- 470 55- 3.961=longitudes) . The climate of the area is hot and dry in summer and cold with moderately rainfall in winter. The mean annual precipitation less than 100mm.The parent material of soils is alluvium rich in calcium carbonates, soils in the study area are classified as Entisols. The soil moisture and thermal regimes are torric-Aridic (Figure 1).

Physical and chemical properties of soils: The soil samples was collected from an agricultural field from depth of 0–15 cm**,** were air-dried, crushed, sieved with a 2 mm sieve and subjected to the physical and chemical analysis (Table1). The particles size distribution of the soil samples was performed according to Piper (1950) and organic matter of the soil samples by Walkely-Black method (Jackson 1973). Calcium carbonate was measured by the calcimeter method according to Nelson (1982). Soil pH was measured in 1:1 water: soil suspension using a glass electrode as reported by Mclean (1982). The electrical conductivity (EC) and soluble ions were estimated in the saturated soil paste extract using a conductivity meter (Jackson 1973). The cation exchange capacity (CEC) of the soil samples was calculated using NaOAC at pH 8.2 as a saturating solution and NH4OAC at pH 7.0 as a displacing solution, and then sodium was measured by flame photometer (Jackson 1973).

Algae isolation and identification: The classification of

algae was done according to Prescott (1975). The classification show that the sample be accustomed to green algae called *Cladophora crispate*. The enough quantity of sample spread on clean clothes cut to dry in laboratory temperature until complete dryness, grinding by electrical grinder and kept in clean container in the refrigerator until extract preparation.

Preparation of algae extract: Algae extract was prepared by solubilized 5g from algae powder in 100 ml of ethanol 70 percent. The extraction process conducted by using magnetic stirrer for 24 h followed by filtration process using 0.45µ opening diameter filter paper. The, filtrate was put in petri dishes exposed to air under natural conditions in the laboratory to allow alcohol to volatile and the residual extract collected which represent the algae extract which kept in refrigerator (Obaed 2015).

Experimental design and treatments: This experiment carried out with completely random design (CRD) with two factors first is soil type include clay loam and sandy texture and second factor is the four concentration of algae extract (0 , 1 , 2 , 3 g/l). Each treatment was replicated thrice.

Addition of algae extract to soil samples: 10 g of air dried soil sample precisely weigh and placed in 25ml conical flask and then required concentration of algae extract was mixed with the soil and left for 24 hrs in incubator before determination of available potassium s (soluble and exchangeable (Page 1982).

RESULTS AND DISCUSSION

The two soils belong to Entisols and were calcareous and alkaline. The particle size distribution of soil samples shown that ranged from 343–908 g/kg, 35–312 g/kg and 57-445 g/kg for sand, silt, and clay respectively, with $CaCO_3$ content and pH ranged from 110 to 230 g/kg and from 7.1 to 7.6 respectively (Table 1). Organic matter constituted 14–50 g/kg of the soils and highest was for fine texture**. T**these results agreed with many studies refers to the differences in soil texture impacts organic matter levels because of organic matter breaks down faster in sandy soils than in fine textured soils within given same environmental conditions and soil fertility, because of a higher percentage of oxygen available for decomposition in the coarse textured sandy soils. Cation exchange capacity ranged from 12 to 26 cmol/kg with the higher value in fine texture sample compared with coarse texture sample, the cation exchange capacity of the soil increases with percent clay and organic matter (Palm and Sanchez 1990 , Marbet et al 2001). All soils were non saline according to its electrical conductivity (EC) values which ranges between 0.13 to 0.61 dc/m were the fine texture has higher value (Table 1)**.**

Table 1. Chemical and physical properties of soil samples

Property	Fine sample	Coarse sample
physical		
Clay (g/kg)	345	57
Silt (g/kg)	312	35
Sand (g/kg)	343	908
Texture class	Clay loam	Sand
chemical		
pH	7.6	7.1
EC (dS/m)	0.62	0.13
Soluble Ions (Meq/l)		
Ca	2.2	0.9
Mg	0.4	0.1
Na	0.6	0.3
K	0.2	0.1
Cl	0.9	0.4
CO_3	Nil	Nil
HCO_3	2.6	0.7
SO_4	0.6	0.2
Organic matter (g/kg)	50	14
$CaCO_3$ (g/kg)	230	110
CEC (Cmol/kg)	26	12

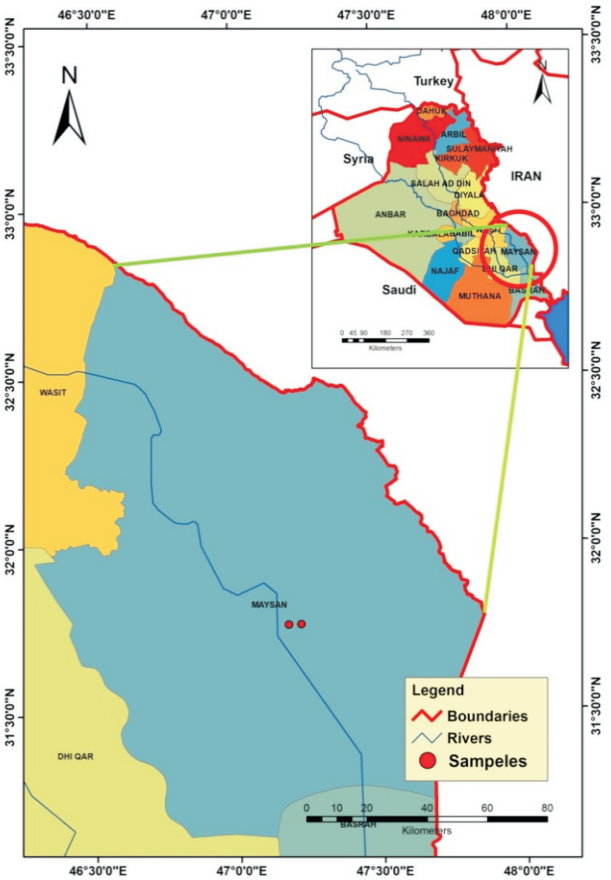

Fig. 1. Study area

Table 2. Effect of algae extract concentration on potassium phases concentrations and percent increase

Soil samples	otassium phases concentration (meq/l)											
	Soluble potassium				Exchangeable potassium				Available potassium			
	0	1	2	3	0	1	2	3	0	1	2	3
Algae extract concentration (mg/l)												
Fine texture	0.2	0.31	0.41	0.5	0.35	0.46	0.53	0.62	0.55	0.77	0.94	1.12
Coarse texture	0.1	0.13	0.21	0.36	0.13	0.15	0.24	0.43	0.2	0.3	0.5	0.8
Percent increase (%)												
Fine texture		55	105	150		31	51	77		40	71	104
Coarse texture		30	110	260		15	85	231		22	96	243

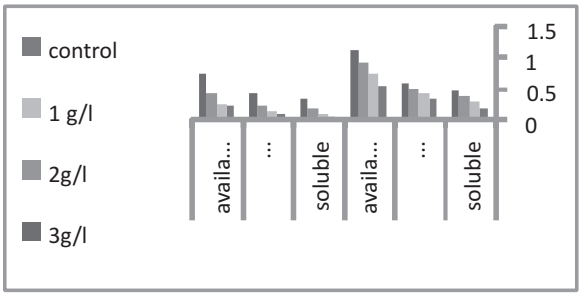

Figure 2. Effect algae extract concentrations on potassium phases concentration for studied soils

Effect of Algae Extract Concentration on Potassium Availability

Fine texture: The results showed that there is linear increase in available potassium (soluble, exchangeable and available) with the increasing of algae extract *Cladophora crispate* concentrations. The soluble potassium at 3 g/l of extract was 0.5 meq/l for fine texture with increase of 150 per cent over the control (Table 2, Figure 2). This may be due to the effect of biochemical compounds in the extract that solubilize the potassium and resulted in more release of non-available potassium. Many researchers also obtained similar results (Rathore et al 2009, Sathya et al 2010, Kumar and Sahoo 2011, Chaiklahan et al 2013, Al-shakankerya et al 2014) . Similar trend was registered for exchangeable potassium which increased to 0.62 Meq/l as compared with 0.35 Meq/l for control treatment. The exchangeable K was high as compared with soluble K. The available potassium have been estimated by sum of two phases (soluble and exchangeable) and the similar trend was observed with increase from 0.55 to 1.12 Meq/l at the higher concentration (3g/l). This is due to the ability of algae extract to solubilize of potassium from K- bearing minerals and release more quantity of both soluble and exchangeable K which represent total quantity of available potassium.

Coarse texture: Same trend was observed as fine texture but was lower because the difference in clay and silt fraction percentage which was lower in coarse texture (Table1) and this results agree with Mengel and Kirkby (2001)and Al-Zubaidi (2001). The higher concentrations for potassium phases was registered in the higher level of algae extract (3g/l) being 0.36, 0.43 and 0.79 Meq/l for soluble, exchangeable and available potassium, respectively.

CONCLUSIONS

Algae extract concentration have precursor role on potassium availability by releasing it from the layers of clay minerals through some biochemical reactions between some active compounds including in algae extract and the element in mineral sheets. This effect more clearly in high concentrations where the results show linear increasing between extract concentration and quantity of soluble , exchangeable and available potassium. The texture of soil have a significant effect on the potassium phases concentration and more concentration of potassium release appear in clay texture and low in coarse texture.

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