The potassium storage & adsorption ability to some of the agricultural kufa lands.

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abstract:
The K+ ion forms were studied firstly in the five locations of agricultural Iraqi calcic soils followed classified as turrifuvents group of Kufa city located in coordination's table(2) the results showed the amount of soluble K+ (0.03-0.09) mg.l-1 exchangeable (1.15-1.45)mg.Kg-1, K+ total (24-50) mg.g-1soil, the ionic storage amounts determined via the thermodynamic function (ΔF) the replacement energy of K+ it ranged from (-2750) to (-2578) Cal.M–1 secondly, So the soils had huge Howard ionic capacity of K+ enough to more than decade it should be released to cover some of the growth of the crop needs to K+ ions at a season. However, the adsorption process described by the Freundlich equation, that equation had a good description of the adsorption process with a high value of (R^2=0.93), less than (SE=0.39). Adding K_2SO_4 achieved a good response with (yield properties , and K+ content) to wheat plants in the agricultural trial.

Keywords: ion potassium forms, the ionic storage (ΔF), Freundlich equation,the wheat yield& K+ content.

Introduction :

There was no doubt Potassium is an essential element for crop production and productivity. it was required for the activation of over 60 enzymes involved in the formation of carbohydrates, translocation of squares, various enzyme actions, yield, quality parameters, tolerance to certain diseases, mechanisms to overcome abiotic stress, cell permeability, and several other functions (8). So that all plants are affected immediately by the availability of K+ ions as exchangeable and soluble forms. The availability of K+ is affected by the physical, chemical, and biological processes of soil. K+ ion's available capacity can be assessed using different techniques. However, the equilibrium among the potassium retained by the interlayer sites, surface and edge sites of mineral crystal, and potassium in soil solution also affect soil K+ adsorption potential. The mobility of soil potassium is affected by the dynamic equilibrium that exists in the soil system. This dynamic equilibrium is affected by clay minerals types, soil organic matter (OM), hydroxide aluminum, soil moisture status, caution exchange capacity (CEC), fertilization, and tillage system (1). Among these, the study of K+ adsorbing potential or transforming available K+ forms into unavailable ones is one of the techniques. Adsorption is the accumulation of a chemical species at the interface between the solution and the solid phase. It affects the mobility and fate of nutrients in the soil. Soil K+ adsorption potential depends upon the amount and type of clay minerals(3), (4 .(

ISSN 2072-3857

Methods and material:

Samples collecting: five different locations were collected in Kufa city from the soil surface (0-30cm) which was classified as the turrifuvents soil group (16). Samples analysis: chemical and physical properties analysis according to(9,12.(

-2Potassium supply expressed by the energy of replacement of K+ (ΔF)was calculated according to (3) as;

ΔF=RTln ARKº……… (1(

where as : ARK º=2.3RTlog aK *(aCa+aMg)^-0.5,

ARK º the equilibrium potassium activity ratio, aCa calcium activity, a magnesium activity(mole.l-1), R=gas constant, T=absolute temperature.

Potassium adsorption experiment: surface sample (5)gm was taken (100) ml plastic bottle after adding (0,50,100, 150,200) mmole.L-1 K+ prepared of K2SO4 solution and then shacked for 24h with150(R.M-1)quietly to prevent soil particle's from broking at 25±1 Cº. the precipitation had been done with 300(R.M-1) for 15mint then filtered by Whatman (42) paper to get the equilibrated extract

ions determination with flame photometer devices (17). The assessment of K+ adsorption capacity is a rather complex procedure and was calculated as follows isotherm equations: The concentration of Adsorbed K+=CK i – CKf ….(1) Where CK i = initial concentration of added K and CK f= the concentration of K+ in supernatant solution percent K+ adsorbed(%)

) =concentrations of K+ adsorbed × 100)/concentrations of added K. +

The K+ adsorption data were fitted into the following adsorption

-5The Freunditch equations and calculating:

Log Qe = log K f + 1\n log Ce ……………………………………. (2(

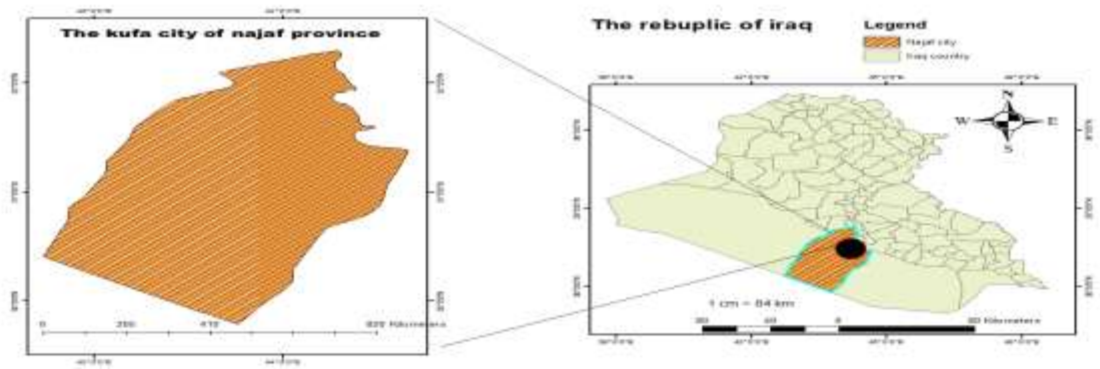
Qe = mg . g-1(material adsorbed amount(

K,f, ns equations constant depended on the nature of Absorbent, adsorbate, and temperature.

The field experiment:

To apply the (53% K2O)K2SO4 we added 60Kg\h for studied land with fertilization program (UREA 46%N the first before Wheat cultivation 200Kg\h, Tri Phosphate Calcium 45%P2O5160Kg\h one potion during cultivation with irrigation and crop service processing then residue three potions had been added at growth stages(branches & pre-flowering) beyond 40,75,90 days of germination via rates(20%,30%,30%)from totally N fertilizer .however the biological yield of dry straw material, grains yield and potassium content estimated with experimental design (R.C.B.D) randomized complete block design by three replicates. Meanwhile, the results statistically analyzed multi levels program at (p≥0.05)level to select the treatment mean (20.(

ISSN 2072-3857



Fig(1) the study area of potassium ions.

Tab(1) the soil properties.

site	PH	EC $ds.m^{-1}$	CaCO3 $gm.kg^{-1}$ soil	CEC c.mole/kg soil	O.M $gm.kg^{-1}$ soil	Silt $gm.kg^{-1}$ soil	Sand $gm.kg^{-1}$ soil	Clay $gm.kg^{-1}$ soil	Texture type
Z1	7.6	3.6	202	31.5	1.25	95	425	480	SC
Z2	7.5	2.8	208	32.1	1.07	139	468	393	SC
Z3	7.5	2.6	198	33.6	0.99	164	296	540	C
Z4	7.3	1.5	217	27.3	0.85	359	510	140	L
Z5	7.6	1.4	185	26.1	0.53	259	541	200	L

Tab(2)the potassium forms.

Site	Exchange mmol/litr	non-exchange mmol/kg soil	Total K mmol/kg soil	ARK $Mole.l^{-1}$	-ΔFCal. $mole.l^{-1}$	Coordination (x,y)
Z1	0.09	1.35	36	0.31	2750	Lat32°02´18"
Z2	0.07	1.25	39	0.42	2620	Lat32°03´13"
Z3	0.05	1.20	43	0.43	2611	Lat32°03´10"
Z4	0.03	1.15	24	0.52	2593	Lat32°02´35"
Z5	0.09	1.45	50	0.58	2578	Lat32°02´20"

Tab(3) the Freundlich equation factors.

Soil type	Freundlich equation	Correlation factor	logK f	1\n
Sandy clay	$y = 1.0551x + 0.0917$	0.92	0.092	1.06
Sandy clay	$y = 0.9386x + 0.1205$	0.85	0.120	0.94
Clay	$y = 1.0426x + 0.0704$	0.77	0.704	1.04
Sandy loam	$y = 1.0546x + 0.0178$	0.94	0.018	1.05
Sandy loam	$y = 1.028x + 0.0113$	0.91	0.011	1.03

ISSN 2072-3857

Tab(4) the yield properties.

No.	K^+ levels	straw	1000 grains	K^+ % straw	K^+ % grains
1	0	25	35	13	3.5
2	15	29	39	13	3.5
3	30	33	43	15	3.8
4	45	38	47	17	4
5	60	45	52	18	4.2
means	30	34	43.2	15.2	3.8
L.S.D0.05		6.81	5.64	1.28	0.17

The results & discussion:

Ptasosium forms:

The values are in general higher than that in other alluvial soils but the results showed the amount of soluble K+ (0.03-0.09)mg.l-1 exchangeable (1.15-1.45)mg.kg-1, Total K+ in the studied soil varied from (24-50)mg.Kg-1soil. (285) to (410) with the mean value of .((333.222) mmol 1.Kg-1 soil..that could be attributed to the presence of easily weatherable Mica and Illite of type of minerals bearing potassium. Generally, the Saline soil solution gives the supplying power of potassium in soil for long-term farming (2); (11

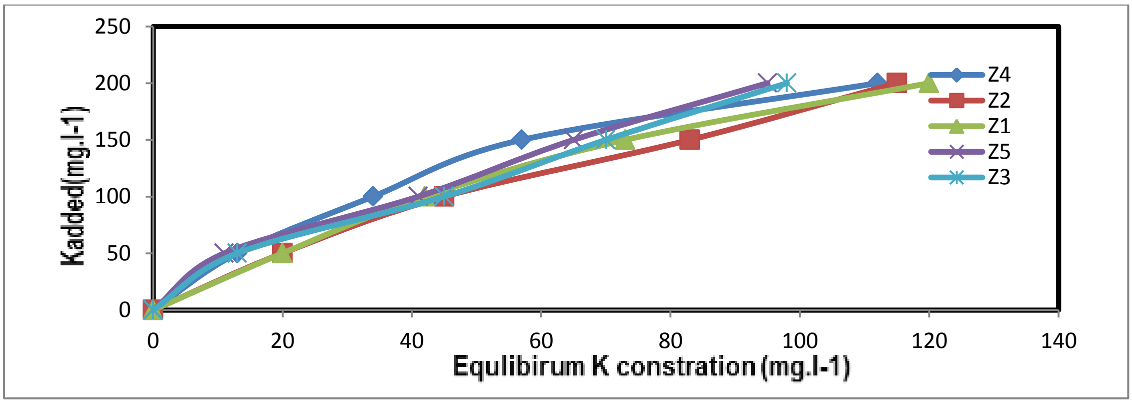


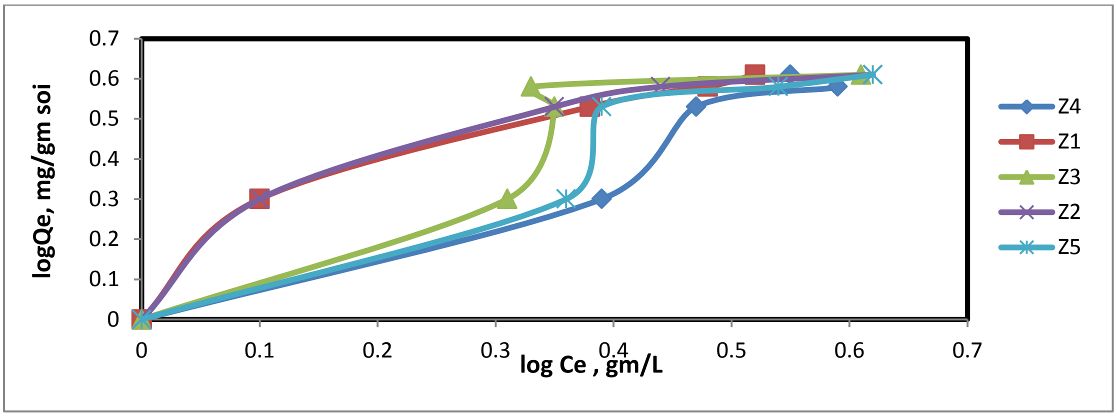
Fig (2) Potassium adsorption characteristics influence soil properties.

The added Kt (total potassium) adsorption curves:

potassium adsorption isotherms of the soils are represented in Fig (2) the soils showed noticeable variation in their K+ adsorption characteristics. The soils responded uniformly increase with increasing K+ concentration. For the initial concentration (0-50) mg.L-1 even high concentration (150-200) mg.L-1, K+adsorbed varied from 22% to 45% in low addition and 34% to 58% for the highest added concentration. the soils stepped as (Z2, Z1, Z3, Z4=Z5), however, the results indicated that K+ adsorbed greatly increased after the additions to the initial levels tend to

ISSN 2072-3857

light of the final levels increase and that related to all soils was including of (42,39,54) % clay fraction with (31,32,33)c.mo.Kg-1 of cation exchangeable capacity then recorded (1.25,1.07,0.99)% organic matter. high concentrate ions into soil compared with K+ adsorption increase of clay for added levels, then the biggest increase (4,7.(



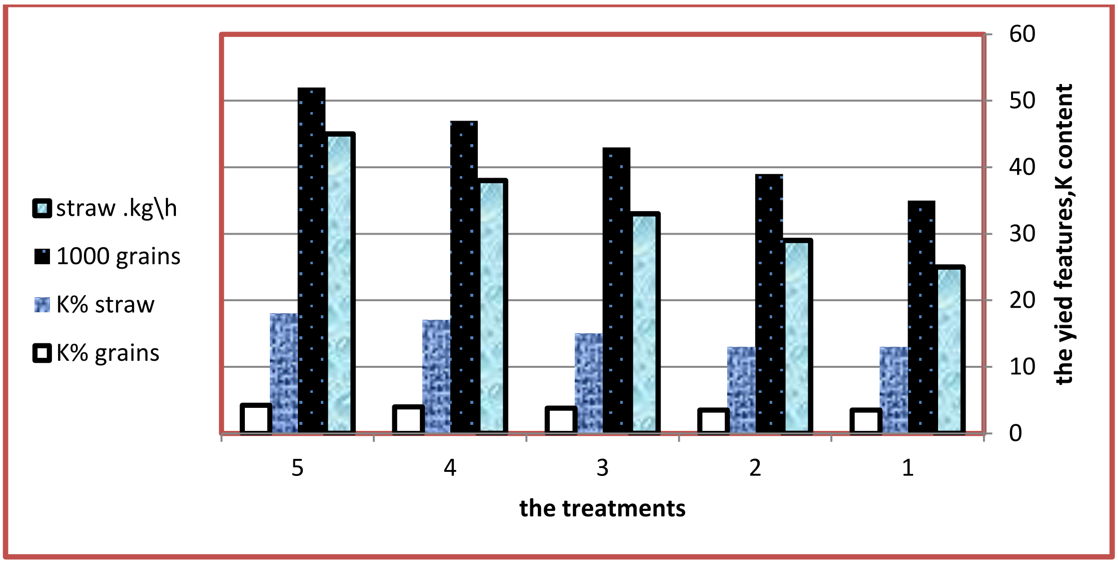
Fig(3) potassium adsorption response of study soils.

Woodruff scale classified different soils concerning the ability for potassium supply to plant according to –ΔF values as follows: soils are poor (deficient in available K+) in potassium supply have values (-4000)–(-3000) Cal. mol–1; soils with adequate potassium supply have –ΔF values (-3000)–(-2500) Cal. mol–1; rich soils (caused potassium toxicity) in potassium have –ΔF values less than (-2000) Cal. mol–1, so According to the previous division the–ΔF of studied soils reached about (-2750) to (-2578) Cal.M–1 in soils (Z1, Z2, Z3, Z4, Z5), receptivity.

The higher values of free energy observed in all soils are associated with other studies such as (18), and (20). that means all soils have an adequate good supply of potassium Intensive Farming application of any amount of potassium as fertilizer will cause a considerable change in –ΔF values to the range of rich potassium supply .

Equations and Describing Adsorption Processes:

Adsorption data were fitted to the Freundlich equation. Because it had more precision to describe the ionic adsorption on the heterogeneous surfaces of soil particles. So Freundlich isotherms assumed low adsorption energy, Their constants values (Kf and 1/n) showed (table 3) Kf values ranging (from 0.1-0.7)mg.Kg-1 these were low amounts against the primarily available K+ soil (table 1) referring to the part of those amounts hold on nonspecific sites that were ready to uptake from the cultivated plants but the other part of exchangeable K+ held on exchange sites by high binding energy. whatever the 1/n values ranged (0.94-1.60) mg.Kg-1 indicated that all these lies among (1-10) favored K+ sorption with big soil buffering capacity, but Z2 soil had high sand proportion tended to monolayer sites adsorption on molecules surface theory. The smaller values of 1/n also revealed great heterogeneity adsorption with decreasing clay of soil sandy clay to sandy loam texture.. (5); (10), (6 .(



The application experiment :
Tab (5), fig (3) referred to the potassium addition levels affecting the product features studied. General the increase of all study features followed to increase in fertilizer levels and the values reached (25-45)Kg\h via response ratio (44%), and (35-52)via response ratio (33%), Withal significantly proceeding to T5 vs others treatments with L.S.D.0.05 (6.81-5.64) straw, grains respectively. final that improvement came from too many reasons related to potassium ions' role physiological (protein formation, water organization, osmotic pressureofsapcell, plan features (type,family, density(clay minerals types, K+ content, fertilization, and tillage system) Besides the critical Initial content of K+ in field soil less than l40mg.K+ g-1(19,20.(

Potassium content:

Fertilizer addition of K2O (15-60)K g.h-1as K2SO4 made a significant increase of K+ content and straw, grains gradually. the values reached (13-18%)via an increased ratio (38%) of K+ straw content .meanwhile the values reached (3.5-4.2)via an increased ratio (20%) of K+ grains content T5 the best treatment vs the others with L.S.D.0.05 (1.28,0.17) straw, grains respectively.. Whatever the good response of the vegetable part (leaves, stems) reflected on the fruit part(grains)with total absorption due to this element addition(21,20 .(

The Conclusion and Discussion:

- The combination addition of 60 Kg/Dunum+Humic acid 2% is most fitful with studied soil features as K+ fertilization.
- Using water quality had (2-4) ds/m to irrigate those soils to encourage K+ release and availability in soil solution.
- Freundlich equation gave us a good description of the adsorption process on the heterogeneous soil surfaces (0.12,1.06) log f, 1/n to sandy claysoils .

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ISSN 2072-3857