The effect of agricultural Exploitation on the availability of nutrients N, P and K for soils of the middle Euphrates regions

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ABSTRACT

The study locations were chosen within the central Euphrates regions, which include the provinces of (Babylon, Diwaniyah, Karbala, Najaf, and Muthanna), which lie between longitudes 31.2926 to 32.9055 north and latitudes 44.0332 to 45.3845 east by UTM system, and 15 pedons were detected, Three pedons in each province, two for cultivated soils and One because five regions and three pedons for each region pedons for abandoned soil. Fertility traits results showed that the available nitrogen value ranged from 50.11 -15.51 mg kg^{-1},As for available phosphorous in the soil, it ranged between 27.22-7.76 mg kg^{-1}, and the values of available potassium ranged between 162.4 - 80.37 mg kg^{-1}. These available nutrients in the soil showed a difference between little, medium and high. The highest variance was the available nitrogen, followed by the available phosphorous and available potassium. As for the effect of agricultural use and location on soil traits, the results showed that the bi-interaction between the type of use and location had a significant effect.

Key words: Soil, Horizons, Orchards, Salinity, Alkaline, Extraction

Introduction

Pedological studies are the basis on which the rest of the sciences related to soil should be based, where these studies provide integrated information on the nature of soils and determine their various chemical, physical, mineral and fertility properties, classification and geographical distribution. Thus, it provides soil users with a wide range of information to make the right decision

ISSN 2072-3857

in the field of using this soil [5]. Many soils have not been subjected to pedological studies due to the lack of a clear and systematic policy for surveying and classifying Iraqi soils. Therefore, any pedagogical study of any region of Iraq is an important addition to the field of investing in the natural resources of this country. The aim is to know the effect of agricultural use on the availability of nutrients.

Materials and methods

Information was collected and some agricultural directorates visited the selected soil sites, as soils were identified in the central Euphrates province of Babylon, Karbala, Najaf, Diwaniyah and Al-Muthanna, according to the presence of palm orchards in those provinces. Fifteen pedons were discovered distributed by three pedons in each governorate, and their horizons were described in fundamental methods according to [15] .

- available nitrogen in the soil:

nitrogen in the soil was estimated according to the following:

- Ammonium N-NH_4:

The prepared ammonium was estimated in the soil by extraction with potassium chloride solution (2M) and for the use of magnesium oxide (MgO), which was distilled after evaporation and using the Microkjeldal device according to the method [9] which is presented in[4]

Nitrate N-$N0_3$: After the ammonium ion was obtained, the nitrate ion was reduced using a Devardy alloy, then distilled with a Microkjedal device according to the method [9] mentioned in [4] .

- available phosphorous in the soil: Soil phosphorus was extracted using sodium bicarbonate $NaHCO_3$ (0.5M) and PH 8.5, and the color of the extract was developed using spectrophotometry at a wavelength of 882 nm according to the method [11] and as mentioned in [12].

- available potassium in the soil: available soil potassium was extracted using ammonium acetate, and it was estimated using a flame photometer, as mentioned in [12].

Results and discussion

The effect of location and agricultural use on soil fertility

1- available nitrogen in the soil

The results of the statistical analysis in Table (1) indicated that the effect of the study location and the interaction between it and the horizons had a significant effect on the values of available nitrogen in the soil mg kg-1 soil, while there was no

ISSN 2072-3857

significant effect of the horizons on the values of available nitrogen.The effect of location 2 is represented in the Al-Diwaniyah province by giving the highest value of available nitrogen mg.N. kg^{-1}, which has a value of 41.79 mg. N . kg^{-1} soil, while location 5, represented by Al-Muthanna province, gave the lowest value for ready nitrogen, its value was 22.11 mg. N . kg^{-1} soil, with an increase of 89.0% There was no significant effect of horizons in this trait, where it is noted from the same table that the effect of the bi-interaction between the study location and horizons had a significant effect on the values of available nitrogen in the soil mg. N . kg^{-1} soil and the highest value of it was at the bi-interaction of the Al-Diwaniyah soils of the horizon Ap, which amounted to 44.72 mg. N . kg^{-1} soil, which did not differ significantly from the bi-interaction represented by Al-Diwaniyah soil of the C1 and C2 horizons, which had a value of 42.62 and 41.50 mg. N . kg^{-1} soil. While the bi-interaction represented by Al-Muthanna soil for the C3 horizon gave the lowest value of the ready nitrogen amounted to 20.35 mg kg^{-1} soil, which did not differ significantly from the bi- interaction represented by Al-Najaf soil for the C3 horizon, which amounted to 20.56 mg. N . kg^{-1} soil. The reason for the variation in the values of available nitrogen in the soil according to the different study sites and horizons may be due to the fact that the soil content of nutrients is very high, especially in the surface horizons due to the increase of organic matter in the surface horizons, which when decomposed works to release most nutrients, including nitrogen, especially that the soil be cultivated [7] The reason for this is due to the fact that the Ap horizon is the surface horizon with a good content of organic matter decomposed by microorganisms, in addition to the plants on the surface of the soil that add nutrients, especially nitrogen, which leads to an increase in this horizon compared to the rest of the horizons C1 And C2 and C3, which are free of plants and few roots, which add organic matter to the soil, and this concept is consistent with what they found [17] which indicated that organic matter is usually considered as a criterion for soil quality and biological transformations and is used as a source of information regarding soil management. The reason for this is also due to the fact that long-term and continuous cultivation causes a loss of available nitrogen and may not be compensated by mineral fertilization, which is either volatilized or fixed, and this was confirmed by [18] ,As a result, the availability of important nutrients for plant nutrition increases, and this is evident through the convergence of some values of nitrogen between the horizons, which led to no significant effect between them, while the surface horizon Ap is planted and residuals are present. This mechanism is consistent with what they found [7] with an increase in the availability of nutrients in the surface horizons as a result of the addition of plant residues and their presence on the surface of the soil.

Table (1) Effect of agricultural use and location of soil horizons of study on available nitrogen in the soil

average	**horizon**				**Location**
	C3	**C2**	**C1**	**Ap**	
28.15	25.01	27.34	29.30	30.96	Babylon
41.79	38.34	41.50	42.62	44.72	Diwaniyah
32.87	30.15	31.61	33.55	36.17	Karbala
23.48	20.56	23.89	22.25	27.21	Najaf
22.11	20.35	21.28	22.52	24.30	Al Muthanaa
average	26.88	29.12	30.05	32.67	
values LSD :Location:6.601 , *horizon :5.904 NS , interaction :13.202*					

2-available phosphorous in the soil

The results of the statistical analysis in Table (2) indicated that the effect of the study location and horizons and their interactions had a significant effect on the values of available phosphorous in the soil, with the exception of the moral effect of the horizons, where it was noted that the location had a significant effect on the values of available phosphorus in the soil mg.P. kg-1 soil, and its highest value was at site 2 within Al-Diwaniyah province, with the highest value reaching 20.67 mg. P . kg-1 soil, While the values of some sites in Babylon, Karbala, Najaf and Muthanna converged, which amounted to 15.47, 15.70, 14.84 and 14.56 mg. P . kg^{-1} soil, and it was noted that there was no significant effect of horizons in the values of available phosphorous in soil mg. P . kg-1 soil, It is also noted from the same table that the effect of the bi-interaction of the values of available phosphorous in the soil is amalgam. P . kg^{-1} soil It had a significant effect, and its highest value was at the bilateral interaction of Al-Diwaniyah soil for the C3 horizon, which reached a value of 21.78 mg. P . kg-1 soil, which did not differ significantly from the values of the binary interactions of

ISSN 2072-3857

Al-Diwaniyah soil of the horizon Ap, C1 and C2, whose values were 19.29, 20.40 and 21.23 mg. P . 1 kg soil each, respectively, While it is also noted through the results of the same table that the lowest value of the available phosphorous mg. P . Kg^{-1} soil was at the bi-interaction represented by the Muthanna soil of the C3 horizon, which was 12.58 mg. P . kg^{-1} soil, an increase of 73.13%,Perhaps the reason is that the available phosphorus decreases with the passage of time, especially if the soil contains a high amount of lime, because of its interaction with the components of the soil and with calcium carbonate, and that our soil has a high pH, which reduces the availability of phosphorus, and it is one of

the unready elements in the soil that It takes longer to be ready [13] These results are consistent with what he found [1] and [2], who attributed the reason to the depletion of the phosphorous element by the roots of plants over time, as phosphorous is a slow-moving element in the soil and exposed to the processes of adsorption and sedimentation since Iraqi soils tend to be alkaline in the interaction It provides a dissolved calcium ion in addition to containing a high percentage of calcium carbonate minerals [8] . The availability of macro and micro nutrients, especially phosphorous, increases at many horizons, especially the deep in the rhizosphere, which can achieve two functions, the most important of which is the formation of complexes and the chelation of minerals, thus ensuring that they remain attached to the surface of the roots.As the availability of phosphorus increases with the increase in the roots of plants, in addition to its important role in facilitating the entry of macro nutrients, including the element phosphorus in the form of chelating compounds into the roots and the reason for this is that the surface horizon Ap is the horizon of the soil planted with wheat and that the roots of palm and the rest of the crops are dense from the top. These results are consistent with what was confirmed by [19] and [7]

ISSN 2072-3857

Table (2) Effect of agricultural use and location of soil horizons study on available phosphorous in soil

average	**horizon**				**Location**
	C3	**C2**	**C1**	**Ap**	
15.47	16.46	16.09	15.007	14.31	Babylon
20.67	21.78	21.23	20.40	19.29	Diwaniyah
15.70	17.17	15.66	14.90	15.07	Karbala
14.84	16.86	16.13	13.71	12.68	Najaf
14.56	16.15	15.38	14.13	12.58	Al Muthanaa
average	17.68	16.90	15.63	14.78	
values LSD :Location :3.38 , *horizon :3.03 NS , interaction : 6.77*					

3- available Potassium in the soil

The results of the statistical analysis in Table (3) indicated that the effect of the study location and the interaction between it and the horizons had a significant effect on the values of available potassium in the soil mg. K. kg^{-1} soil, while there was no significant effect of horizons on the values of available potassium in the soil. It is noted that potassium values increased with the effect of the study site and that the highest value was at location 2 within Al-Diwaniyah province, which reached 199.82 mg. $K.kg^{-1}$ soil, while the lowest value of available potassium was at location 5 within Samawah province, which amounted to 144.47 $mg.Kg^{-1}$ soil, with an increase of 38.31%.It is also noted that there was no significant effect of horizons on the values of available potassium in the soil $mg.K.kg^{-1}$ soil. It is noted from the same table that the effect of the bi-interaction of the study available and horizons had a significant effect on the values of available potassium mg.K.kg-1 soil and that Its highest value was at the bi-interaction represented by Al-Diwaniyah soil for horizon C3, which reached a value of 202.62 mg.K.kg-1 soil, which did not differ significantly from the bi-interaction represented by Al-Diwaniyah soil for horizons C3, which reached values of 196.58, 199.72 and 200.38 mg.K $kg^{-1}$of soil respectively. Whereas, the bi-interaction represented by Al-Muthanna soil for the horizon Ap gave the lowest value of the available potassium which was 140.33 $mg.K.kg^{-1}$ soil, with an increase of 44.39% on the bi-interaction of Al-Diwaniyah soil to the horizon C3, the

ISSN 2072-3857

reason for this is due to the fact that the continuous cultivation of the soil leads to Potassium depletion and the variation of its values between horizons and in different locations within the different provinces, and this is what found [10] As for the reason for the high potassium within the study available and subsurface horizons, it is due to the fact that soil salinity has a significant effect on the release of potassium, and that the presence of naturally occurring salts or fertilizing salts in the soil increases the speed coefficient of potassium release [14] and this was explained by [3] showed that there is a significant correlation between soil salinity and available potassium in the soil. As we showed that soil salinity has a positive role in increasing the available potassium through the presence of a positive correlation between the available potassium and soil salinity.Also, the reason for the increase of potassium in some surface horizons may be due to the fact that the surface Ap horizon in which agricultural operations occur is due to the addition of organic matter by cultivated plants and thus its decomposition by multiple microorganisms and the release of many nutrients, including potassium [6]. This explains what we have indicated the surface Ap horizon in which agricultural operations occur by adding organic matter from the natural plant and plant roots, as potassium increases with the depth of the soil with the penetration of the roots of palm trees [2]

Table (3) Effect of agricultural use and location of soil horizons of study on available potassium in the soil

average	**horizon**				Location
	C3	**C2**	**C1**	**Ap**	
181.66	184.46	182.55	181.39	178.24	Babylon
199.82	202.62	200.38	199.72	196.58	Diwaniyah
171.86	173.55	172.20	172.04	169.67	Karbala
149.04	152.14	149.45	148.08	146.50	Najaf
144.47	146.70	146.29	144.59	140.33	almuthanaa
average	171.89	170.17	169.16	166.26	**average**
values LSD :Location :17.60 , *horizon :15.74 , interaction : 35.21*					

ISSN 2072-3857

Conclusions

Pedological investigations in the central Euphrates governorates give that geographic location and long-term agricultural practices exert a significant influence in the availability and distribution of macronutrients in the soilprofile. The evaluation of fifteen pedons across varying of managing environments highlights distinct behavioral trends for each primary macronutrient:

Available Nitrogen: Geographic location and the interaction with soil horizons significantly effect nitrogen distribution in the horizon . The soil of Al-Diwaniyah governorate exhibited the highest overall nitrogen availability in it, peaking explicitly within the surface (Ap) horizon because of higher accumulation of plant residues and active microbial decomposition. Conversely, the lowest nitrogen levels were recorded in Al-Muthanna, where deeper subsurface horizons dropped to their minimum values.

Available Phosphorous: Horizon depth is not the only factor that determines phosphorus availability; regional soil properties and geochemical limitations also play a significant role. While values in Babylon, Karbala, Najaf, and Al-Muthanna converged at lower levels, Al-Diwaniyah soils retained the highest concentration. These Iraqi soils' natural high lime (CaCO3) concentration and alkaline pH cause quick adsorption and sedimentation processes, making phosphorus comparatively immobile and less accessible during long stretches of continuous cultivation..

Available Potassium: Potassium distribution is strongly influenced by geographic site dynamics and soil chemical factors. Al-Diwaniyah recorded the maximum concentration, while Al-Muthanna registered the lowest. Notably, potassium release in subsurface horizons shows a strong positive correlation with soil salinity, where the presence of soluble salts accelerates nutrient displacement and availability within the deep root zones of perennial crops like date palms.

In conclusion, continued intensive agriculture without systematic, targeted mineral and organic fertilization poses a clear risk of macronutrient depletion, even while active surface cultivation and plant residue management momentarily raise nutrient levels in the upper Ap horizon. To maintain soil quality, enhance fertility retention, and maintain agricultural productivity throughout these areas, targeted, governorate-specific soil management strategies must be developed.

ISSN 2072-3857

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ISSN 2072-3857