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EFFECT OF ZEOLITE ON SOME PHYSICAL PROPERTIES OF WHEAT PLANT GROWTH (*TRITICUM AESTIVUM* L.)

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This study was conducted at agriculture college field, Al-Muthanna University at the winter season of 2016-2017 to study the effect of zeolite on some physical properties of wheat plant growth (*Triticum aestivum* L.).Six levels of natural zeolite metal were used, 0.2, 0.4, 0.6, 0.8 and 1% with two levels of decomposing animal organic matter 0.2, 0.4%, with two different type soils (Sand and loamy), mix the zeolite with organic matter with 10 kg soil in a pot. Zeolite significantly reduced (p=0.05) the Bulk density values of both sandy and mixed soils, a significant decrease (p=0.05) in Water saturated conductivitywith sandy soil with a significant increase (p=0.05) in the mixed soils at 0.4% zeolite, significant decline (p=0.05) at a higher than 0.6% zeolite, significant increased (p=0.05) in soil absorption of water with increased zeolite level, high proportion of available water in both soil types,increased the weighted soil ratio of the soils with increased zeolite ratio in soils.

Key words: Zeolite, Physical properties, Sandy and Loamy Soils

Introduction

Zeolite is a natural mineral formed by a change in volcanic rocks rich in glass by its interaction with seawater (Badillo-Almaraz *et al.*, 2003), high porosity, low density, crystalline structure filled with holes and high efficiency in cation exchange,reformer soil uses(Sartbeva *et al.* 2011), added to the soil exposed to drought and water stress, improve physical properties, to be more humid and nutrient (Zahedi ,2011), Sulakhudin and Sunarminto (2011) reported that adding zeolite to dry soils resulted in increased soil retention and water adsorption to 100% with slow nutrient release.Islam *et al.* (2011) explained that the use of zeolite in arid and semi-arid areas reduced the water stress conditions, Zeolite is a highly absorbent material for water. Ghazavi (2015) noted that the use of zeolite with sandy soils in arid and semi-arid areas resulted in improved cationic capacity and soil ability to retain moisture and reduce evaporation with a significant increase in retention of nutrients, especially potassium, ammonium and calcium, as well as improved soil concentrations, resulting in a significant increase in soil-available water. The addition of zeolite to the soil reduced salinity due to increased soil susceptibility to water retention, which reduced soil salinity concentration (Ghorbani and Bababi, 2009). Demirbas (2009) noted that the zeolite addition to high montormonlite soils reduced the phenomenon of swelling, expansion and soil shrinkage due toimproved soil plastic properties. Zeolite reduced nitrate filtration and increased soil nutrient retention (Afrous and Goudarzi, 2015). Zeolite improves physical properties such as water conductivity, ventilation and soil moisture, as well as mitigating soil erosion caused by surface runoff, reducing the speed of running, reducing soil loss, and improving degraded pastures (Behzadfar *et al.*, 2017).

Sandy soils and some sedimentary soils in southern Iraq suffer from poor physical properties, low productivity, degradation of soil fertility and water scarcity, and agricultural and environmental damage, therefore, the study aims to study the effect of natural zeolite in improving the physical properties of light and medium-sized texture in southern Iraq.

Matirals and methods

The experiments was conducted at Agriculture college field, Al-Muthanna University, longitude 476 31 45 and a width 205 12 31 two type of soils (Silty Loam and sandy), under the Torriorthentscategory, the aim of this study to determined the effect of zeolite and different soil texture on physical properties structureof soils. Zeolite included six levels (0, 0.2, 0.4, 0.6, 0.8and 1%), with animal organic matter added of 0.2 and 0.4%, for (S_1) sandy and (S_2) Silt Loam, with three replicates.Soil randomized collected from two sites (no zeolite or fertilizer were used in siol), samples were mixed, soil samples were collected at 0-30 cm depth, transferred to laboratory to physical properties assay.Soils were drained aerobic, Grinded using a hammer Polyethylene, filtered a 2 mm diameter sieve slot. A sample was taken to estimating some physical soil properties according to Black and others (1965), and Jackson (1958) (table 1).10 kg Plastic pot capacity with 25 cm depth were used for zeolite 0 and 0.2%, levels, 15 kg plastic pot capacity with 28 cm depth were used for zeolite 0.4 and 0.6% levels and 20 kg plastic pot capacity 32cm depth were used for zeolite 0.8 and 1% levels. Placed 300 grams of fine gravel (less than 4.0 mm) in the pot base, adding lumbar tissue to prevent soil leaks, soil was added with a weight of 10 kg per sample after mixing with the level of added zeolite metal and organic matter ratios for each treatment. The density was estimated in the cylinder (Core Sample) mode as stated in (Black *et al.*, 1965), porous values measured of virtual density, true density in the method Vomocil contained in (Black *et al.*, 1965) is the relationship:

$$\text{Total porosity\%} = (1 - \text{bulk density} / \text{partial density}) \times 100$$

The Hydraulic conductivity of each experimental unit was estimated at the end of the experiment following the method of the fixed water column shown in Black (1965).

Soil sorptivity of water was measured from the speed of wetting Aggregates as recommended by Al-Ani and Dudas1988 and developed (Khatib, 2000) This is by taking totals Total soil is 3 g and the absorption time register is 0.2 Cm 1 water and absorption calculation of the following relationship:

$S=0.1211t^{-½}\ \rho b^{2/3}$

S\sorptivity $LT^{-½}$ cm $Mt^{-½}$

t/Time, minute

ρb/Bulk density of Mg m^{-3}

The stability of the soil aggregates has been estimated by the wet sieving using the wet sieving method described in Daoud (1996) by passing dried soil samples from a sieve Diameter of openings8 mm and received on a 4 mm diameter sieve,taking then 25 grams of weight was moistened with the poetic Capillary Vis for 6 minutes, transferred. To a range of sieves of wet sieve, how far 4,2,1,0.5 and 0.25 mm, After the device is turned on for 6 minutes. The sieves were separated and the contents of each sieve were dried in the oven and then dry, and the results were expressed by the mean weighted diameter (MWD) after subtracting the weight of sand from them,and through the application of the proposed equation previously Youker and Guinness (1956).

Table 1: Some physical and chemical properties of pre-plant breeding

Adjective		Sandy soil	Silty Loam	Unit
pH		7.12	7.10	
EC		3.47	3.80	dSm^{-1}
CEC		CEC	9.32	Mol. Kg $^{-1}$ C.
Organic matter		4	6	gm kg^{-1}
Lime		300	340	Gm kg^{-1}
Bicarbonate		5.27	6.33	MMol L^{-1}
Calcium		16.62	18.8	MMol L^{-1}
Magnesium		4.61	5.70	MMol L^{-1}
Sodium		3.7	8.10	MMol L^{-1}
Chloride		7.50	8.73	MMol L^{-1}
Sulphates		8.22	10.1	MMol L^{-1}
Boron		0.32	0.28	MMol L^{-1}
Partial density		2.65	2.60	Mg m^{-3}
Bulk Density		1.6	1.3	Mg m^{-3}
Porosity		39.62	50	%
Nitrogen		0.002	0.003	mg kg^{-1}
Prepared ions	Phosphorus	16.12	19.12	mg kg^{-1}
	Zinc	0.203	0.148	mg kg^{-1}
	Manganese	1.263	1.384	mg kg^{-1}
	Potassium	14.3	30.2	mg kg^{-1}
Soil separators Clay		40	220	gm kg^{-1}
	Silt	30	670	
	Sand	930	110	
	Texture	**Sandy**	**Silty Loam**	

Table 2: Some physical and chemical properties of zeolite

PH	EC dSm^{-1}	Partial density$^{Mg\ m-3}$	Bulk Density$^{Mg\ m-3}$	porosity %	CEC Cen. $Molkg^{-1}$
7.3	0.01	1.0	0.09	91	73.6

Distribution of sizes of metal (microns)

More than 4750	4750-2360	2360-1000	1000-600	600-300	300-125	125-75	Less than75
14.44%	39.11%	25.11%	16.13%	0.65%	3.23%	1.12%	0.21%

MWDe = Σ x¯ *iωi*…………
MWD = 0.876 MWDe – 0.079 ………… (7)
MWDe/ estimated Mean Weighted Diameter mm
X¯*i*/Average diameter of any size range for separated groups (mm)

w*i* The weight of the remaining aggregates within the single volumetric range as a percentage to the total dry weight of the soil model after subtracting the sand.

Available Water (AW): Available water content (AW) by the difference between the moisture content Volumetric when waterpotential 10 Kpa sandy soil and the potential of water 33 Kpa loamy soil, which represents field capacity, and the moisture content of VolumetricFor both soils when water potential 1500 Kilo Pascal, which represents a point permanent wilt according to equation:

A W= θ*f*C-θ W*P*

Data were statistically analyzed by analysis of variance and t test using SPSS Statistical Package for Social Science and the least significant Difference according to Warda Al-Rawi and Khalaf, (1980).

Results

Bulk DensityMg m^{-3}

The results showed that a significant differences in the values of the apparent density treatment of zeolite soils (fig. 1), It shows the lowest average of all virtual recorded in the sandy soil was When the treatment of 1% zeolites, amounted to 0.75 Mg $m^{-3}$and 0.8Mg m^{-3} when the treatment of 0.8% zeolites and 0.70, 0.66Mg m^{-3} For the mixed soil of the same transactions and respectively. Moral difference in the virtual density values of both soils with non-treated Zeolite(1.53 Mg m^{-3} Sandy soil and 1.2 Mg m^{-3} loamy soil). Added zeolite by (0.2 to 0.4, 0.6, 0.8 and 1%) of sandy soil led to virtual densities decreasedin (1.28 to 1.15, 1.08, 0.84 and 0.75) Mgm^{-3} and (1.12, 0.92, 0.87, 0.70 and 0.66) Mg m^{-3} loamy soilat the same additive levels as the metal.

Porosity

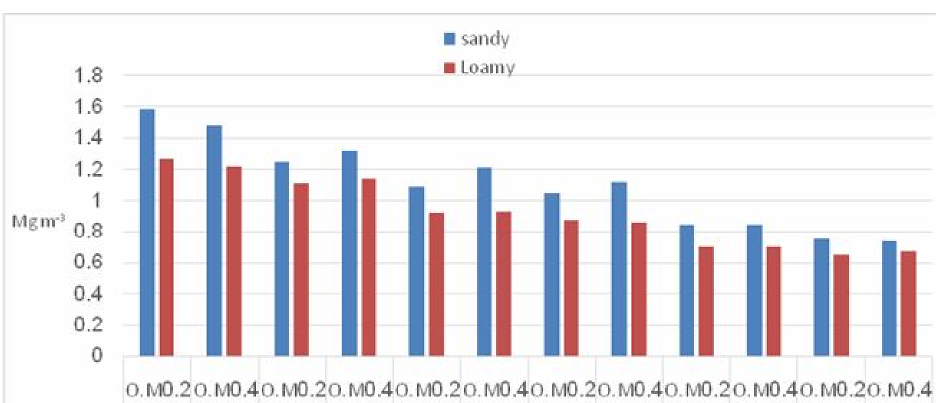
Fig. 2 shows significant differences in the effect of zeolite ratios added on the porosity values of the soil, there were significant differences in the survival of factors and overlaps among them. Soil porosity increased with metal level increase, both type soils at 1% zeolite increased to 63.96% and to 61.52% at a level 0.8% zeolite and to 59.82%, 56.83% loamy soil for the same levels and respectively. When comparing these values with a 0% Zeolite comparison transaction (38.83% sandy soil and 46.86% loamy soil), the differences are very high for all metal transactions used appear the porosity of the sandy soils increased from (38.8 to 46.79, 50.32, 55.21, 61.52, and 63.96) % When the level increases Metal from (0 to 0.2, 0.4, 0.6, 0.8 and 1) % zeolite on Respectively.

Hydraulic conductivity (cm min^{-1})

Fig. 3 showed the susceptibility of zeolite added to the sandy soil reduces the values of saturated hydraulic conductivity in the soil, these values have decreased from 0.317 cm min^{-1} comparing with 0% Zeolite to 0.117 cm minut^{-1} in 1% treated zeolite. In the mixed soil, showed that a low levels of added metal have led to Increase the values of saturated conductivity from 0.016 cm minut^{-1} comparison with 0.029 cm minut^{-1}at 0.2% zeolite to 0.030 cm minut^{-1} at 0.4% zeolite.The levels of organic fertilizer due towater connectivity increased. 0.2% Organic material an average of 0.123cm minut^{-1} was a significant difference from the average 0.4% Organic material 0.101 cm minut^{-1}.

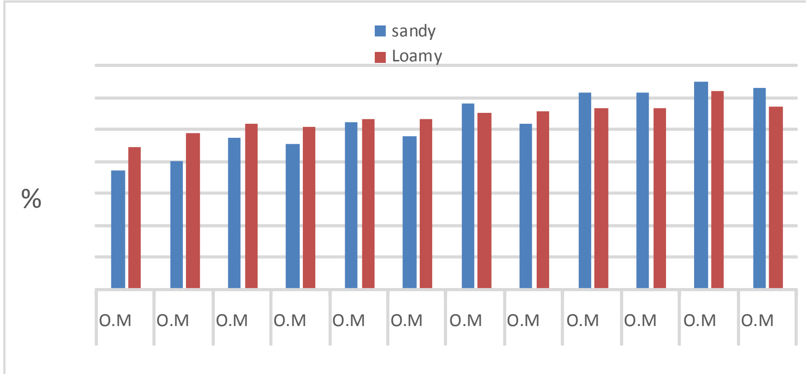
Sorptivity (cm min $^{-½}$)

Figure4. showed a significant effect of Zeolite and organic matter and soil texture in Sorptivity, the highest



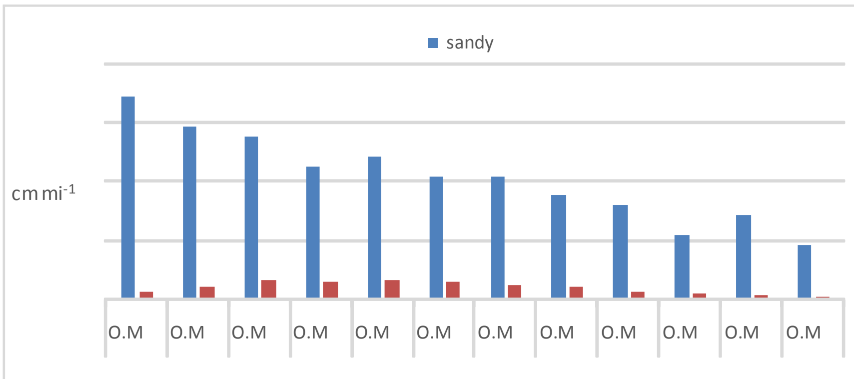
LSD 0.05 = Zeolite 0.0083, O.M=N.S, Type soil =0.0048, O.M× Zeolite= N.S, Type soil × Zeolite= 0.0118, Type soil ×, O.M =N.S, Type soil × O.M × Zeolite=N.S.

Fig.1: The effect of zeolite in the Bulk density of soils experiment (Mg m^{-3}).



LSD 0.05 = Zeolite 3.761, O.M=N.S, Type soil= N.S, Zeolite ×O.M= N.S, Type soil × Zeolite= 5.819, Type soil × 0.M= N.S, Type soil × O.M× Zeolite =N.S.

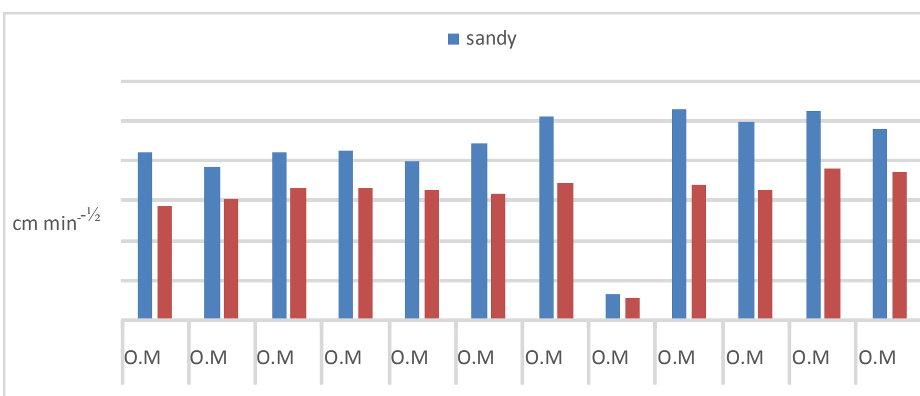
Fig. 2: The effect of zeolite in the Porosity of soils experiment (%).



LSD 0.05= Zeolite 0.047, O.M = 0.032, Type soil= 0.032, Zeolite× O.M =0.082, Type Soil × Zeolite= 0.082, Type soil × O.M=0.091, Zeolite× Type soil × O.M=0.107.

Fig.3: the effect of zeolite in the Hydraulic conductivity of soils experiment (cm min^{-1}).

Sorptivity values in sandy soils1.02, 1.01 cm minute$^{-½}$ added level 0.8%, 1% Zeolite respectively, and the loamy soil 0.76, 0.75 cm minute$^{-½}$ in the same levels, compare with the another treatment 0% Zeolite 0.80 cm min$^{-½}$ for sandy soil 0.59 cm min$^{-½}$ to the loamy soil. The role of the metal in the increase sorptivity appear in soil was a significantly different from the other zeolite levels, increased the Sorptivity with high ratio were metal added, the sandy soil increase of 0.80 to 0.84, 0.84, 0.57, 1.02 and 1.01 cm min$^{-½}$ when increasing the level of metal added from 0 to 0.2, 0.4, 0.6, 0.8 and 1% Zeolite respectively, this was repeated in the loamy soil as the Sorptivity values increased between 0.59 to 0.66, 0.65, 0.40, 0.67, 0.75 cm min$^{-½}$ respectively. Organic fertilizers



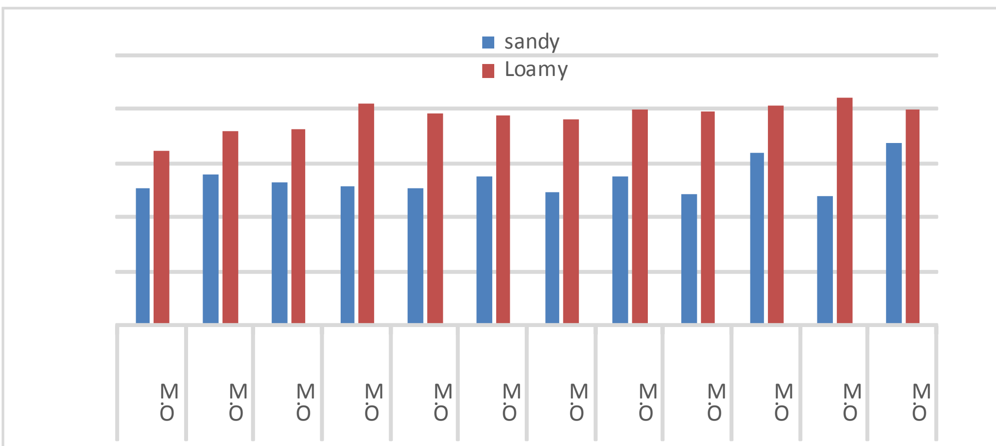
LSD0.05= Zeolite 0.083, O.M = 0.048, Type soil= 0.0048, Zeolite× O.M = N.S, Type soil × Zeolite =0.0118, Type soil × O.M = 0.0069, Zeolite × Type soil×0.M= N.S.

Fig. 4: the effect of zeolite in the Sorptivily of soils experiment (cm min $^{-½}$).

have had a role in improving properties physical, which shows the positive correlation with Sorptivity it noted of excellence the level 0.2% Organic material significant with an average of 0.80 cm minute$^{-½}$ On the level Organic material with an average of 0.67 cm min$^{-½}$. A significant differences between the two soil types Sorptivity, it was sandy soil average 0.85 cm min$^{-½}$, was a higher from loamy soil 0.62 cm min$^{-½}$ both soil typeswereincreased in absorbance values with in metal addition ratio increasing,as shown in the same figure a significant differ between the organic matter additive and soil type,the response to the sandy and loamy soil to add organic matter due to properties improve. Overall results showed a significant effect of zeolite interaction and soil texture and organic matter.

Available Water %:

Fig. 5 showed that a significant effect of zeolite and organic matter and soil texture in available Water, and significant differences for the overlap between zeolite, soil texture, zeolite and matter Organic and soil, The soil capacity to hold water at matrices different Increases significantly with increase in additive level of zeolite Recording the highest average For sandy soil 14.32, 13.98%WeightAt the add level 1, 0.8% Zeolite Respectively, comparison with 0% Zeolite (13.22%)for sandy soil,the role of metal appears increasing the proportion of water available in this soil,this was repeated in the mixed soil by increasing available water with increasing extrusion level of metals from 16.92 to 19.29, 19.41, 19.46, 19.99 and 20.44% when increasing the level of metal added from 0 to 0.2 , 0.4 , 0.6 , 0.8 and 1% zeolite respectively. As for the effect of organic matter if it exceeds the level of 0.4% an average 17.04% On the level 0.2% organic matter Which scored an average of less 15.64%. It is that organic matter has an important role in increasing the available water for both sandy and loamy soils. Soil texture has a significant effect on the available water, as noted all levels of loamy soils are significantly higher than levels its comparison is in sandy



LSD 0.05= Zeolite 0.629, 0.M= 0.364, Type Soil =0.364, Zeolite× 0.M= N.S, Zeolite × Type Soil= 0.890, Type Soil ×0.M= 0.514, Zeolite ×Type Soil× O.M= 1.258.

Fig. 5: The effect of zeolite in the Available Water of soils experiment (%).

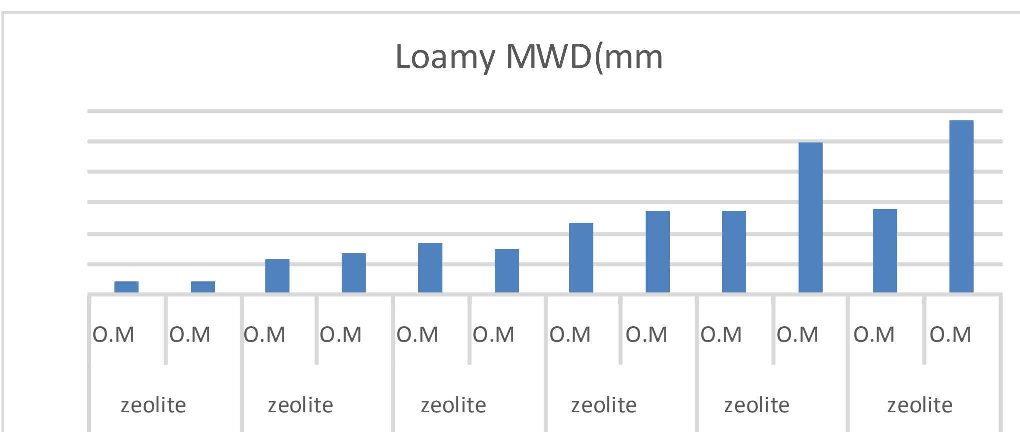


Fig. 6: The effect of zeolite in the Soil aggregate stability of soils experiment (mm).

soils. The average loamy soil was recorded 19.25% reached while the sandy soil recorded 13.43%The amount of available water in the loamy soil is higher than the sandy soil,.

Soil aggregate stability mm:

Figure 6. show a significant difference in the effect of levels the added metal in the diameter rate of soil aggregates the mixture with wet sieve, 1% higher than zeolite 2.831 mm compared to the level of 0% Zeolite, which recorded a less value 0.213 mm with 0.4 level organic material, Increased values were observed The soil aggregates stability with increasing the level of addition of metal values increased a level of 0.2% organic matter from 0.575 to 0.835, 1.166, 1.36, 1.39 mm when upgrading the metal 0.2 to 0.4 ,0.6 ,0.8 and 1%. But the zeolite added to the sandy soil was not given improving weighted diameter because there are no fixed aggregates in wet silt of soil. Organic fertilization gave a significant effect on the percentage of aggregates, the fertilization treatment recorded 0.4% organic matter a slight increase in the values of the Soil aggregate stability a slight increase in the values of the Soil aggregate stability amount 0.213 mm Comparison At the level of 0.2% organic material recorded a lower value reached 0.193 mm For the same treatment 0% zeolite But the role of the substance membership increases with increased zeolite level.

Discussons

Bulk DensityMg m^{-3}

Decline of Bulk Densitywas gradually due to the increase in the addition rate From metal to porous zeolite porosity and interspersed with gaps and Many channels have an impact on the properties of physical soil in particular Total porosity resulting in reduced virtual density values is consistent with these The result with (Hassan and Mahmou, 2013). Soil the highest sandy values reached (1.08) Mg m^{-3} Compared to the soilswhich recorded lower density values (0.99) Mg m^{-3} It may be attributed This is due to the difference in the nature of the structural structure of the soil and any increase in The softness of soil minutes leads to increased surface surface quality Of the soil and the proportion of micro pores which increases the density reduction Of sandy soil compared to sandy soil with fewer pores.

Porosity:

The results of porosity may be due to the impact of zeolite metal on Engineering of soil pores resulting in improved porous soil system, Improve soil construction and decrease the density of the soil density in both soils Increase in the total porosity values of soil, may be due to High porosity For zeolite metal (Georgiev, 2009). And improved soil concentrations (Ghazavi, 2015) and characteristics Physical properties of the soil in terms of porosity and retention of water (Hassan and Mahmoud, 2013). Interference shows an important relationship between soils, Levels of added zeolite metal, this means Sand and mix reaction to add and improve metals their physical properties and composition of high pores are capable of constipation Water, nutrients and soil ventilation (Nozari *et al.*, 2013) (Behzadfar *et al.*, 2013).

Hydraulic conductivity (cm min^{-1}):

The decrease of Hydraulic conductivitywas significant as the zeolite level increased Added to soil This reflects the metal's ability to improve Hydraulic properties of the soil, Increase its water capacity and reduce the rate of sandy soil Hydraulic conductivity, and the rate of water filtration (Ghazavi, 2015) (Behzadfar *et al.*, 2017). In the mixed soil, the results of the added metal showed different behavior. Low levels of added metal have led to Increase the values of saturated conductivity this may be due to the metal's role in water sorptivily and change Soil pores by zeolite metal (Brady and Weils,1999). As Hydraulic conductivity depends on the geometry of the pores And tropics And moisture content. The added metal led to the production of different porous voids, the This is due to changes in soil characteristics When treating soil with zeolite And its role in increasing content Soil moisture And psoriasis And reduce bulk density (Lin *et al.*, 1998), and the horizontal spread of water to sandy soil and agree this result with (Hassan and Mahmoud, 2013). Total results showed that the levels of organic fertilizer was added has a role in increasing water connectivity. The results of organic material indicates a contribution Both levels of organic matter In improving the physical properties of both Sandy soil, and Loamy Which has a significant effect on improvement Water delivery and these results are consistent with (Auerswald,1995). It also shows significant differences between soil types in values water conductivity it was the general average of sandy soil 0.205 cm $minut^{-1}$ and Loamy 0.019 cm $minut^{-1}$.However, the extent of the increase in values The water conductivity of the sandy soil is higher than the Loamy soils The This is due to different Texture soil, And the size of soil pores Rough Texture compared to medium- Texture soil.

Sorptivity (cm $min^{-½}$)

The differences of sorptivity may be attributed to the fact that the metal has increased, of porosity values in both soils When increasing in soil As well as On the role of metal in the Sorptivity of water when increasing the amount in the soil (Cairo *et al.*, 2017), The organic matter had a significant effect on the soil Sorptivity of water for their direct qualitative effect, or for its role to improve the physical properties of soil (Ali and shaker, 2016). The reason may be due low impact of organic matter in the level of 0.4% to High Zeolite Effect on Water Sorptivity in Soil (Bernardi *et al.*, 2009) And to water membranes for minutes Membership gluten added to the soil. The shape may be due to the effect of zeolite metal in sandy soils of loamy soil (Korkuna *et al.*, 2006). There is also a significant effect of overlap between zeolite and organic matter Note the increased absorption when mixing Zeolite organic matter With soil This is due to a large number of pores of the metal capillary zeolite Which promotes water Sorptivity, The increase in Sorptivity values was accompanied by Increase the added zeolite ratios (Lal, 2015).

Available Water %:

The amount of available-made water held by the soil Treatment with zeolite was significantly higher than untreated soil Zeolite Available-water ratio is increasing with Increase the level of metal added to both sandy and loamy soil This may be due to the role of the metal in increasing the area Surface quality of soil (He, 2002), Increase the percentage of pores, Minute, which increases the ability of soil to retain water inside Pores at low and medium matric levels (Korkunna *et al.*, 2006), At high humidity matrices, changes occur In sandy soil moisture and loamy. In terms of the amount of water held, water is increasing aavailable to increase the level of addition to metals, and the water goes down available in soil not treated with Zeolite (Bozorgi *et al.*, 2012). Any increase or decrease in available water is associated Increase or decrease in the amount of metal added to the soil. For the role of metal in adsorption of water, cavities and canals in its crystalline construction (Pisarovic *et al.*, 2003). Organic matter may be due to an increase in the amount of pores in the soil texture medium and especially medium and small pores size, In sandy soils, most pores are wide and when there is matric a certain tension emptying these pores. A small amount of water remains. Held in the soil, so the increase in matric strength led to a sharp drop in moisture content. Figure shows the significant effect of interference between zeolite and texture of soil as a result of a difference in response available water recipe for soil texture with different levels of zeolite metal indicating the role of the metal in the lifting of the available of water in the soil through increased porosity, and reduce bulk density values. And the presence of small pores connecting the large cavities within Metal crystals (Korkuna *et al.*, 2006) Increase capacity Exchange surface area of quality soils when treated (Sulakhndin and Sunarminto, 2011). The results showed a significant effect of the interaction between Zeolite, organic matter and texture soil In raising water values available in soil./ And the response of different texture soils when treated zeolite And a proportion of organic matter in raising available water (Ersin *et al.*, 2004).

Soil aggregate stability mm:

The results of soil aggregate stabilitymay be due to from the metal has improved the physical properties of the soil, including the soil structure (alkhudar, 2012) the process of mixing the soil with zeolite Leading to increased Soil aggregate stability (Ghazavi, 2015). But the zeolite added to the sandy soil was not given Results in improving the Average Mean Weighted Diameter because there are no fixed aggregates in wet silt of soil. This may be due to from the organic material infection zeolite when added together to the soil, these results are consistent with (alkhudar, 2012) and (Jebbar, 2013).

Conclussions

The results showed that the addition of zeolite metal to the sandy and mixed soil has improved the physical properties of sandy soils, by increasing total porosity, ready water and soil absorption of water. Reduction of the particle and bulk density value of soil and the water conductivity saturated with sandy soils, increase the rate of water conductivity saturated with mixed soilsthen all the values decreased at 0.6% zeolite.

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