*Eco. Env. & Cons. 27 (November Suppl. Issue) : 2021; pp. (S109-S113)*
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*ISSN 0971–765X*

# The physical properties of Najaf province soils, Iraq

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(Received 20 March, 2021; Accepted 19 May, 2021)

**ABSTRACT**

Physical properties of soils are parts of the environment that sustain development as abiotic factors. These include texture, pH, salinity, water holding capacity, and water permeability. This study comes to evaluate the soil physical properties of Najaf province for agricultural purposes. Soil samples were collected from different types of soil (five sites from five transects at north to south of Najaf province) using hand auger from a depth ranging up to 20 cm. The results showed that the most sites of transect 1 were silty clay loam while the other transects were sandy silts. The soil salinity was gradient from low in transect 1 (0.1 ppt) to high in transect 5 (5.2±1.7 ppt). The pH was fluctuated between 7.19±0.38 – 7.81±0.42 in transect2 and transect3 respectively, but in general all studied soils were slightly alkaline. The highest permeability of water was related with sandy soil components, and there were no significant change in water permeability among all of transects, but there were significant changes between gropes of study (P-value > 0.05). The water holding capacity was ranged between 201.228±76.207 – 527.891±75.891 ml/kg in transect five and one respectively. The organic matters of studied transects were ranged between 20.393±15.771 – 72.921±8.961 g/Kg in transect five and one respectively. This study concluded that the most of Najaf province physical soil properties were slightly alkaline, silty salts, low organic matters, slightly salty, high water permeability, and low holding capacity. Also, the western parts which closed to Euphrates River was more water holding capacity, and organic matters.

***Key words :*** *Physical Properties, Organic matters, Soil quality*

## Introduction

Physical properties of soils are parts of the environment that sustain development as abiotic factors. These include texture, structure, bulk density, porosity, consistency, temperature, pH, salinity, color and resistance (Gardner and Unger, 1999).

Soil texture is determined by the proportions of the three soil minerals (sand, silt, and clay). The soil aggregates form when iron oxides, carbonates, clay, silica and humus coat the particles and allow them to bind to larger, more stable secondary structures (Six *et al.*, 2000). Soil bulk density is an estimate of soil compaction (Håkansson and Lipiec, 2000). The soil porosity consists of an empty volume of soil and contains gasses or water. Consistency of soil refers to soil particles sticking together. The temperature of the soil, soil resistance and concrete surface affect the rate of corrosion of metal and concrete in the soil (Schwerdtfeger, 1965).

The province of Najaf is central of Iraq in the southwest of the capital Baghdad at a distance of one hundred and sixty kilometers. The study area is located in the hot-dry desert climate. The average

rainfall is 7.2 mm/year. The annual aggregate depth is 86.2 mm. The average annual temperature is 25.5 ° C, with a sharp increase in the summer months to 37.7 ° C in July. Therefore, the soil of the study area is a hyper thermic thermal system (Soil Survey Staff, 2017). The study area is characterized by low vegetation cover, which is due to the climate factor and its direct impact on its two main elements temperature and rain, which play an important role in the distribution and growth of plants (Garamvölgyi and Hufnagel, 2013).

The role of climate is the most important influence of soil and soil factors in determining the quality of vegetation. Lack of water resources and scarcity also lead to weak vegetation (Soloamou *et al.,* 2017). In general, the natural plant of the study area have annual and perennial herbs of varying density and diversity depending on the nature of the geographical location like *Phargrnites Communis,* and *Typhaangustat* which is grows in low-lying soils, adjacent to the irrigation channels and the gas table. While drought-tolerant plants and poor water were identified in desert areas such as *Prosopisspp*, *Marurum, Alhagi*, *Artemisia scopari*, and *Achillea Fragrantissma* (Al-Haidarey *et al*., 2016). Also, can found plants with high tolerability of salinity which are scattered in the study area with minimal intensity like *Tamarixmannifera*, *Aeluropuslittorolis* and *Schanginiaaeg*, and it is noted that the density of natural plants in the north-eastern parts of the region is higher than the western desert region. Because of the important of soil physical properties of Najaf province for agricultural, this study was conducted.

## Methodology

**Study sites description:** In general, the area of the study was characterized by its landslides and the availability of natural characteristics in the sedimentary plain, which helped the success of agricultural land use, but in varying degrees from one place to another. The cultivation of fodder crops such as maize, wheat, barley and vegetable crops such as cucumbers and tomatoes are concentrated in palm groves Surrounding the Ghazi River with a small percentage of trees like Archives and Eucalyptus.

Twenty five pool soil samples were collected from five transect in Najaf province (Fig. 1) to investigation the goal of this study.

**Collection of Samples:** Soil samples were obtained

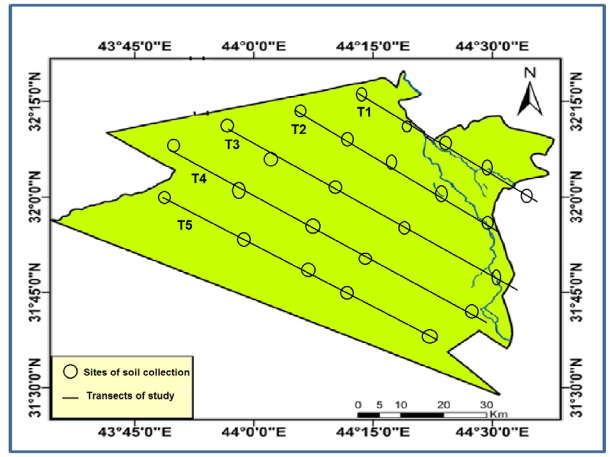


**Fig. 1.** The locations of soil sampling (T is transect)

from various forms of land use (transects were according to land use), using hand auger from a depth ranging up to 20 cm and stored in clean sealing plastic. Collected soils were air-dried in the laboratory, and passed through a 2mm mesh sieve, after they had been disaggregated with a porcelain pestle and mortar. Subsequently, samples were examined in sealed plastic bags (McCauley, 2005).

According to Salwan *et al.* (2011**)** soil textural was analyzed then used GIS to obtained soil textural map (Brown, 2003).To determination of salinity and pH of soil samples, 1:1 soil extraction was prepared, then using of EC-Meter for measurement EC and pH-meter for measurement pH (Richards, 1954). The water permeability was calculated according to NJDEP (2013). The water holding capacity was depend on McCauley (2005). To estimate the percentage of the organic matter in the soil we followed Walworth (2012).

## Results and Discussion

Soil texture is a common term used to describe the proportionate distribution of particles in a soil (Brown, 2003). Figure 2 shows the soil texture map of the studied locations. The most sites of transect 1 (T1) were silty clay loam, because this transect is closed to Euphrates river basin while with other transects the soil textures were sandy silts and that was agree with Jassim and Goff (2006) and Al-Mamoor *et al*. (2017)

As shown in Fig.3 the soil salinity was gradient from low in transect 1 (0.1 ppt) to high in transect 5 (5.2±1.7 ppt) that because the transect 1 soils used to agriculture so by flushing water and planting, the

salts and nutrients will depletion from the soils (FAW, 2021), and other transects increased toward west of studied region.

Fig. 4 explains show pH acidity fluctuated between 7.19±0.38 – 7.81±0.42 in T2 and T3 respectively, but in general all soils of studied area were slightly alkaline and that is agree with Al-Mamoor *et al*. (2017)

The water permeability, mainly, depends on the soil texture, size of soil particles, organic material contents, temperatures (Jackson, 1957) so in the current study we found that the highest permeability related with sandy soil components. The permeability ranged between 3.247±0.841 – 3.913±1.161 ml/hr (Fig. 5) in transect three and five respectively, and there were no significant change in water permeability among all of transects, but there were significant changes between gropes of study (P-value > 0.05).

One of the key functions of soil is to preserve water and make it accessible for the plant to access. None of the soil's water is accessible to plants. The size of the soil's pores is dictated by the amount of water available to plants. Soil's water holding capacity is the volume of water retained by the soil's capillary spaces after gravitational water percolates into the deeper layers. Sand, sandy loam and loamy sand have the highest water-holding capacity, while silt loam and fine sandy loam have minimal water-holding capacity. The physical definition of field capacity as èfc (Veihmeyer and Hendrickson, 1931). In present study, the water holding capacity was

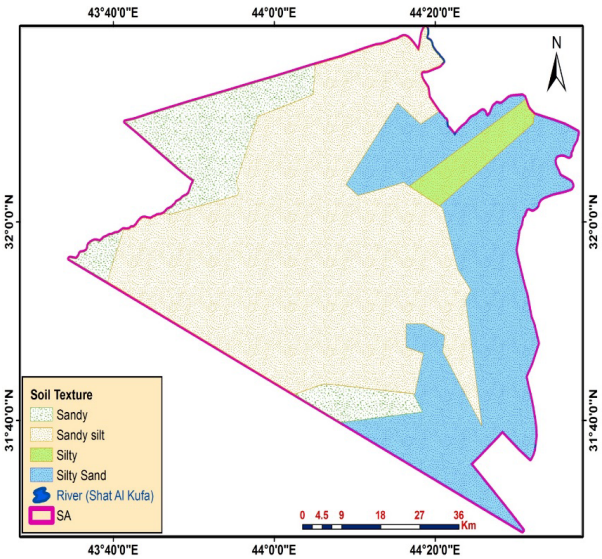


**Fig. 2.** The soil texture map of the studied sites

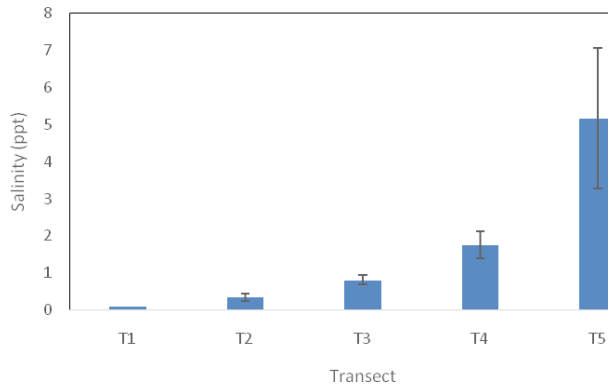


**Fig. 3.** The salinity of studied soil transects ± standard deviation

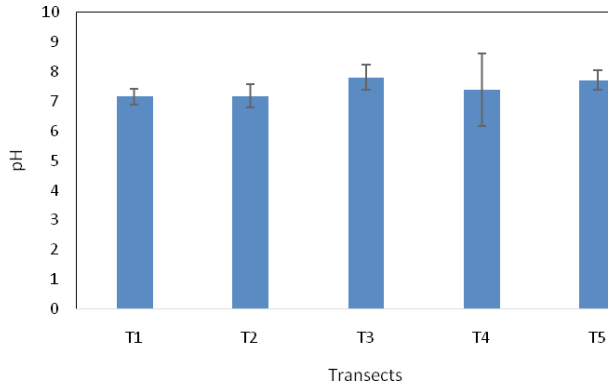


**Fig. 4.** The pH values of studied soil transects ± standard deviation

ranged between 201.228±76.207 – 527.891±75.891 ml/Kg (Fig. 6) in transect five and one respectively. This results was depend on the kind of soil that in transect one there are more clay than other sites, so the ability of water keeping was more (Veihmeyer and Hendrickson, 1949).

Organic soil matter consists of plant and animal detritus at various stages of decomposition, soil

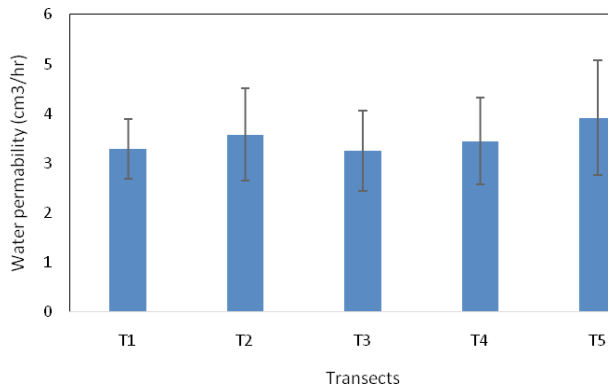


**Fig. 5.** The water permeability of studied soil transects ± standard deviation

microbial cells and tissues, and soil microbial substances. It provides numerous benefits to the physical and chemical properties of the soil and its capacity to provide regulatory ecosystem services (Brady and Weil, 1999). It is also particularly critical for soil functions and quality (Beare *et al*., 1994). In the present study, the organic matters of studied transects were ranged between 20.393±15.771 – 72.921±8.961 g/Kg (Fig. 7) in transect five and one

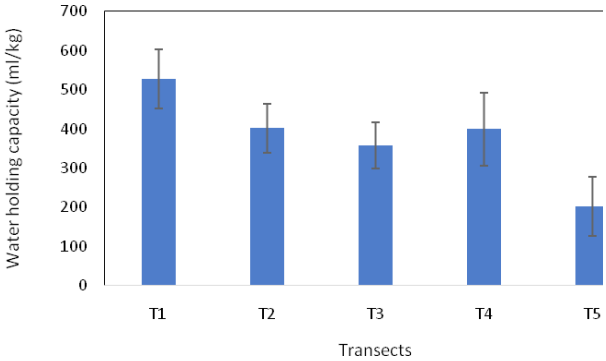


**Fig. 6.** The water holding capacity of studied soil transects ± standard deviation

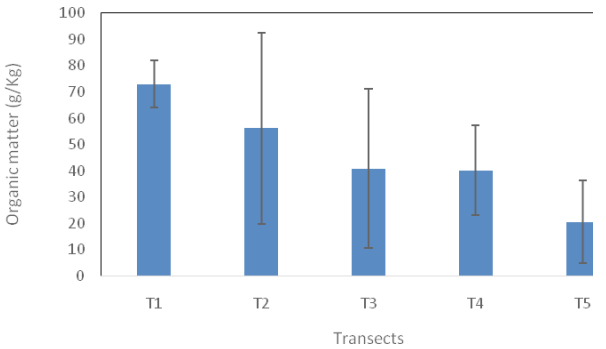


**Fig. 7.** The organic matter components of studied soil transects ± standard deviation

respectively. These results were in agreement with (Alattabi *et al*., 2020).

## Conclusion

This study concluded that the most of Najaf province soils are slightly alkaline, silty salts, low organic matters, and slightly salty. Also, the western parts which closed to Euphrates River was more water holding capacity, and organic matters.

## Acknowledgments

We would like to express our gratitude to the Head of the Department of Ecology and Pollution at the University of Kufa for funding and promoting this research.

### Conflict of interest

This work is herewith submitted for publication in this journal. It has not been published before, and it is not under consideration for publication in any other journal (s), and I certify that I have obtained written permission for the use of text, tables, and illustrations from any copyrighted source(s), and I declare no conflict of interest

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