EJONS International Journal on Mathematic, Engineering and Natural Sciences | ISSN 2602 - 4136

Article Arrival Date	Article Type	Article Published Date
12.11.2023	Research Article	20.12.2023

DETERMINATION OF SOIL PROPERTIES OF APPLE ORCHARD IN DUHOK PROVINCE, NORTHERN IRAQ

Bekas Yousif HUSSEIN
Duhok Polytechnic University, Technical College of Administration, Duhok, IRAQ

Füsun GÜLSER*
Van Yüzüncü Yıl University, Faculty of Agriculture, Soil Science & Plant Nutr. Dept., Van,
ORCID NO: 0000-0002-9495-8839
*Corresponding Author

Abstract
A field survey was carried out on apple orchards within four different rural areas at Duhok province, north of Iraq during the growing season of 2018-2019. The survey consisted of three apple orchards, that were chosen for sampling, in four different villages of Duhok province in north of Iraq (Bagira, Babire, Dillia and Kanimassi). In order to determine some soil properties, four soil samples were taken from each orchard, and the number of samples taken for the entire research was forty-eight. Some soil properties including soil texture, EC, pH, O.M, O.C, and CaCO3 and nutrients contents were analysed. According to analyses result soil samples were in silty loam and loam texture classes. Soil pH, EC and $CaCO_3$, organic carbon (OC) and organik matter (OM) values were determined in range of 6.69-7.75, 0.340 dSm^1 - 1.160 dSm^1 , 8.95 % - 25.23 % , 0.60 % - 2,83 % and 1.04 % - 4.88 % respectively. On the other hand deficiencies were determined in phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg) contents of soils in some sites of study area.

Keywords: Apple, Tree, Orchard, Soil properties, Nutrient

Introduction
Apple is one of the most important fruit trees belonging to the general of pomefruit trees of the temperate zones and a member of the Rosaceae family which is considered as garden crop. Apple is characterized with high adaptability and for that reason is one of the most extensively fruit trees cultivated in temperate zones. Apple fruits are well-known for their taste, flavor and dietary values. The health value and superior quality of fruit as one of the most prestigious organs of the trees is in direct correlation with health of humans (El-Boray, 2015).
Apple tree growth and development requires an adequate supply of 14 essential mineral nutrients. These nutrients fall into two groups: macronutrients that are required by the tree in large amounts: N, P, K, Ca, Mg and S; and micronutrients that are needed only in small quantities: B, Cu, Zn, Fe, Mn, Mo, Cl and Ni. Each nutrient performs unique functions in tree growth and development, and good tree growth, cropping and fruit quality depend on not only the adequate supply of each nutrient, but also the proper balance between them.
Nitrogen, phosphorus and potassium as major essential nutrients, are regularly applied in the orchard to meet the requirement of these elements by the apple plants.The heavy production

of fruits year after year caused depletion of the soil nutrient storesand thus necessitates nutrient element application every year in order to maintain soil fertility at optimum level and to have economic returns every year. After yearly pruning in the dormant season, apple trees demand for nutrient elements increases for thevegetative growth and initiation of flowering in the spring season. The nutrient elementswhich need constant replenishment are mainly N, P and K as these are absorbed in considerable quantities by the crop (Marchner, 1995). Soil fertility are crucial factors of sustainable agriculture that control the soil tree growth environment. The interdependence and interconnection of soil fertility balance isvery effective for the growth of plants. The Soil fertility is defined as the inherent capability of a soil to supply plants with essential nutrients in adequate amount, in optimum proportion and at the proper time for their optimum growth. Evaluation of soil fertility and nutritional requirements of fruit crops is considered significant and critical for growers and planners since crop growth and quality are decreased and negatively influenced under nutrient deficient conditions. Soil fertility is mainly affected by soil physical, chemical, and biological properties such as soil texture, soil PH, organic carbon, EC and microorganism groups and their activity in the soil (Stutter et al., 2012). In this study, it was aimed to determine the soil properties in the growing environments of apple trees widely grown in Duhok, Northern Iraq.

Materials and Methods

The field study was carried out on apple orchards on four different rural areas within Duhok province, in northern of Iraq during the growing season of 2018-2019. Four different Apple tree orchards have been selected for taking sample, in four different villages of Duhok province north of Iraq (Bagira, Babire, Dillia and Kanimassii). The GPS coordinates of each sampling point was recorded. Duhok province is located at longitude (20-, 42°) (10-, 44°) E and from latitude (40-, 36°) (20- 37°) and the elevation of sea level of Duhok province varies from 445m to 1215m (Figure1). North of Iraq is characterized by semi-arid clime (Mediterranean-type climate) (DMD, 2008).

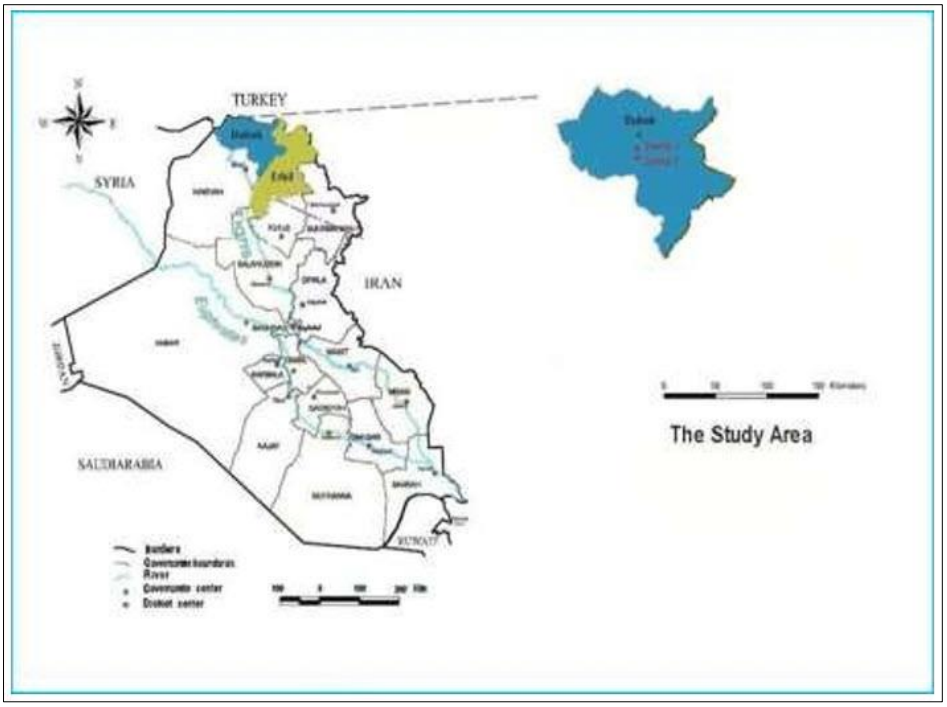

Figure 1. The study area (Duhok, Iraq).

A field survey was carried out on apple orchards within four different rural areas at Duhok province, north of Iraq during the growing season of 2018-2019. The survey consisted of three apple orchards, that were chosen for sampling, in four different villages of Duhok province in north of Iraq (Bagira, Babire, Dillia and Kanimassi). In order to determine some soil properties, four soil samples were taken from each orchard, and the number of samples taken for the entire research was forty-eight. Soil samples taken from 0-20 cm depth then, air-dried soil samples were crushed by wooden hammer and passed through 2.36 mm sieve. Soil samples will store in plastic bags and carried to the of Department Soil and water in college of Agriculture university of Duhok-Iraq. The soil properties were determined by following methods: particle size distribution by Bouyocous hydrometer metod (Gee and Bauder,1986), soil reaction in 1:2.5 (W:V) soil:water suspension by pH meter and soil salinity by EC meter, in the same suspension (Black,1965); lime content by Scheibler calcimeter (Goh et al.,1993), organic matter by Walkley-Black method (Tiessen and Moir,1993), available phosphorus by Olsen's method (Olsen and Sommers,1982), exchangeable cations (Ca, Mg, K, Na) by ammonium acetate extraction (Kacar, 2016). Data analysis was conducted by analysis of variance (ANOVA) with General Linear Model (GLM) procedure to examine the significant effect of different locations on selected parameters, using the Minitab software package 16. Subsequently, Tukey's HSD (honestly significant difference) test was used to identify significant differences between means of selected parameters of different locations at P value = 0.05.

Results and Discussions

The results of variance analyses results belong effects of location difference were given in Table 1.

Table 1. Results of variance analyses for soil properties (F values).

Source	d.f	pH	EC	$CaCO_3$	OC	OM	N	P	K	Ca	Mg
Location	11	4.66**	58.20**	11.98**	87.84**	68.92**	4.66**	58.20**	11.98**	87.84**	68.92**
Error	24										
Total	35										

**: P<0.01

According to variance analyses results effects of location differences on soil properties were found significant (p <0.01) statistically.

The some soil properties of soil samples taken from 0-20 cm depth in this study were given in Table 2 ,3 and Figure 2,3. As regard reported limit values (Alpaslan et.al., 1998) it was determined that the soils of the study area have silty loam in Bagera, Babire and loamy texture in Dilia and Kanimassi. While soils of Babire and Dilia 2 have slightly alkaline reaction (7.52-7.75) the other location soils were found as neutral reaction (6.69-7.32) reaction and and nonsaline (0.882-0988 dSm-1) properties. Lime content were determined as moderate limely in range of 8.95 % - 10.17 % in soil samples taken from Kanimassi while Bagera, Babire and Dilia soils had high lime values in range of 19.94 %- 25.2 %. As regard soil organic matter contents were obtained in high (4.72 %-4.88 %) for Kanimassi, sufficient (3.00 %-3.65 %) for Bagera and Babire and low (1.04 %- 1.44%) levels for Dilia varying each other among locations (Table 2 and Figure 2,3).

Table 2. Some soil properties of apple orchards at the four different districts.

Locations	Texture	pH	EC	CaCO3	O.C	O.M
			(dSm^{-1})		%	
Bagera 1	Silty loam	6.69c	0.988abc	25.23a	1.94b	3.35b
Bagera 2	Silty loam	7.13abc	0.882c	24.82a	1.81b	3.12b
Bagera 3	Silty loam	7.32abc	0.910bc	24.42a	1.73b	3.00b
Babire 1	Silty loam	7.62abc	0.980abc	19.94ab	1.80b	3.11b
Babire 2	Silty loam	7.52abc	1.160a	20.35bc	2.12b	3.65b
Babire 3	Silty loam	7.68ab	1.12ab	20.75ab	1.86b	3.22b
Dilia 1	Loam	7.71ab	0.370d	22.79ab	0.60c	1.04c
Dilia 2	Loam	7.75a	0.366d	22.38ab	0.76c	1.44c
Dilia 3	Loam	7.63ab	0.372d	21.97ab	0.76c	1.32c
Kanimassi 1	Loam	6.80bc	0.350d	8.95c	2.78ab	4.80a
Kanimassi 2	Loam	6.98abc	0.370d	10.17c	2.83a	4.88a
Kanimassi 3	Loam	6.85abc	0.340d	9.76c	2.73a	4.72a

a, b, c ; values followed by the different letter are significantly different.

Table 3. The P, K, Ca, and Mg contents in the soil of apple orchards at the four different districts

Locations	P	K	Ca	Mg
	$mgkg^{-1}$		**$me100g^{-1}$**	
Bagera 1	9.90b	2.40ef	2.80ab	2.20bc
Bagera 2	8.70bc	1.80f	3.10ab	1.60cde
Bagera 3	9.60bcd	2.80def	2.70ab	2.05bcd
Babire 1	8.00cde	3.50de	2.90ab	2.60ab
Babire 2	8.20bcd	3.97d	2.77ab	2.10bc
Babire 3	9.13cde	4.20cd	2.67b	2.30abc
Dilia 1	5.60ef	2.40ef	1.80c	1.06e

Dilia 2	5.10f	3.10f	1.75c	1.34de
Dilia 3	7.10def	2.90def	1.45c	1.20e
Kanimassi 1	17.20a	5.60bc	3.15ab	2.95a
Kanimassi 2	19.20a	7.40a	3.08ab	2.15bc
Kanimassi 3	18.40a	6.90ab	3.40a	2.70ab

When taking into account soil nutrients contents, available phosphorus contents of soil samples from taken Dilia were in range of 5.10 $mgkg^{-1}$ -7.10 $mgkg^{-1}$ and were in low level. At the other locations, all of soils phosphorus contents were in sufficient level (8 $mgkg^{-1}$ -19.20 $mgkg^{-1}$). Exchangeable potassium contents of soils were in high level (1.80 $me100g^{-1}$ - 2.40 $me100g^{-1}$) for Bagera 1, Bagera 2 and Dilia 1 and were in very high level (2.80 $me100g^{-1}$ - 7.40 $me100g^{-1}$) for the all of other Exchangeable calcium contents of soils were found in low level (2.67 $me100g^{-1}$ -3.40 $me100g^{-1}$) except soils taken from Dilia 1 which contains exchangeable calcium in very low level as 1.45 $me100g^{-1}$. Exchangeable magnesium contents all of soils were found in sufficient level (1.34 me100g-1 -2.95 $me100g^{-1}$) except soils taken from Dilia 1 and Dilia 3 which have magnesium in low level as 1.06 $me100g^{-1}$ and 1.20 $me100g^{-1}$ respectively (Table 3).

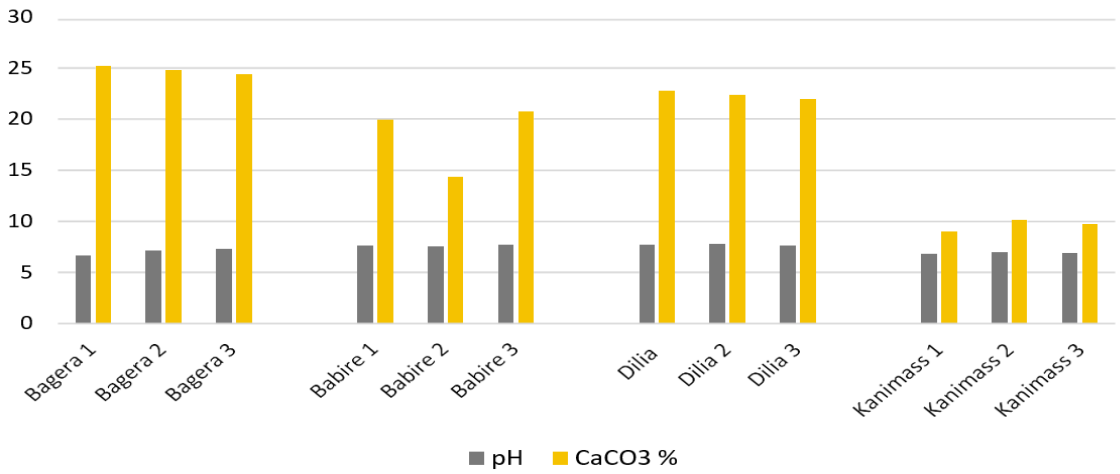

Figure 2. The pH and CaCO3 values in the soil of apple orchards at the four different districts.

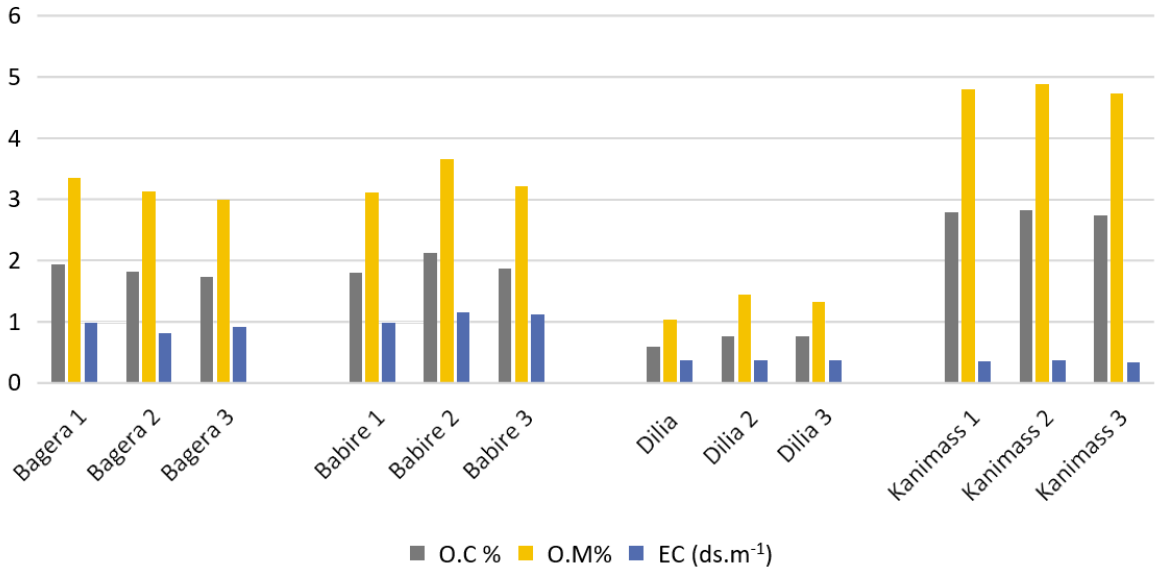

Figure 3. The organic carbon, organic matter and EC values in the soil of apple orchards at the four different districts.

In general, it was determined that the apple orchard soils in Kanmassi contained higher levels of nutrients compared to those in the other three villages (Bagira, Babire, Dillia). The lowest values regarding the nutrient content of the soils were obtained in the gardens in Dillia village. This situation is due to the fact that Dila soils have high pH and high $CACO_3$ content and low organic matter content (Figure 2, 3). It is known that high pH and high $CACO_3$ content negatively effects availability of phosphorus and the other nutrients in soils. On the other hand, soil organic matter is the source of plant nutrients in soils and ameliorates soil's physical, chemical, and biological properties (Blum et al. .2017).

Conclusion

As a result, farm manure, NH4(SO4)2 and triple super phosphate applications are recommended to eliminate these deficiencies in apple orchards in the research area where organic matter and nutrient element deficiencies were determined. Since there has never been a study on soil properties in apple orchards in Duhok, Northern Iraq, the results of this research will be useful for apple producers to enable conscious fertilization programs. In addition, this study is informative research for scientific studies to be carried out in the field of fruit growing in this region.

References

Alpaslan, M., Güneş, A., İnal, A. 1998. Deneme Tekniği. Ankara Üniversitesi, Ziraat Fakültesi Yayınları, s. 437, Ankara

Black, C.A. (1965) Methods of Soil Analysis: Part I, Physical and Mineralogical Properties. American Society of Agronomy, Madison, Wisconsin.

Blum, Winfried, Schad,P., Nortcliff,S.. 2017."Essentials of soil science." (2017). ISBN ebook (pdf) 978-3-443-01129-1

DMD, 2008. Duhok meteorological directorate Duhok, Iraq (2008)

El-Boray, M. S. S., Mostafa, M. F. M., Abd El-Galel, M. M., Somaa, I. A. I., 2015. Effect of humic acid, fulvic acid with some nutrients at different time of application on yield and fruit quality of anna apple trees. J. Plant Production, Mansoura Univ., 6(3): 307-321.

Gee, G.W., and J.W. Bauder. 1986. Particle-size analysis. p. 383–411. In A. Klute (ed.) Methods of soil analysis. Part 1. 2nd ed. Agron. Monogr. 9. ASA and SSSA, Madison, WI.

Goh T.B., Arnaud R.J.St., Mermut A.R., 1993. Aggregate stability to water. In: Soil sampling and methods of analysis (Cartner M.R., ed). Canadian Society of Soil Science. Lewis Publ, Boca Raton, Canada. pp. 177-180.

Kacar B., 2016. Toprak Analizleri. Genişletilmiş Baskı, XVIII, Nobel yayın Dağıtım. 468p.

Marschner, H., 1995. *Mineral Nutrition of Higher Plants*. 2nd. Ed. Academic Press. San Diago, USA.

Minitab® 16 2014. Minitab 16 English (30-Day Trial) for Windows. Minitab Inc.

Olsen, S. R., Sommers, L. E. (1982). Phosphorus. In A. L. page et al., (ed) Methods of soil analisis, 2nd ed. Agronomy 9:403-430.

Stutter, M. I., Richards, S., 2012. Relationships between soil physicochemical, microbiological properties, and nutrient release in buffer soils compared to field soils. Journal of Environmental Quality, 41: 400-409.

Tiessen, H and Moir, J.O (1993) Characterization of available phosphorus by sequential extraction. In: Carter MR (ed) Soil Sampling and Methods of Analysis. Can Soc Soil Sci, pp 75-86. Lewis Publishers. Boca Raton, Ann Arbor, London, Tokyo