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RESEARCH ARTICLE

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EFFECTS OF SOIL TEXTURE ON CHEMICAL COMPOSITIONS, MICROBIAL POPULATIONS AND CARBON MINERALIZATION IN SOIL

ABSTRACT:

Soil texture plays a key role in carbon storage and strongly influences nutrient retention and availability. The objective of this study was to 1) determine the effects of soil texture on soil chemical compositions and abundance of microbial communities in soils collected from nine different localities of Sulaimani governorate, 2) the correlation between mineralization of carbon and tested parameters. After analysis, soils were classified into six textural classes (sandy loam, loamy sand, silty loam, silty clay loam, clay loam and loam) which are of significant ($p \leq 0.01$) effects on concentration of most soluble ions (Ca^{+2}, K^+, HCO^-_3, Cl^- and $SO_4^=$), and other soil chemicals (PO^-_4, $CaCO_3$, organic matter and total nitrogen contents); as well as, the distribution of soil bacterial population. Results of carbon mineralization, using CO_2 respiration method under laboratory conditions indicate that rates of CO_2 in fine soil textures (viz: clay loam, loam and silty clay loam), are significantly ($p \leq 0.01$) higher than coarser soil textures (silty loam, loamy sand and sandy loam). Meanwhile, mineralization rates showed a significant positive correlation with the amount of soil organic matter, and total nitrogen content (r=0.62, r=0.61), respectively. In conclusion, this study indicates that (i) the capacity of soils to preserve soil organic matter and total nitrogen in clay and silt sized particles is greater than sandy one, (ii) abiotic factors such as soil texture; chemical components had a marked influence on the structure and activity of microbial population and mineralization of carbon.

KEY WORDS:

C-Mineralization, Soil microorganisms, C-cycle, Soil texture, Soil chemistry.

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INTRODUCTION:

Carbon (C) and nitrogen (N) are two of the most important elements that affect the soil's productivity and environmental quality (Franzluebbers, 2002). Most of the organic carbon photosynthesized from atmospheric CO_2 to the plant body is finally decomposed and converted from organic substrate to inorganic products (CO_2 and water in aerobic mineralization). The microbial community in this process uses carbon as the substrate to increase its number and biomass (Hessen, 1992; Hiroki, 1995), therefore any synthesized biologically compound is subjected to destruction by the soil inhabitants (Moran and Hodson, 1989; Hanisch *et al.,* 1996). The dominant organisms which are responsible for the decomposition of organic matter and associated mineralization of C and N are soil microorganisms, such as bacteria, fungi and protozoa. Soil fauna also indirectly affects C and N cycles (Carney and Matson, 2005). There are several factors affect mineralization of added organic materials and rapidity oxidation of substrate (Moran and Hodson, 1989; Hanisch *et al.,* 1996). This will probably depends on the interaction between physical, chemical and biological processes which are influenced by local environmental conditions (Bismarck *et al.*, 2006). Soil texture as abiotic factor is important factors that influence distribution of minerals, organic matter retention, microbial biomass and other soil properties (Scott and Robert, 2006). Accordingly, pore space distribution and the small soil pores has a major impact on the abundance of bacteria and fungi and might be responsible for higher rates of carbon mineralization (Jensen, 1996; Raiesi, 2006). Therefore, the objective of this study was to investigate and compare chemical parameters and microbial communities among soil types, as well as, to find out the correlation of tested soil parameters with the distribution and function of soil microbial communities in degradation process of added plant residue.

MATERIAL AND METHODS:

Soil sampling:

This study was carried out in July 2008 at the Biology Department, University of

Sulaimani. Nine locations of Sulaimani governorate were selected for soil sampling (Arbat, Grgasha, Mawat, Penjwen, Qashan, Qaradagh, Sharazwr, Sulaimani (city center) and Taben). From each location 25 random soil samples were collected at a depth of 15 cm using a 2.5 cm diameter soil auger. Soil samples were mixed and homogenized. After removing recognizable stones, plant and animal debris, these composite samples were air-dried and sieved through a 2 mm mesh sieve before analysis and kept in sealed containers at 4°C before analysis and incubation experiment (Day, 1965; Amin and Flowers, 2004; Carney and Matson, 2005; Fang, 2007). Then, soils were subjected to physical, chemical and microbial analyses.

Soil characteristics & texture:

Soil samples were analyzed for major exchangeable cations using an ion exchange method (Rowell, 1996), pH was measured with a pH meter, chloride by titration with (0.01N) $AgNO_3$ according to the Mohr method; carbonate and bicarbonate were titrimterically estimated as described by (Jackson, 1958), Electrical conductivity EC (ds.m-1) at 25ºC was determined in soil extract by using EC- meter (Hesse, 1972). Organic matter and total nitrogen were estimated using Walkely and Black; Micro-kjeldahl methods respectively as mentioned in (Rowell, 1996), estimation of available phosphorus was done according to the Olsen's method; Calcium, Magnesium, and sulfate by Versene method; flame photometer was used for estimation of sodium and potassium (Rowell, 1996), and particle size distribution (psd) were determined according to the international pipette method (Day, 1965).

Microbial Community Analyses:

Microbial communities in soils were typically assessed using viable plate count method for counting bacteria and fungi. One gram of air dried soil was placed in 99 ml sterile physiological saline and shaken for 30 min. After settling, soil suspension was diluted ten folds. From each diluted sample, 3 petri plates for bacteria and 3 for fungi were inoculated with 1 ml of the suspension. It was determined that dilutions of 10^{-4}, 10^{-5}, and 10^{-6} were the most appropriate for bacterial counts, and 10^{-2} and 10^{-3} were used for fungi. The numbers of bacterial and fungal colony-forming units (CFU) per gram soil were estimated. The selective medium of nutrient agar was used for detection of bacteria and sabouraud dextrose agar for fungi (Schenck, 2003). Petri plates were incubated for 2 days/37°C and 7 days/ 25°C for bacteria and fungi respectively, which monitored daily for the appearance of colonies. Then, the plates were counted for bacteria and fungi and calculation was made according to (Benson, 2001). As follows:

Colony forming unit (CFU)/ gram of soil = count/plate dilution used.

Design of experiment:

Microbial respiration (mineralization of carbon) was determined by measuring either the release of CO_2, or the uptake of O_2. Measurement of CO_2 production is more sensitive than O_2 uptake method (Popelářová *et al.,* 2008). In this study the potential of soil texture on C-mineralization rates were determined in mesocosms (that is, mason jars) in aerobic incubation method described by Motavalli *et al.* (1995), Carney and Matson (2005). Triplicates of 100g dry soil samples were mixed thoroughly with plant residues at the rate of 2.0g plant residue /100g dry soil (amended soil) and other sets of soil jars without plant residue (unamended soils) served as control were also prepared to control released CO_2 from mineralization of native organic matter in soil samples. Soils were kept at a constant soil moisture (50%) and temperature (25°C). Mineralized carbon was evaluated seven successive times each at seven days interval using CO_2 respiration method (Carney & Matson, 2005).

Catabolic Potential Assay:

For CO_2 absorption the soil was kept in sealed glass jars, containing trapping alkali solution vial (15 ml, 1M NaOH). Alkali solution was replaced with a fresh prepared NaOH at every week of the examination period (Alef, 1995). Upon replenishing the NaOH solution, the jars were opened and samples were reaerated to supply adequate oxygen. The evolved CO_2 was trapped by NaOH and the excess alkali was titrated with 1M HCl after precipitating the carbonate with 15% $BaCl_2$ solution in the presence of phenolphthalein (Nourbakhsh, 2003; Naher *et al.,* 2004; Raiesi, 2006). The cumulative C mineralization was calculated as the difference between CO_2 evolved from the soil-containing residue and CO_2 evolved from the soil without residue (control). The measurements were carried out in triplicate and C mineralization was averaged for all three replicates (Jensen *et al.,* 1996; Raiesi, 2006).

Statistical analysis

Data of soil chemical and biological parameters were tested using one-way analysis of variance (ANOVA, n=3) and Duncan's test was used for mean comparisons at level ($p \leq 0.01$). Correlation co-efficient was performed in order to detect the relationships between soil chemical parameters and microbial communities, as well as correlation between soil carbon, and nitrogen contents with mineralization process using ver. 11.5 (SPSS Inc.).

RESULTS AND DISCUSSION:

From the nine collected soils, six different textural soil classes (sandy loam, loamy sand, silty loam, silty clay laom, loam and clay laom) were detected (Table 1).

Table 1. Soil locations and textural classification

Soil series	Different locations of soil samples		Textural class
	Location name	Replications in catabolic assay	
1. (A)	Arbat	Three replicates	1.Sandy loam
2. (G)	Grgasha	Three replicates	
3. (M)	Mawat	Three replicates	2. Loamy sand
4. (T)	Tabeen	Three replicates	3. Silty loam
5. (Q)	Qaradagh	Three replicates	4. Silty clay loam
6. (S)	Sharazwr	Three replicates	
7. (C)	Sulaimani	Three replicates	
8. (Qa)	Qashan-Mawat	Three replicates	5. Loam
9. (P)	Penjween	Three replicates	6. Clay loam

Soil chemical properties:

Soil chemical properties are shown in tables 2 & 3. The data of soil pH values showed significant differences ($P \leq 0.01$) among different soil textures, since the lowest value (pH=6.6) was recorded in clay loam and the highest one (pH=7.75) in silty loam (Table 2). Soil pH might be related to soil sulphate concentration (Table 3), since clay loam soil showed the highest sulphate concentration (1.38 m mol L^{-1}). The results of soil textures showed no significant effects on concentration of (Mg^{+2} & Na^{+}) ions and available phosphorus. However, high significant differences in Ca^{+2}, HCO^{-}_{3}, Cl^{-}, and $CaCO_3$ among different soil textures were recorded (Table 3).

Table 2. Total soluble salts (E.C, ds.m^{-}1) and pH of different soil textures (values are mean ± S.E)

Soil texture	(E.C) ds.m^{-1}	(pH)
Sandy loam	0.36±0.05^{a}	7.58±0.01^{ab}
Loamy sand	0.55±0.04^{a}	7.57±0.02^{ab}
Silty loam	0.69±0.01^{a}	7.75±0.05^{b}
Silty clay loam	0.85±0.23^{a}	7.29±0.09^{a}
Loam	0.99±0.01^{a}	7.47±0.02^{ab}
Clay loam	0.36±0.03^{a}	6.60±0.10^{c}

Values followed by different letters are significantly differed at a ($P \leq 0.01$)

Table 3. The soluble ions (mmole.L-1) and other chemical properties of different soil textures; values are mean ± S.E (n=3)

Soluble ions (mmole.L^{-1})	Soil texture					
	Sandy loam	Loamy sand	Silty loam	Silty clay loam	Loam	Clay loam
Calcium	1.42±0.20^{ab}	1.38±0.18^{ab}	1.90±0.10^{b}	1.21±0.11^{ab}	1.23±0.11^{ab}	0.95±0.04^{a}
Magnesium	0.42±0.01^{a}	0.60±0.01^{a}	0.71±0.01^{a}	0.41±0.08^{a}	0.51±0.01^{a}	0.62±0.02^{a}
Potassium	0.13±0.015^{a}	0.13±0.005^{a}	0.24±0.005^{b}	0.11±0.01^{a}	0.13±0.005^{a}	0.16±0.005^{a}
Sodium	0.46±0.04^{a}	0.37±0.03^{a}	0.51±0.01^{a}	0.51±0.18^{a}	0.58±0.03^{a}	0.44±0.01^{a}
Bicarbonate	2.89±0.08^{b}	3.21±0.11^{b}	2.57±0.07^{ab}	3.00±0.23^{b}	2.62±0.12^{ab}	2.00±0.01^{a}
Chloride	0.52±0.01^{ab}	0.72±0.01^{b}	0.61±0.01^{ab}	0.51±0.09^{ab}	0.31±0.01^{a}	0.41±0.01^{ab}
Sulphate	0.63±0.18^{a}	0.42±0.08^{a}	0.66±0.06^{a}	0.67±0.12^{a}	0.57±0.07^{a}	1.38±0.18^{b}
Available Phosphorus (mg.Kg^{-1})	4.66±1.35^{a}	5.56±0.76^{a}	3.95±0.85^{a}	4.47±0.47^{a}	5.36±1.06^{a}	4.36±0.86^{a}
CaCO3 (g.Kg^{-1})	130.2±12.7^{ab}	131.1±10.9^{ab}	175.6±5.55^{b}	114.2±7.85^{a}	122.6±11.4^{a}	82.6±2.55^{a}

Values followed by different letters are significantly differed at a ($P \leq 0.01$)

The present study (Table 4) indicated that the highest value of soil organic and total nitrogen contents were recorded in fine texture soils (clay loam, loam, and silty clay loam), whereas the lowest contents were in coarse texture soil (loamy sand silty loam). These differences were documented previously by Silver *et al.* (2000), who found that soil texture plays a key role in belowground C storage in soil ecosystems and strongly influences nutrient availability and retention, particularly in fine textural soils. Recently, Matus *et al.* (2008) observed that soil organic C tends to be associated with the fine fraction of soils and it was significantly greater three times in clay-rich soils than coarser soils. Fine texture soil shows more stable aggregates, which in turn may act as a media of greater amount of organic C and total nitrogen contents (Raiesi, 2006).

Table 4. Organic matter and total nitrogen in various soil textures (values are mean ± S.E)

Soil Texture	Organic matter (g.Kg^{-1})	Total nitrogen (mg.g^{-1})	mg of C/100g soil
Sandy loam	20.65±0.05^{b}	0.77±0.01^{bc}	318.76±21.6^{a}
Loamy sand	10.25±0.15^{a}	0.34±0.0^{ab}	316.65±3.79^{a}
Silty loam	13.35±0.15^{ab}	0.48±0.03^{ab}	312.67±2.67^{a}
Silty clay loam	27.43±2.77^{c}	1.04±0.10^{d}	338.9±2.86^{ab}
Loam	14.35±0.15^{ab}	0.53±0.03^{abc}	348.81±2.41^{b}
Clay loam	24.80±0.20^{c}	0.88±0.03^{cd}	351.38±4.05^{b}

Values followed by different letters are significantly differed at a ($P \leq 0.01$)

Effect of soil texture on soil microbial populations:

Bacteria and fungi were counted according to Zak *et al.* (1994) who stated that bacteria and fungi are the major types of microorganisms found in soil and play an essential role in nutrient transformations and litter decomposition rates.

The average counts of bacteria and fungi in different soil textures are expressed as log of colony forming unit CFU per 1 g dry soil (Table 5). Bacteria ranged between 6.07–8.77 log of CFU per 1 g dry soil; fungi from 4.09–4.49 log of CFU per 1 g dry soil. The results showed that clay loam and silty clay loam soil showed the highest bacterial populations 8.77 and 8.03 log of CFU per g air dry soil, respectively. However, the lowest level of bacterial populations were detected in sandy loam and silty laom soils (6.07 and 6.42 log of CFU per g dry soil), respectively. Previous studies showed that soil types influence the structure of microbial communities, especially bacterial population among soils of different textures (Garbeva *et al.,* 2004 and Fang *et al.,* 2005). On the other hand, no significant differences were noticed among average counts of soil fungi due to soil textures.

Table 5. Average counts of microorganisms in different soil textures (values are mean ± S.E.)

Soil texture	Log CFU of bacteria /g of soil	Log CFU of fungi/g of dry soil
Sandy loam	6.07^{a}	4.29^{a}
Loamy sand	6.77^{a}	4.49^{a}
Silty loam	6.42^{a}	4.37^{a}
Silty caly loam	8.03^{b}	4.35^{a}
Loam	6.81^{a}	4.09^{a}
Clay loam	8.77^{b}	4.36^{a}

Values followed by different letters are significantly differed at a ($P \leq 0.01$)

It could be indicated that the average counts of microorganisms correspond with usual counts of microbes in arable soils (Paul, 2007), and the same results in evaluating both groups of microorganisms in different soil types were obtained previously (Critter *et al.,* 2002; Popelářová *et al.,* 2008), possible explanation for the higher number of bacteria in soil with clay contents was documented by Carney and Matson (2005) who mentioned that fine textured soils support more microbial biomass than coarse textured soils. The distribution of microorganisms in various soil textures might be related to soil moisture and nutrient contents as explained by Heritage *et al.* (2003), who stated that sandy soils cannot retain water very well and drain very quickly. In contrast, clay loam preserves water and hold nutrients for longer period of time**.**

Carbon Mineralization:

Statistical analysis illustrated that CO_2 effluxes from bacterial utilization of carbon substrate in plant residue showed a significant difference ($p \leq 0.01$) among clay loam, loam and silty clay loam texture, which amended with plant residue during incubation time. They had higher CO_2 effluxes than silty loam, sandy loam and loamy sand textures, where the later three soil types showed no significant differences among them (Table 4). Soil texture affects litter decomposition by altering soil water availability, pore size distribution, nutrient availability, and surface area (Scott, 1996).

The patterns of CO_2-C evolution against time for the soil treated with the same plant residues were some what similar. Results showed that, in general, the amount of CO_2-C initially released rapidly during the first 7 days followed by a more slowly evolution during the rest of incubation period and decreased over the time. The present data revealed that soil texture had a marked influence on the cumulative CO_2 where the cumulative amount of CO_2-C released (Fig. 1), were significantly higher ($P \leq 0.01$) in fine textural soils than coarse textural soil samples.

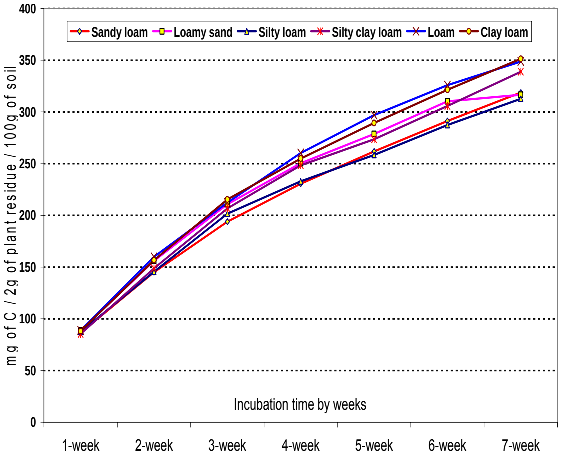

Fig. 1. Cumulative mean of C mineralization in treated soils with plant residue during seven weeks of laboratory incubation at 25°C

Soil represents a highly heterogeneous environment for the microbiota inhabiting it; whereas the different components in soil (sand, silt, clay, and organic matter) provide different microhabitats. The indigenous organisms in soil are exposed to abiotic and nutritional conditions that may vary even over the micrometer scale (Garbeva *et al.,* 2004). Chemical and physical disturbances of soil organic matter have been proposed as mechanisms for increasing the flush of CO_2 associated with soil properties and microorganisms, which are critically important in the decomposition of crop residue (Jensen *et al.,* 1996). Therefore, correlations between soil parameters and soil microorganisms, bacteria, and fungi are useful for better understanding degradation of added plant residue, total nitrogen (r=0.59, r=0.42), organic matter (r=0.6, r=0.09) soluble chloride (r=0.56, r=0.79), bicarbonate (r=0.41, r=0.56), are among soil chemical components that are positively correlated with bacterial and fungal population in all soil textures. Furthermore, soluble calcium, potassium and sodium (r=-0.4, r=-0.44,

$p \leq 0.01$) are negatively correlated with bacteria and fungal population in all soil samples.

This study shows that microbial activity in soils is often limited by the soil textural class, availability and concentration of substrates and nutrients. This trend was confirmed by the result of C-mineralization process, which showed a positive correlation with the amount of soil organic matter, total nitrogen contents ($r=0.62$, $r=0.61$, $p \leq 0.001$), respectively. Also, the additions of plant residue to soil samples generally enhanced C mineralization as affected by large amounts of available resources of carbon and nutrient availability for microbial activity. This is in agreement with results obtained by Wright and Reddy (2001), who reported a stimulated heterotrophic microbial activity after additions of substrates containing C, N, and P.

Soil texture represents one of the most important factors influencing the structure of microbial communities as well as, pH, cation exchange capacity, and organic matter content, can affect microbial community structure directly by providing a suitable habitat for specific microorganisms which in turn making a maximum degradation process (Girvan, *et al.,* 2003). In conclusion it could be suggested that interactions among soil organic matter and total nitrogen contents with soil texture may enhanced soil microbial communities and their functions for degradation of plant residue. Accordingly the present data supported that soil textures and soil chemical properties are the dominant factors that influencing the extent of decompositions process.

REFERENCES:

Alef K. 1995. Estimation of microbial activities. In: “Methods in Applied Soil Microbiology and Biochemistry, (Alef K, Nannipieri P Eds)”. Acad. Press: New York. P. 193–262.

Amin M, Flowers T. 2004. Effect of two applications of substrate on nitrification and pH soils. J. Res. Sci., 15(3): 263-269.

Benson T. 2001. Microbiological Applications Laboratory Manual in general microbiology. Eighth Edition. The McGraw−Hill.

Bismarck NH, Dominique M, Luc A. 2006. Effect of fallowing on soil organic matter pools and associated microbial activities in a humid savannah (Mangodara, Burkina faso). World J. Agr. Sci.*,* 2(2): 180-184.

Carney KM, Matson PA. 2005. Plant communities, soil microorganisms, and soil carbon cycling: does altering the world belowground matter to ecosystem functioning? Ecosystems, 8: 928–940.

Critter S, Freitas S, Airoldi C. 2002. Comparison between microorganism counting and a calorimetric method applied to tropical soils. Thermochim. Acta, 394: 133–144.

Day PR. 1965. Particle fraction and particle size analysis, in method of soil analysis. Part 1: Agronomy monograph. Am. Soc. Agron., Medison.

Dinnes D, Jaynes D, Kaspar T, Colvin T, Cambardella C, Karlen D. 2000. Plant-soil-microbe n relationships in high residue management systems. USDA-ARS National Soil Tilth Laboratory.

Fang M, Kremer RJ, Motavalli PP, Davis G. 2005. Bacterial diversity in rhizospheres of nontransgenic and transgenic corn. Appl. Environ. Microbiol., 71: 4132–4136.

Fang M, Motavalli P, Robert J, Kelly A. 2007. Assessing changes in soil microbial communities and carbon mineralization in Bt and non-Bt corn residue-amended soils. Appl. soil ecol., 37: 150–160.

Franzluebbers AJ. 2002. Ecology and the cycling of carbon and nitrogen. Marcel Dekker. Madison Avenue. New York. pp. 374-377

Garbeva P, van Veen JA, van Elsas JD. 2004. Microbial diversity in soil: Selection of microbial populations by plant and soil type and implications for disease suppressiveness. Ann. Rev. Phytopathol., 42: 243–70.

Girvan MS, Bullimore J, Pretty JN, Osborn AM, Ball AS. 2003. Soil type is the primary determinant of the composition of the total and active bacterial communities in arable soils. Appl. Environ. Microbiol., 69: 1800–1809.

Hanisch K, Schweitzer B, Simon M. 1996. Use of dissolved carbohydrate by planktonic bacteria in a mesotrophic lake. Microbial Ecol.*,* 31(1): 41-55.

Heritage J, Evans E, Killington R. 2003. Microbiology in action. Cambridge University Press.

Hesse PR. 1972. A textbook of soil chemical analysis, William Glowers and Sons Limited, London, Beccles and Cochester, UK.

Hessen DO .1992. Dissolved organic carbon in a humic lake: effects on bacterial production and respiration. Hydrobiology*,* 229: 115-123.

Hiroki M. 1995. Study on carbon flow by microbial community in the soils of temperate zone. Soil Sci. Plant Nutr., 41: 262-266.

Jackson M. 1958. Soil Chemical Analysis, New Jersey: Prentice-Hall Inc.

Jensen LS, McQueen DJ, Ross DJ, Tate KR. 1996. Effect of soil composition on N-mineralization and microbial-C and –N II: Laboratory simulation. Soil Till. Res.*,* 38: 189-202.

Matus FJ, Christopher HL, Christian RM. 2008. Effects of soil texture, carbon input rates, and litter quality on free organic matter and nitrogen mineralization in Chilean rain forest and agricultural soils. Commun. Soil Sci. Plan., 39:187 – 201.

Moran MA, Hodson RE. 1989. Formation and bacterial utilization of dissolved organic carbon derived from detrital lignicellulose. Limnol. Oceanogr., 34(6): 1034-1047.

Motavalli PP, Frey SD, Scott NA. 1995. Effects of filter type and extraction efficiency on nitrogen mineralization measurements using the aerobic leaching soil incubation method. Biol. Fert. Soils, 20: 197–204.

Naher UA, Hashem MA, Uddin MK, Ahmed M, Saleque MA. 2004. Carbon mineralization and carbon dioxide evaluation rate of cow dung and poultry manure along with rice straw and lime under covered condition in the topical environment. Pakistan J. Biol. Sci., 7(2): 155-158.

Nourbakhsh F. 2003. Fate of Carbon and Nitrogen from Plant Residues Decomposition in a Calcareous Soil. Plant Soil Environ., 52(3):137–140.

Paul EA. 2007. Perspective in soil microbiology, ecology and biochemistry. In: “Soil Microbiology, Ecology and Biochemistry, (Paul EA. ed.)”, Academic Press and Elsevier Inc. Burlington. 3: 3–24.

Popelářová E, Voříšek K and Strnadová S. 2008. Relations between activities and counts of soil microorganisms. Plant Soil Environ., 54 (4): 163–170.

Raiesi F. 2006. Carbon and N mineralization as affected by soil cultivation and crop residue in a calcareous wetland ecosystem in Central Iran. Agr. Ecosyst. Environ., 112: 13–20.

Rowell D L. 1996. Soil Science, Method and application, University of Reading, UK.

Schenck S. 2003. Soil incorporation of covercrop biomass: Effects on soil microorganisms and nitrogen levels. Hawaii Agriculture Research Center. Diversified Crops Report No. 23.

Scott J, Robert J. 2006. Soil texture and nitrogen mineralization potential across a riparian toposequence in a semi-arid savanna. Soil Boil. Biochem., 38(6): 1325-1333.

Scott NA. 1996. Soil textural control on decomposition and soil organic matter dynamics. Soil Sci. Soc. Am. J., 60:1102-1109.

Silver W, Neff J, McGroddy M, Veldkamp E, Keller M, Cosme R. 2000. Effects of Soil Texture on Belowground Carbon and Nutrient Storage in Lowland. Amazonian Forest Ecosystem. Ecosystems, 3: 193–209.

Wright AL, Reddy KR. 2001. Heterotrophic microbial activity in northern Ever glades wetland soils. Soil Sci. Soc. Am. J., 65: 1856–1864.

Zak D R, Tilman D, Parmenter R R, Rice CW, Fisher FM, Vose J, Milchunas D, Martin CW. 1994. Plant production and soil microorganisms in late successional ecosystems. A continental-scale study. Ecology, 75(8): 2333-2347.

تأثيرات قوام التربة على التراكيب الكيميائية والعشائر الميكروبية وعملية معدنة الكربون في التربة

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الهدف من هذه الدراسة هي أولاً: تَحديد تأثير قوامِ التربةِ على خواصها الكيميائية وتوزيع العشائر الميكروبية في التربة التي جمعت من تسعة مناطق مختلفة بمحافظة السليمانية، ثانياٍ: معرفة الارتباطات بين تعدين الكربون والمعايير المُجرّبةِ. بعد التحاليل صنفت التربة إلى ستة أصناف من قوام التربة (رملية مزيجية, مزيجية رملية , مزيجية غرينية, غرينية طينية مزيجية، تربة مزيجية وتربة طينية مزيجية) والتي كانت لها تأثير معنوي ($p\leq0.01$) على تركيز معظم الأيونات القابلة للذوبان (كالسيوم،بوتاسيوم, بيكاربونات,كلور, سلفيت) والمواد الكيميائية الأخرى للتربة (فوسفات،كالسيوم كاربونات, والمواد العضوية والمحتوى النيتروجين الكلي)، وكذلك أثرت على توزيع المجتمعات البكتيرية للتربة والتي ترتبط ارتباطا وثيقا مع نوعية القوام. من جهة أخرى أظهرت النتائج تعدين الكربون بأستخدام طريقة تنفس ثاني اوكسيد الكربون في الظروف المختبرية للتربة المعالجة بأضافة 2جم من أوراق نبات والتربة غير المعالجة (السيطرة), أن معدلات CO_2 في تربة ذات قوام دقيقة (تربة طينية مزيجية, مزيجية ,غرينية طينية مزيجية)كانت أعلى معنوياَ ($p\leq0.01$) مقارنة بترب ذات قوام خشنة (مزيجية غرينية, رملية مزيجية, مزيجية رملية) على التوالي, وكذلك أظهرت النتائج أن معدلات التعدين كانت إيجابية الارتباط مع تركيز الَمواد العضويَة و النتروجينِ الكليٍّ للتربة (R=0.62, R=0.61) على التوالي, وأخيرا أوضحت هذه الدراسة بان (1) القدرة على حفاظ المواد العضوية والنيتروجين الكلي في تربة ذات حبيبات طينة و غرينيه كانت أكبر مقارنة بالرملية,(ب) العوامل غير الحيوية بما فيها قوام التربة ومكوناتها الكيميائية كانت لها تأثير على تركيب ونشاط العشائر الميكروبية للقيام بعملية تعدين الكربون.

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