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RELATIONSHIPS BETWEEN OF CARBON, NITROGEN STOCKS AND TEXTURE OF THE HARRAN PLAIN SOILS IN SOUTHEASTERN TURKEY

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Abstract

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Present studies have focused on carbon (C) and nitrogen (N) stocks of soils because of increases in atmospheric carbon dioxide (CO_2) and terrestrial ecosystems with wide N storages. Total C amounts were between 3.61 and 6.47 kg C m^{-2} and total nitrogen amounts were between 0.73 and 0.99 kg C m^{-2}. C:N ratios were between 4.3:1 and 6.0:1 and bulk density (BD) was between 1.23–1.34 Mg m^{-3}. Carbon and N stocks were determined as 10.53 Tg C and 1.96 Tg N, respectively. A highly significant relationship existed between carbon and nitrogen contents (R^2=0.99; p<0.01). Soil organic carbon (SOC) concentration was found to be directly related to soil texture at all depths. A very strong relationship was found between SOC and soil texture in Harran Plain soils. According to statistical analyses (p<0.001), the strongest relationship was detected between SOC and clay (R^2=0.96) and silt (R^2=0.95). The relationship between sand and SOC was determined as (R^2=0.65). The findings indicated that, in practice, areas containing low carbon should be preferred for use in carbon storage rather than areas containing high carbon stocks.

*Key words***:** Carbon cycle, nitrogen cycle, nitrogen, carbon, C:N ratios, soil texture
Abbreviations: C, carbon; SOC, soil organic carbon; N, nitrogen; SAR, Southeast Anatolia Region; BD, bulk density; SOM, soil organic matter; CV, coefficient of variation; TSMS, Turkish state meteorological service

Introduction

The importance of the biogeochemical cycles of carbon and nitrogen has increased in terrestrial ecosystems throughout the world because of their oxidation into gasses and emission into the atmosphere plays an important role in global warming maintenance (Post and Kwon, 2000). Moreover, changes in SOC pools can increase the carbon dioxide (CO_2) concentrations in the atmosphere (Smith, 2008). Therefore, understanding soil carbon storage potential and developing effective methods to decrease the atmospheric CO_2 concentration are vitally important (Fu et al., 2010).

Soil is one of the most important C and N pools, and including approximately 75% OC and 95% N (Schlesinger, 1997). The plants that are present, which affects the ecosystem yield and the terrestrial C cycle, affect the interaction between SOC and N. Numerical models of C and N cycles include terms for the climate, the atmosphere and land-use alternation (Homann et al., 2000; Kirschbaum, 2000; Pepper et al., 2005). Jenny (1941) synthesised and summarized the interaction between climate and soil humidity. According to her study, when humidity increases, the N ratio in soil increases in the meadows lands.

Soil texture (silt+clay+sand) protected soil organic matter (SOM) from being decomposed by physical, chemical and biological mechanisms (Six et al., 2002; Krull et al., 2003). It was suggested that chemical stabilization of organic molecules were well protected via

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mineral-organic matter bond from the beginning. According to some evidence, clay concentration affects SOC accumulation in different ratios. It was found that maximum and medium SOC increased with increasing clay content in soil (Nichols, 1984; Burke et al., 1989). However, it was expressed that this relationships was not global and SOC was sometimes much more strongly related to other factors in comparison to clay (Percival et al., 2000; Krull et al., 2003). The relationships between clay concentration and SOC content was expressed to be strong (at a sufficient level) according to SOM models such as Century (Parton et al., 1987) and RothC (Jenkinson, 1990). As clay concentration increases, SOM weathering decreases. It was determined that, if other factors were fixed, as clay concentration increased, SOC accumulated faster (Jenkinson, 1990). Many studies determined that soil texture affected soil aggregation (Chaney and Swift, 1984; Schlecht-Pietsch et al., 1994). As the clay content increases, they combine with SOC aggregate stability. It affects the increase in soil aggregation and clay content and indirectly affects SOC stores by absorbing organic materials in soil. For this reason, soil texture also plays direct and indirect roles in chemical and physical protection mechanisms (Plante et al., 2006).

In studying ecosystem stability, it is important worldwide to determine C:N ratios and create data banks of the results because this ratio serves as an indicator of stability and examine the affects of abiotic factors such as climate, temperature and rainfall as well as texture on SOC stocks and accumulation. The goal of this study was to determine the C and N stocks, the C:N ratios and the relationship between C and N using samples taken from 16 soil profiles in the Harran Plain soils that cover around 225 000 ha.

Materials and Methods

The Study Area

The study was carried out in the Harran Plain located in the Southeastearn Turkey; between 38º 48’ to 39 º 12’ E longitudes and 37º 09’ to 36º 42’ N latitude. The total area of the plain is 225 000 ha (Figure 1). Rainfall is limited during most of the year, and the climate is arid. According to 33 years of data (1975–2008) from the Turkish State of Meteorology Service (TSMS, 2008), the average annual precipitation was 277.8 mm at Akcakale station and 448.1 mm at Sanliurfa station. The soil moisture regime of important parts of the plain is Xeric, and the temperature regime is Mesic. An Aridic soil humidity regime is seen in parts of the areas near the south of the plain (Soil Survey Staff, 1996).

Laboratory Analysis

Soil samples were taken from 16 series of genetic horizons on the Harran Plain. The soil samples were dried at room temperature and passed through a 2 mm sieve prior to analysis. The bulk density (BD) (Mg m^{-3}) was determined according to Black (1965). The organic carbon content was estimated by titration the samples boiled with sulphuric acid and Fe_2SO_4 (Walkely and Black, 1934). The SOC (kg C m^{-2}) stock was calculated according to Batjes (1996) (Eq 1). The nitrogen content was analysed using the micro-Kjeldahl method (AOAC, 1990). The samples were read on a device that was set at 850 ºC (FP 526 LC, LECO). The total nitrogen stock (Kg N m^{-2}) was computed with the method that was used for calculating the SOC stock. Students t-test was used on all of the data comparisons

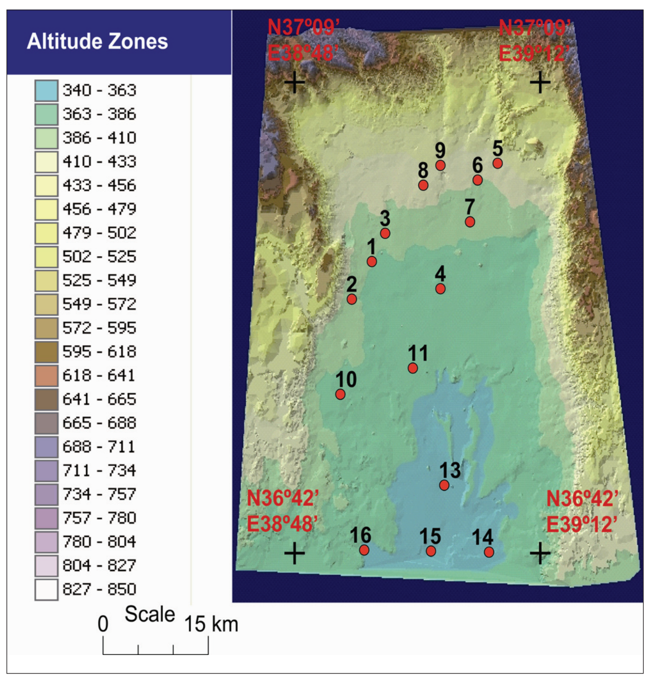

Fig. 1. Study area of Harran Plain

and equation determinations and the data were examined at $p<0.05$ and $p<0.01$ significance levels.

$$SOC = (Di \times D_bi \times \%OCi/1.724) \times 10, \quad (1)$$

where SOC is the soil organic carbon stock (kg C m^{-2}), D_bi is the bulk density (Mg m^{-3}) of layer i, Oci is the proportion of organic carbon (%) in layer i, Di is the thickness of the layer (cm), 0.58 (1.724) is the Van Bemmelen factor.

Results

Soil organic carbon stocks

The total carbon amounts changed between 3.57 and 6.47 kg C m^{-2}. The SOC content was at its lowest in the Harran series (3.57 kg C m^{-2}) and at its maximum level in the Sırrın series (6.47 kg C m^{-2}). The carbon amounts of the other series varied significantly ($p<0.05$) and are shown in Table 1. The organic carbon stock of the Harran plain was 10.53 Tg C. The organic carbon contents were higher on the northern side where precipitation was higher. It is commonly known that, in general, temperature decreases as precipitation increases. High temperatures generally accelerate organic matter decomposition; hence, SOC decreases. Whereas the precipitation amount was 277 mm in the southern region, it was nearly 450 mm in the north. Therefore, carbon amounts were lower in the southernmost Akcakale series than in the northern Sırrın series. The carbon content of the plain was higher than that expected of an arid or semi-arid region because of increased soil depth, movement and accumulation of surface materials from high areas to the plain, high clay content (45–73%), too much calcareousness, and the constant rejuvenation of the plain soils.

Total nitrogen stocks

The total nitrogen contents were between 0.72 and 1.07 kg N m^{-2}, with the lowest content occurring in the Akcakale series and the highest content occurring in the Sırrın series. The nitrogen amounts of the other series are represented in Table 2. The total N stock was 1.96 Tg N on the Harran plain. The nitrogen content, like the carbon content, was higher in the northern profiles than in the southern profiles. It is hypothesised that the reason for this is high precipitation. Moreover, there is little effect of temperature and humidity parameters affecting carbon stocks on nitrogen stocks. However, to explain their relation with nitrogen, guesses are done related to their effects on carbon.

Table 1
Carbon amounts of Harran Plain soils, kg C m^{-2}

Soil series[a]	N	Mean	Min.	Max.	CV[b]	Total SOC[c]
Ugurlu	10	1.14	0.78	1.47	22.38	4.62
Cekcek	10	0.80	0.57	0.93	19.90	4.03
Sultantepe	10	0.97	0.43	1.47	43.87	4.84
Kisas	10	1.01	0.29	1.76	67.14	4.75
Bellitas	10	1.38	0.56	1.96	45.99	4.94
Bozyazi	10	1.23	0.94	1.64	21.75	5.04
Ikizce	10	1.44	0.79	1.98	39.71	5.22
Sirrin	10	1.85	0.91	2.79	47.71	6.47
Irice	10	1.54	1.21	1.86	19.76	5.85
Begdes	10	1.16	0.34	1.98	69.40	5.45
Harran	10	0.85	0.63	1.26	29.79	3.57
Gurgelen	10	0.87	0.58	1.21	32.33	3.78
Akoren	10	1.00	0.89	1.21	12.17	4.06
Ekinyazi	10	1.72	1.06	2.16	34.63	4.31
Akcakale	10	1.26	0.8	1.46	20.81	3.61
Kap	10	1.44	1.21	1.62	10.20	4.29

[a]Soil series are listed by Dinc et al. (1988); [b]CV is the coefficient of variation (%)
[c]Soil depth of 100 cm total SOC; N is number of observations

Carbon: nitrogen (C: N) ratios

The C: N ratios were important ($p<0.01$) in all series throughout the profile (100 cm). The average C: N ratios of all of the series were ordered as follows: Sırrın›Irice›Bellitas› Ikizce› Begdes›Ugurlu›Gurgelen ›Ekinyazi›Akoren›Kısas›Sultantepe›Akcakale›Kap›Bozyazi›Cekcek›Harran (Table 3). The C: N ratios were generally high in areas where the altitude, the vegetation and the precipitation were high. The C: N ratio was similar in the plain soils. This shows that the resolution and separation amounts are high. Moreover, the application of too much nitrogen fertiliser may have narrowed this ratio. A highly significant relationship existed between carbon and nitrogen contents ($R^2=0.9973$; $p<0.01$).

The C: N ratios ranged between 5.38:1 and 6.33:1 in surface soils (0–20 cm). There was not much variation among the C: N ratios of the plain soils, which may be due to the similar climatic conditions and the agriculture management techniques adopted by the farmers. However, the small differences in the C: N ratios may also be due to variations in the microclimatic conditions, especially the temperature and the quantity and distribution of precipitation.

Discussion

SOC, N and C: N

In this study, a small difference was observed between SOC and total N stocks and C: N ratios of Harran Plain soils in the north-to-south direction. Average carbon stocks were slightly higher on the northern side than on the southern side, which may be due to higher precipitation on the northern portion than on the southern portion of the plain (450 mm vs. 277 mm). Furthermore, high precipitation caused temperatures to decrease to some extent. This corroborates the observation that the SOC content decreases with increases in the annual temperature, as reported by Post et al. (1982), Tremblay et al. (2002), Ganuza and Almendros (2003), Lemenih and Itanna (2004), Wang et al. (2004), and Sakin (2010). According to Yimer et al. (2006) and Sakin et al. (2010a:b:c), the SOC stocks increase based on annual precipitation and biomass amounts and decrease relative to temperature. Soil C and N stocks are affected by climate (Post et al., 1982). In line with several earlier studies (Bationa and Buerkert, 2001; Yimer et al., 2006; Moges and Holden, 2008; Fu et al., 2010), a very strong relationship between C and N was observed in this study.

Table 2
Nitrogen amounts of Harran Plain soils, kg N m^{-2}

Soil series[a]	N	Mean	Min.	Max.	CV[b]	Totan N[c]
Ugurlu	10	0.21	0.14	0.28	24.13	0.85
Cekcek	10	0.16	0.13	0.18	11.87	0.81
Sultantepe	10	0.19	0.12	0.26	27.85	0.94
Kisas	10	0.21	0.14	0.30	32.99	0.91
Bellitas	10	0.25	0.10	0.35	45.74	0.88
Bozyazi	10	0.29	0.16	0.28	19.80	0.94
Ikizce	10	0.26	0.14	0.37	42.11	0.93
Sirrin	10	0.32	0.15	0.49	51.30	0.97
Irice	10	0.26	0.20	0.33	23.29	0.99
Begdes	10	0.22	0.11	0.34	51.20	0.98
Harran	10	0.19	0.11	0.25	27.57	0.73
Gurgelen	10	0.18	0.14	0.24	23.97	0.76
Akoren	10	0.20	0.17	0.23	11.75	0.78
Ekinyazi	10	0.34	0.19	0.44	40.27	0.81
Akcakale	10	0.26	0.15	0.30	24.79	0.72
Kap	10	0.30	0.23	0.33	14.91	0.85

[a]Soil series are listed by Dinc et al. (1988); [b]CV is the coefficient of variation (%)
[c]Soil depth of 100 cm total N; N is number of observations

The total N amounts and stocks were high on the northern portion of the Harran plain. The high nitrogen content is probably due to the high SOC content. The main reason for this is high precipitation; Ganuza and Almendros (2003) verify this theory. The clay content of the plain soil is high. Although the effect of clay on nitrogen stocks and amounts is unknown, a positive relationship is predicted. Some studies (Cote et al., 2000) state that the net N mineralization decreases when the clay amount increases in the soil, but other studies have found that the effect of clay on the net N mineralization is low under different temperature and humidity conditions in the laboratory. McLauchlan (2006) explains that when clay amounts increase in soil, aggregate amounts increase dramatically and the potential net N mineralization decreases. Whatever, the age of the field, each 10% increase in clay concentration increases the aggregate size index by 0.039 and decreases the net N mineralization by 0.16 kg ha^{-1} day^{-1}.

The total nitrogen range (0.72–1.07 kg N m^{-2}, in 100 cm depth) observed was similar to those observed in several previous studies. Carter et al. (1998) reported a total nitrogen range of 0.36–1.05 kg N m^{-2} in Canada farming soils. Zinke and Stangenberger (2000) found 0.61 kg N m^{-2} in Sierra shallow cone forests and 0.27 kg N m^{-2} in Nevada forests. Other nitrogen ranges observed include 0.5 kg N m^{-2} in mineral soils (Vejre et al., 2003), 0.21–3.13 kg N m^{-2} in Amazon soils, 1.39 kg N m^{-2} in Podzol (Spodosol) soils, 1.03 kg N m^{-2} in Luvisoller (Alfisol) soils, 0.52 kg N m^{-2} in Arenosoller (Entisol) soils (Batjes, 1996), 0.17–0.29 kg N m^{-2} (Fu et al., 2010) and 0.05–1.65 kg N m^{-2} (Callesen et al., 2007). According to Callesen et al. (2007), N is higher in calcareous soils (1.12 kg N m^{-2}) than in fine-textured soils (0.62 kg N m^{-2}) and medium- and coarse-textured soils (0.51 and 0.48 kg N m^{-2}). In the research area, the Bellitas, Ikizce and CekCek series (Entisol) include, respectively, 0.81, 0.88 and 0.93 kg N m^{-2}; these amounts are high when compared with the Batjes (1996) studies and normal when compared with Batjes and Dijkshoorn (1999) study. It is hypothesised that this is based on high precipitation and soils that are calcareous and contain too much clay.

The C: N ratio in the surface soil was higher than that in lower portions of the subsurface soil horizons. This indicates high resolution and separation rates. Furthermore, it is thought that extreme cultivation techniques affect the C: N ratios. The C: N ratios varied between 4.86:1 and 6.02:1. Lal et al. (1995) indicated that C: N ratios are low during resolution and separation times.

Table 3
C:N ratios of Harran Plain soils, kg m^{-2}

Soil series[a]	N	Mean	Min.	Max.	CV[b]
Ugurlu	10	5.48	5.22	5.75	4.06
Cekcek	10	5.03	3.24	5.68	20.02
Sultantepe	10	5.08	2.62	5.78	27.09
Kisas	10	4.32	2.16	5.81	45.63
Bellitas	10	5.64	5.58	5.78	1.38
Bozyazi	10	5.17	4.27	5.81	15.97
Ikizce	10	5.61	5.37	5.78	3.91
Sirrin	10	6.04	5.75	6.30	4.43
Irice	10	5.87	5.68	6.33	4.91
Begdes	10	4.77	3.04	6.01	33.13
Harran	10	4.70	3.56	5.71	22.97
Gurgelen	10	4.80	4.01	5.58	15.18
Akoren	10	4.14	4.78	5.51	6.59
Ekinyazi	10	5.25	4.91	5.75	8.77
Akcakale	10	4.84	4.45	5.58	11.23
Kap	10	4.80	4.37	5.71	12.90

[a]Soil series are listed by Dinc et al. (1988)
[b]CV is the coefficient of variation (%); N is number of observations

Brady and Weil (2008) showed that C: N ratios varied between 8:1 and 15:1, with an average of 12:1. Batjes (1996) determined (at a depth of 100 cm) that the lowest average C: N ratio was 7:1 in Xerosols and that the highest average C: N was 24.5:1 in Podzols. Although the C: N ratios in this study showed similarities to the Batjes (1996) findings, this study's ratios were lower. It is hypothesised that this phenomenon was caused by low precipitation, high resolution and separation rates and extreme cultivation techniques. Whereas the C: N ratio increases with precipitation, it decreases with higher temperatures (Miller et al., 2004). Other researchers argue that there is a positive relationship between C: N ratios, precipitation and temperature (Callesen et al., 2007). It is argued that although the cultivation systems and farming activities used 10 years ago did not affect C: N ratios (Sainju et al., 2008; Fu et al., 2010), today's farming techniques and agriculture do affect C:N ratios (Puget and Lal, 2005; Yimer et al., 2007).

Soil texture and SOC, N and C: N

Soil texture analysis showed that the Harran Plain samples contained 65-28% clay, 41-22% silt and 3-31% sand. A summary of statistically analyses showing the distribution of texture particles of soil samples is presented in Table 4. Table 5 shows the statistical relationship between soil texture and organic carbon ($p \leq 0.001$). As shown in Table 5, a strong relationship was found between SOC and soil texture ($R^2=0.92$). Regression analysis of the relationship between soil texture particles and SOC is given in equation 2.

$$\text{SOC (kg C m}^{-2}) = 0.0305\ \text{Clay\%} + 0.0015\ \text{Silt\%} + 0.0162\ \text{Sand\%} \quad \text{(eq. 2)}$$

Statistical analyses between soil particles (clay-silt-sand) and SOC are given in Table 5. There was a very significant relationship between SOC and clay, silt and sand, with order or clay›silt›sand. It was observed that as the amount of clay in soil increased, the amount of SOC increased indicated by a close relationship between SOC and clay ($R^2=0.96$). Although it is a physical disadvantage that soils of Harran Plain are very clayish, it is an advantage for accumulation, protection of SOC. Clay constitutes organo-mineral complexes by combining with SOC in soil, and helps retain carbon within the soil for long periods. Since the soils contain 2:1 type clay minerals, the carbon entering into the layers are flipped and thus protected against oxidation and weathering of organisms. Some metals in soil, clay minerals, Ca and Fe constitute complexes with carbon in soil and protect carbon.

Plante et al. (2006) examined soils in Ohio and Saskatchewan, and found a statistically significant relationship ($r^2=0.48$, $p<0.01$) between clay and SOC. According to their study, as the amount of clay increased, the amount of carbon retained in soil also increased. Nichols (1984) and Burke (1989) determined a strong relationship between clay and organic carbon concentration ($r=0.86$) in Southern Great Plains soils. Arrouays et al. (2006) detected a very strong correlation between SOC and clay content. Burke et al. (1989) and Schjonning (1999) determined that SOC content and clay concentration were related. Many researchers reported a strong relationship between soil particles and SOC

Table 4
Statistical distibution of texture classes

	N	Mean	SD[1]
Clay (%)	131	51 504	7 054
Silt (%)	131	33 298	4 989
Sand (%)	131	15 290	6 844

[1]SD is standart deviation

Table 5
The relationships between of texture particles (clay-silt-sand) and SOC, N and C:N

Source	DF	F	P<(0.001)	R^2
Factor	1	6352.97	0.000	
Error	260			
Total	261			
Clay				0.96
Factor	1	4490.64	0.000	
Error	260			
Total	261			
Silt				0.95
Factor	1	492.77	0.000	
Error	260			
Total	261			
Sand				0.65
Factor	2	3273.59	0.000	
Error	390			
Total	392			
Clay + Silt				0.94

(Kern, 1994; Burke et al., 1995; Percival et al., 2000; Arrouays et al., 2006). In numerous studies, it is suggested that SOC storage depends on soil texture (Scott et al., 1996; Hassink and Whitmore, 1997). Kölbl and Kögel-Knabner (2004), determined that the amount of organic carbon in soil increased with the increase for clay. They also suggested that this relationship was not global, and sometimes depended on factors such as extractable aluminium, allophone content or physical surface area, that can extract SOC more than clay (Percival et al., 2000; Krull et al., 2003).

A strong relationship was detected between soil silt particles and SO (Table 5). A close relationship was found between soil organic carbon and silt (R^2=95.0). Therefore, it was determined that the most important particle in storing SOC was clay, followed by silt. A strong relationship was found between soil sand particles and SOC (Table 5). However, this relationship was not as strong (R^2=65.46) as that found for clay and silt.

Hassink and Whitmore (1997) determined that, on the condition that soil organic carbon combined with clay and silt fractions of soil, SOC retention was maximized, which was suggested to cause excessive accumulation of organic carbon in soil. Hassink (1997), Kiem et al. (2002), Kiem and Kögel-Knabner (2002), and Six et al. (2002) found that mineral soil particles (clay-silt) protected organic carbon against chemical weathering. Many studies indicate that soil texture affects aggregation (Chaney and Swift, 1984; Schlecht-Pietsch et al., 1994), and thus increasing clay content combines with increasing aggregation or aggregate stability. It was determined that, on the condition that soil aggregation increased, soil clay content affected carbon storage indirectly and thus soil carbon was protected against oxidation and organisms. According to Plante et al. (2006), there was a statistically significant relationship between SOC and clay + silt (p=0.99, r^2=0.76) in Ohio and Saskatchewan soils. Many researchers found a strong relationship between SOC and clay+silt. This correlation was observed, respectively, as: R^2= 0.91, R^2= 0.97, R^2= 0.98, R^2= 0.86 and R^2= 0.93 (Roscoe et al., 2001; Zinn et al., 2005). Plante et al. (2006) reported a direct proportional link between organic carbon concentration and silt+clay in the soil (R^2=0.48 and 0.46).

Contrary to the findings of the present study and previous studies in the literature, some researchers have reported a very weak relationship between SOC and texture. In a study of New Zealand soils, Percival et al. (2000) found a low relationship between clay and carbon concentration (r^2<0.05). McLauchlan (2006) reported a very slight relationship between SOC and texture, and thus texture had a lesser effect on SOC storage in comparison to other parameters. According to Six et al. (2000), clay concentrations have a very slight effect on SOC accumulation rate and soil aggregate dynamics are relatively affected by low clay concentration.

Although significant correlations between SOC and soil textural fractions, the relationships between soil textural groups and N and C: N were poor. The R^2 values between N and textural groups were 0.07 (p<0.01), 0.04 (p<0.01) and 0.10 (p<0.01) for sand, silt and clay, respectively. Although not very strong, the positive relationships have been found between clay and N whereas the correlations between N and other two fractions (silt and sand) were negative. Generally, concentrations of nitrogen are high in areas where the SOC is high. According to this relationship, clay decreases SOC oxidation. This shows a positive N relationship. Hence, it is hypothesised that there is a positive relationship between clay and nitrogen. Similar poor correlations have been obtained between N and soil clay (Yao et al., 2010).

The role of clay content is important within nitrogen cycle in soil, and plays a key role in the mineralization of nitrogen (Cote et al., 2000). According to some studies, nitrogen mineralization decreased with an increase in clay content (Cote et al. 2000; McLauchlan et al., 2006). The studies reporting decrease in net N mineralization with increasing amount of clay content help to explain the positive correlation between clay and nitrogen. McLauchlan (2006) stated that organic Nitrogen is protected in aggregates rich in clay, which explains the high concentrations of organic N onto clay particles. On the other hand, Vejre et al. (2003) found opposite results. They reported an inverse relationship between clay content and Nitrogen within soil depth of 100 cm. The soils they worked as Spodosol, Alfisol that are well weathered and formed under high precipitation.

Conclusion

Carbon amounts and stocks, N amounts and stocks and C:N ratios of plain soils are generally higher than similar environments. The reasons for the high C and N contents are high precipitation, high clay and calcareous contents, soil depths, material movement from high areas to the plains and soil regeneration. The close C:N ratios are based on high resolution and separation amounts because of high temperatures, oxidation and fertiliser usage by farmers, which contain high levels of nitrogen. A very strong relationship was determined between SOC and soil textural groups. SOC was positively correlated with Clay and Silt. Another important finding of the present study is a statistically strong relationship between sand and SOC. The results suggest that retaining SOC in arid and semi-arid regions maybe depend on texture fractions since the quantity of clay and silt is high in Harran Plain soils.

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