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Organic matter in size fractions of soils of the semiarid Argentina. Effects of climate, soil texture and management

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Abstract

Soil organic matter contents (SOM) of soils of the Semiarid Pampas of Argentina (SAP), mostly Entic Haplustolls, increase with the amount of silt + clay, but it is still not known how soil texture affects its qualitative composition in interaction with climatic and management conditions. Because of that the organic matter content of the following aggregate size fractions were determined: < 2000 μm (SOM), 100–2000 μm (YOM), < 100 μm (HOM), water floatable organic matter (FOM), and the E4/E6 quotient. These fractions were studied in the 20-cm topsoils of seven REFERENCE (virgin *Caldenal* savanna-like soils), and 10 CULTIVATED soils (under continuous conventional tillage since more than 50 years). Results showed that SOM of both REFERENCE and CULTIVATED soils was mainly composed by YOM (57%), and to a lesser extent by HOM (37%) and FOM (5%). Silt + clay conditioned positively the contents of SOM, YOM and HOM of both REFERENCE ($R^2 = 0.18$, $R^2 = 0.21$, $R^2 = 0.21$, respectively, $n = 21$, $p < 0.05$) and CULTIVATED soils ($R^2 = 0.62$, $R^2 = 0.44$, $R^2 = 0.52$, respectively, $n = 30$, $p < 0.001$). The positive relationship existing between silt + clay and both SOM and YOM seems to be not longer valid in sites with mean annual temperatures (MAT) higher than 17 °C. YOM and HOM accumulation were positively affected by precipitation and negatively by temperature in combination with silt + clay. This effect was more pronounced for HOM. The slopes of the regressions between SOM, HOM and YOM with silt + clay were more pronounced for REFERENCE soils than for CULTIVATED soils, indicating the largest absolute losses of these organic matter fractions in fine- rather than in coarse-textured soils. E4/E6 quotients were lower than 5 in all studied soils indicating that humic rather than

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fulvic acids exist in the well humified organic fraction of the studied soils. Contents of FOM and E4/E6 values did not correlated with the climatic conditions nor with soil texture or management. Potential SOM losses can be larger in fine-textured soils (up to 54.3 Mg C ha^{-1}) than in coarse-textured (up to 35.7 Mg C ha^{-1}). Probable changes of soil texture by wind erosion will modify absolute contents of SOM, YOM and HOM, while modifications of temperature or rains regimes will affect HOM more.

Keywords: Semiarid regions; Organic matter; Size fractions; Climate; Soil texture; Cultivation

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1. Introduction

The positive effect of soil organic matter (SOM) on soil properties has been demonstrated for many soil types (Burke et al., 1989; Rasmussen and Collins, 1991). The soil organic matter improves soil productivity, because it determines soil resistance to erosion, increases the soil water holding capacity and the nutrient availability to plants (Tisdale and Oades, 1982; Rasmussen and Collins, 1991; Gregorich et al., 1994). In the Semiarid Pampas of Argentina (SAP), Quiroga et al. (1999) demonstrated that an inverse relationship among SOM contents and soil compaction exists. Díaz Zorita et al. (1999) found that losses of 1 Mg SOM ha^{-1} were associated with a decrease in wheat yield of approximately 40 kg grain ha^{-1}.

Several studies demonstrated that some soil properties are dependent more on the amount of organic matter accumulated in different size fractions than on the SOM contents (Anderson et al., 1981; Tiessen et al., 1983; Dalal and Mayer, 1986). For instance, the amount of soil macro-aggregates increases when the particulate organic matter, a coarse sized SOM fraction composed by recently accumulated organic rests, increases (Cambardella and Elliot, 1992). On the other hand, soil microaggregation is improved by the amount of fine-sized humified organic matter (Buyanovsky et al., 1994). Nutrient availability to plants largely depends on the decomposition rates of particulate organic matter (Cambardella and Elliot, 1992; Gregorich et al., 1994).

The knowledge of how soil forming factors and soil management affect SOM contents and quality allows to determine soil productivity levels and soil behavior against degradation processes. In the SAP, it has been demonstrated that SOM depends on soil texture, as the amount of fine-sized fractions (silt + clay) increases the water holding capacity of the soil, the biological activity, and therefore, the deposition rates of organic residues to the soil and SOM contents (Buschiazzo et al., 1991). The accumulation rate of SOM as well as its fractions, depend on soil texture, and on precipitation and temperature (Amelung et al., 1998). Burke et al. (1989) found that organic carbon increases with precipitation and clay content and decreased with increasing temperature. Little information is available in relation to the combined effect of soil texture, climatic conditions and management systems on SOM quality in the SAP. Because of that the purpose of this study was to evaluate the SOM quality and quantity as a function of climate, soil texture, and management type in SAP.

2. Materials and methods

The study was carried out in 10 plain sites of the SAP. Their climatic and edaphic conditions are detailed in Table 1. Two soils placed 50 m apart were selected at each site. The parent material of the soils is loess, which clay fraction is composed mainly by montorillonite and illite (INTA et al., 1980). One of these soils was noncultivated (REFERENCE soil) in the savanna-like "Caldenal", an ecosystem composed by a bush strata dominated by "Caldén" trees (*Prosopis caldenia* Burkart) and a grass strata dominated by *Stipa tennuis* Phil., *Stipa speciosa* Trin. et Rupr., or *Panicum* sp. extensively grazed by cattle. The other soil was tilled with conventional tillage systems (disks and harrow disk up to 18 to 20 cm depth) more than 50 years (CULTIVATED soil). Most commonly crops were nonfertilized and not irrigated wheat (*Triticum aestivum*), oats (*Avena sativa*), corn (*Zea mays*) and sorghum (*Sorghum* sp.). A typical crop rotation carried out on CULTIVATED soils in this region is: wheat–cattle grazed oat–summer crop (sunflower, corn or sorghum).

In Spring 1996, triplicate random 20-cm topsoil samples were taken from each soil, from three 10-m^2 plots. Each sample was air dried and sieved (2 mm). The following determinations were carried out in each sample: grain size composition by the combined wet sieving and pipette method, using a sodium hexametaphosphate solution as dispersant (Schlichting et al., 1995), pH potentiometric in a 1:2.5 soil/water extract, the E4/E6 ratio, calculated on the basis of the quotient between the 465 and 665 nm absorbance of a $NaHCO_3$ 0.05 mol dm^{-3} (pH = 8) extract (Chen et al., 1977). Organic matter content was determined in the < 2000 μm fine soil (SOM). The fine soil was hand dry sieved through 100 μm, and the organic matter content was then determined in the < 100 μm size aggregates (HOM). HOM was expressed on fine soil weight basis.

The water floatable organic matter (FOM) was determined using the method detailed in Fig. 1, consisting in the separation of the water floatable material (plant rests) from the < 2 mm fine soil by successive treatment with distilled water. The FOM content was calculated

Table 1
Mean annual precipitation (MAP), mean annual temperature (MAT), and soil types of the studied sites

Site	Placement (Lat., Long.)	MAP[a] (mm)	MAT[a] (°C)	Soil type
Gral. Acha	37°22′S–64°55′W	550	13.8	Typic Ustipsamment[b]
Ruta 18 km 77	37°10′S–64°00′W	560	14	Typic Ustipsamment[b]
Winifreda	36°13′S–64°15′W	640	15.2	Entic Haplustoll[b]
Castex	35°55′S–64°18′W	650	15.5	Entic Haplustoll[b]
La Victoria	36°34′S–64°16′W	640	15.2	Entic Haplustoll[b]
Trenel	35°41′S–64°07′W	670	15.8	Entic Haplustoll[b]
La Primavera	36°30′S–64°16′W	640	15.2	Entic Haplustoll[b]
Manfredi	31°49′S–63°46′W	760	17	Typic Haplustoll[c]
Bordenave	37°51′S–63°01′W	660	15.1	Entic Haplustoll[d]
Villegas	34°55′S–62°44′W	830	15.5	Typic Haplustoll[e]

[a] Casagrande and Vergara (1996).
[b] INTA et al. (1980).
[c] Nuñez Vázquez et al. (1996).
[d] Krüger (1996).
[e] Díaz Zorita (1996).

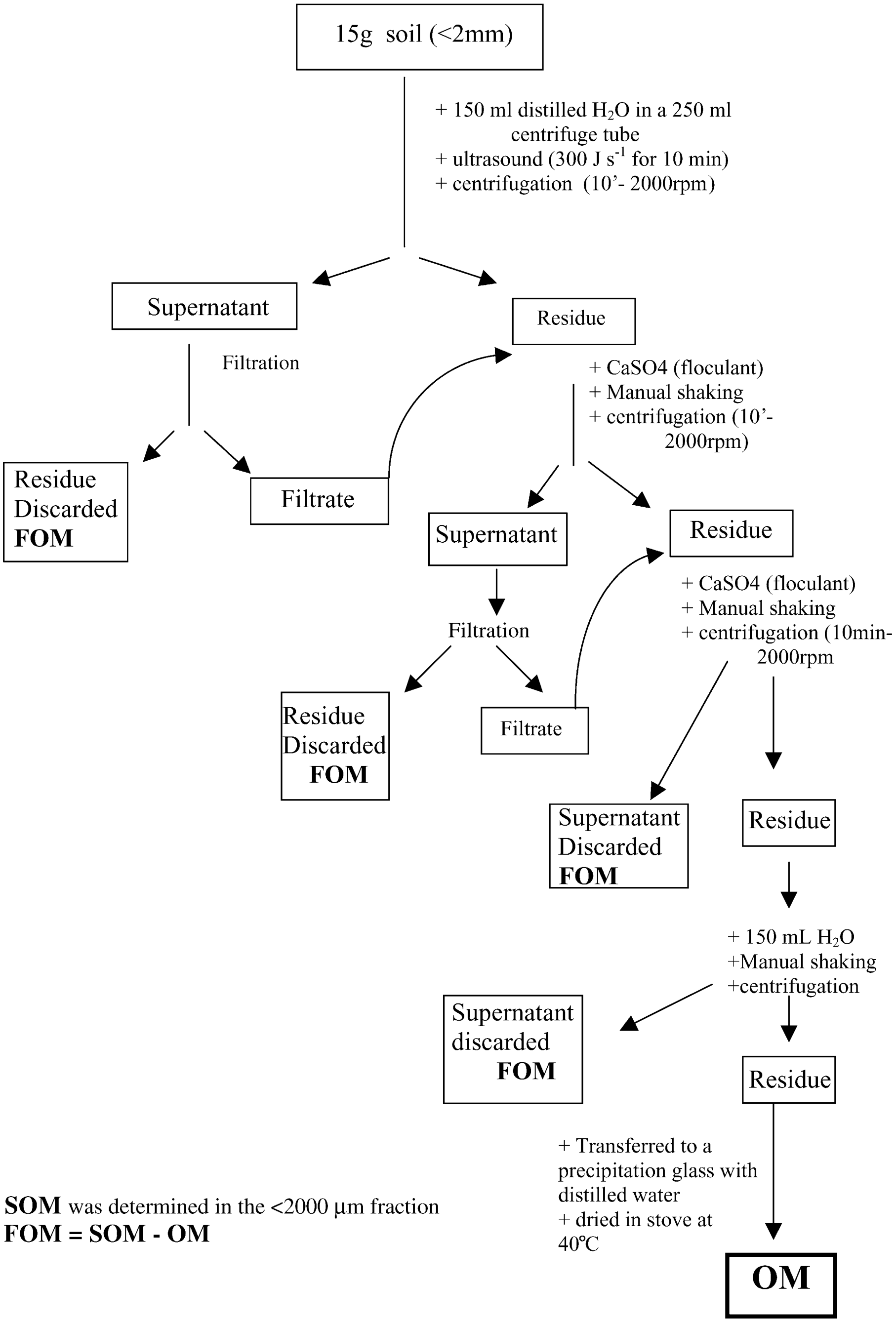

Fig. 1. Schematic representation of the method used for the separation of the water floatable organic matter fraction (FOM).

from the difference between SOM and the organic matter content of the residue resulting from this separation (OM).

The difference between OM and HOM was used to calculate the organic matter content of the 100 to 2000 μm size aggregates (YOM) (Andriulo et al., 1990).

SOM, OM and HOM contents were determined by wet digestion with the Walkley and Black (1934) method.

The potential SOM losses of each textural soil type was calculated from the difference between SOM of REFERENCE soils and CULTIVATED soils at a given texture, assuming a bulk density of 1.20 Mg/m^3 for all studied soils (Quiroga et al., 1999).

The relationships between soil texture, mean annual temperature (MAT) and mean annual precipitation (MAP) with SOM fractions were studied by means of simple linear, exponential and potential relationships. The combined effect of soil texture, MAT and MAP on all organic matter fractions were studied by regression analysis between these fractions and the quotient MAP/MAT and the index "silt + clay × MAP/MAT".

3. Results and discussion

Results presented in Table 2 show that SOM varied between 0.99% and 5.95%, HOM between 0.30% and 2.02%, YOM between 0.54% and 3.32%, and FOM between 0.01% and 0.69%, being YOM the most variable fraction and FOM the less. Considering all soils together, SOM was composed mainly by YOM (58%), followed by HOM (37%) and FOM (5%). Relative contents of these fractions were similar between soils with different management conditions and textures, indicating that the relative composition of the organic compounds remained unchanged. The predominance in all studied soils of YOM, a fraction composed mainly by recently formed organic matter (Andriulo et al., 1990), agrees with the general coarse texture of the soils, which limited the formation of well humified soil organic matter and stable organo–mineral complexes. It is known that a rapid turnover of organic matter exists in coarse-textured soils of arid and semiarid regions (Quiroga et al., 1999), and that only a low amount of the fresh organic residues will contribute to the formation of humified soil organic matter. Under these conditions most of plant and animal residues incorporated to the soil will be mineralized (Gregorich et al., 1994).

Absolute contents of all studied soil organic fractions were mostly higher in REFERENCE soils than in CULTIVATED soils indicating that cultivation produced decreases of all fractions.

None of studied fractions correlated significantly neither with MAT, MAP nor the quotient MAP/MAT, in REFERENCE soils and in CULTIVATED soils. This does not agree with results of Burke et al. (1989), Rasmussen and Collins (1991), and Alvarez and Lavado (1998), who found a positive influence of precipitation and an inverse for increased temperature on soil organic matter contents. The lack of correlations between these climatic variables and the studied organic fractions were probably consequence of the low variation of temperature and precipitation conditions in this rather homogeneous climatic area (Casagrande and Vergara, 1996).

Table 2

Contents of organic matter in the < 2000 μm (SOM), 100 to 2000 μm (YOM) and < 100 μm (HOM) size aggregate fractions, water floatable organic matter (FOM) and E4/E6 quotients of REFERENCE and CULTIVATED soils of studied sites

Site	Management	Clay	Silt	SOM	HOM	YOM	FOM	E4/E6
		%						
G. Acha	REFERENCE	11.77 (0.51)	29.73 (1.57)	3.59 (0.32)	1.27 (0.10)	1.98 (0.48)	0.34 (0.28)	2.17 (0.1)
	CULTIVATED	9.19 (0.85)	30.16 (0.96)	1.56 (0.08)	0.84 (0.05)	0.6 (0.01)	0.12 (0.05)	1.87 (0.07)
Ruta 18 km 77	REFERENCE	13.49 (0.26)	29.54 (0.52)	2.85 (0.28)	1.18 (0.07)	1.47 (0.14)	0.19 (0.15)	1.99 (0.02)
	CULTIVATED	11.23 (0.84)	19.47 (0.97)	1.21 (0.10)	0.57 (0.05)	0.54 (0.04)	0.10 (0.08)	2.02 (0.03)
Winifreda	REFERENCE	16.49 (1.22)	42.61 (0.20)	3.1 (0.31)	1.1 (0.14)	1.59 (0.41)	0.41 (0.31)	2.36 (0.189)
	CULTIVATED	21.89 (2.73)	41.61 (1.50)	2.34 (0.05)	0.75 (0.06)	1.53 (0.09)	0.07 (0.07)	2.23 (0.09)
Castex	REFERENCE	16.0 (1.04)	43.71 (1.70)	5.95 (0.39)	1.98 (0.09)	3.28 (0.08)	0.69 (0.40)	4.61 (0.139)
	CULTIVATED	18.53 (0.88)	47.84 (2.47)	2.42 (0.03)	0.99 (0.08)	1.25 (0.14)	0.18 (0.06)	2.06 (0.059)
La Victoria	REFERENCE	20.63 (2.31)	42.59 (2.57)	4.75 (0.37)	1.44 (0.08)	3.05 (0.29)	0.26 (0.14)	2.34 (0.06)
	CULTIVATED	27.20 (0.83)	45.03 (0.35)	3.22 (0.18)	0.73 (0.12)	2.33 (0.25)	0.16 (0.07)	1.99 (0.012)
Trenel	REFERENCE	18.64 (3.37)	45.92 (1.27)	5.07 (2.25)	2.02 (0.77)	3.32 (2.26)	0.12 (0.11)	3.76 (1.35)
	CULTIVATED	15.87 (1.33)	33.17 (1.88)	1.55 (0.02)	0.65 (0.03)	0.76 (0.08)	0.14 (0.11)	4.61 (0.13)
La Primavera	REFERENCE	21.07 (1.35)	47.74 (3.21)	3.66 (0.22)	1.5 (0.08)	2.2 (0.04)	0.03 (0.03)	1.93 (0.006)
	CULTIVATED	20.53 (1.28)	45.82 (1.41)	3.22 (0.18)	1.17 (0.12)	1.99 (0.29)	0.06 (0.05)	2.04 (0.049)
Manfredi	CULTIVATED	18.80 (0.42)	61.03 (2.14)	2.02 (0.16)	0.97 (0.08)	1.02 (0.12)	0.03 (0.04)	2.22 (0.03)
Bordenave	CULTIVATED	6.98 (1.48)	9.65 (1.07)	0.99 (0.06)	0.30 (0.06)	0.67 (0.05)	0.02 (0.02)	2.57 (0.01)
Villegas	CULTIVATED	16.78 (0.55)	28.37 (0.65)	2.24 (0.03)	0.88 (0.04)	1.35 (0.04)	0.01 (0.02)	2.65 (0.25)

Numbers in parenthesis indicate standard deviation (S.D.).

SOM correlated positively with "silt + clay" in REFERENCE and CULTIVATED soils (Table 3, Fig. 2). The increase of SOM with finer particle sizes is in agreement with results of Buschiazzo et al. (1991) and Quiroga et al. (1999) who previously studied the variations of soil organic matter in the same soil types. This correlation can be explained on the basis of the stabilizing influence of clay and silt on SOM (Burke et al., 1989), and the larger water holding capacity of fine-textured soils (Hartge, 1978). In a semiarid environment, where soil water contents defines the amount of yearly litter production, the extent of SOM accumulation will be highly dependent on the water holding capacity of the soil (Schachtschabel et al., 1992).

"Silt + clay" contents explained only a 19% of SOM variability in REFERENCE and 62% in CULTIVATED soils (Table 3). The lower incidence of the grain size composition in REFERENCE soils than in CULTIVATED soils can be attributed to the high contribution of grasses and trees residues to soil organic matter in REFERENCE soils, as this vegetation strata produced organic rests with different composition, being therefore highly spatially variable (Buschiazzo et al., 2001). The good fitting of the SOM–"silt + clay" model for CULTIVATED soils can result from the deposition of plant residues of similar chemical composition (annual crops) and by their incorporation into the soil by tillage practices. Under such conditions, a more uniform spatial distribution of the organic matter occurred,

Table 3

Parameters of the regressions between the contents of different soil organic matter fractions (SOM, HOM, and YOM) with silt + clay, and the index [(silt + clay) × MAP/MAT] of REFERENCE and CULTIVATED soils

Soil type		b coefficient	S.D. of b coefficient	R^2	F
SOM vs. silt + clay ($y = a + bx$)					
Reference	$n = 21$	0.0559	0.0267	0.1875	4.385*
Cultivated	$n = 30$	0.0300	0.0045	0.6163	45.020***
	$n = 27$	0.0400	3.7E – 03	0.8180	112.340***
SOM vs. (silt + clay) × MAP/MAT ($y = ax^b$)					
Reference	$n = 21$	0.6370	0.2705	0.2258	5.54*
Cultivated	$n = 30$	0.6707	0.0763	0.7520	84.830***
HOM vs. silt + clay ($y = a + bx$)					
Reference	$n = 21$	0.0193	0.0086	0.2086	5.01*
Cultivated	$n = 30$	0.0090	0.0016	0.5206	30.403***
HOM vs. (silt + clay) × MAP/MAT ($y = ax^b$)					
Reference	$n = 21$	0.5605	0.2352	0.2301	5.68*
Cultivated	$n = 30$	0.6707	0.0834	0.6978	64.654***
YOM vs. silt + clay ($y = a + bx$)					
Reference	$n = 21$	0.0478	0.0211	0.2125	5.127*
Cultivated	$n = 30$	0.0204	0.0044	0.4366	21.696***
YOM vs. (silt + clay) × MAP/MAT ($y = ax^b$)					
Reference	$n = 21$	0.9075	0.3524	0.2586	6.63*
Cultivated	$n = 30$	0.7571	0.1384	0.5165	29.913***

*= $p < 0.05$, ***= $p < 0.001$; S.D.: standard deviation.

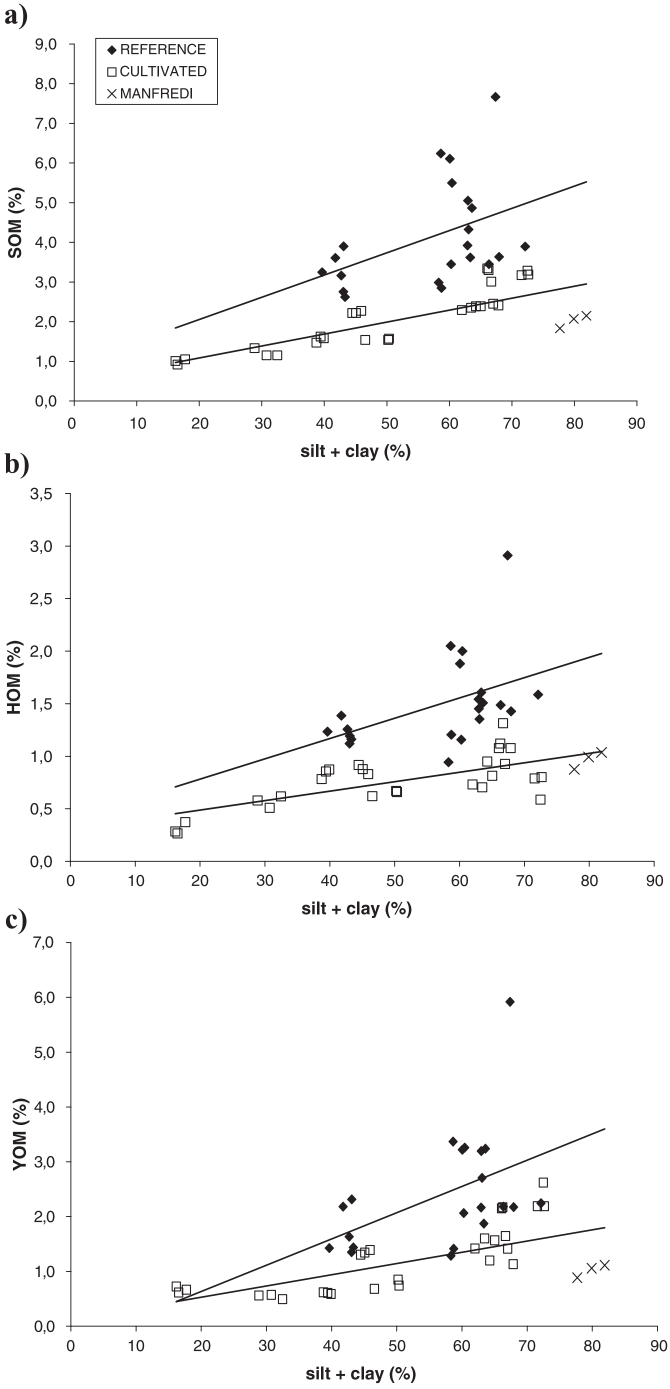

Fig. 2. Contents of (a) SOM, (b) HOM and (c) YOM as a function of silt + clay of REFERENCE and CULTIVATED soils, and the cultivated soil of the site Manfredi.

being its accumulation in the soil more dependent on soil conditions (i.e. soil texture) rather than on the amount and quality of plant rests as occurred in REFERENCE soils. The variation coefficient of SOM varied between 6.1% and 44.5% in REFERENCE soils and between 1.1% to 8.7% in CULTIVATED soils, supporting this assumption.

The correlations between SOM and "silt + clay" of REFERENCE and CULTIVATED soils were not parallel at any "silt + clay" interval, indicating that variations of SOM with "silt + clay" were different in both management types. The slope of the regression between SOM and "silt + clay" for REFERENCE soils was more pronounced than for CULTIVATED soils, indicating the largest absolute SOM losses in fine- than in coarse-textured soils. The potential SOM losses can rise up to 54.3 Mg C ha^{-1} in fine-textured soils (silt + clay = 70%) and 35.7 Mg C ha^{-1} in coarse-textured soils (silt + clay = 40%). Such results agree with those of Quiroga et al. (1999), and indicates that the degradation of fine-textured soils can produce larger CO_2 fluxes to the atmosphere than coarse soils, having, on the other hand, a large organic C fixation potential than sandy soils.

The correlation between SOM and "silt + clay" fitted better for CULTIVATED soils when soil of the site Manfredi was excluded from the regression (Table 3). This soil showed lower SOM as expected from the correlation between SOM and "silt + clay". Probably, the relative high temperatures of this site (MAT = 17 °C) favoured the mineralization of soil organic matter to a larger extent than in the other cooler sites. Similar results were found by Alvarez and Lavado (1998) for soils of the Pampas of Argentina and by Campbell et al. (1981) and Kirshbaum (1995) for other soil types.

A regression analysis between SOM and the index "silt + clay × MAP/MAT" was tested for REFERENCE and CULTIVATED soils in order to evaluate if the combined effect of texture and climatic variables increased the explanation of "silt + clay" alone (Table 3). The best explicative model for all these regressions was the potential form. In REFERENCE soils, a low increase of SOM explanation was observed (4%), indicating that SOM contents were little conditioned by the combined effect of texture and the climatic variables.

In CULTIVATED soils, the index "silt + clay × MAP/MAT" increased 13% the explanation of SOM variability in relation to the same analysis made with "clay + silt" as independent variable. These results indicated that a moderate positive effect of rain and an inverse effect of temperature on SOM were detected for CULTIVATED but not for REFERENCE soils. Such tendencies can be attributed to the influence of the high spatially variable vegetation coverage on SOM in REFERENCE soils (Table 2), and of the homogeneous plant residues of CULTIVATED soils. The incorporation of these residues into the soil increased the interaction between soil texture and climatic conditions.

In both REFERENCE and CULTIVATED soils, HOM and YOM also correlated positively with "silt + clay" (Table 3, Fig. 2), but the explanation of their variations were lower in REFERENCE (20.8% and 21,2%, respectively), than in CULTIVATED soils (52 and 43.6, respectively).

When the regression between YOM and silt + clay for CULTIVATED soils included Manfredi soil, its R^2 was 0.43 (Table 3), and when the soil of this site was excluded from this regression the R^2 rose up to 0.65 ($F = 47{,}434$, $p < 0.001$, $n = 27$). On the other hand, the inclusion or exclusion of Manfredi samples in the regression between HOM and silt + clay did not change its R^2 to a large extent ($R^2 = 0.49$, $F = 24.508$, $p < 0.001$, $n = 27$).

Such results show that YOM of Manfredi soil was lower than expected for its texture. This low YOM content can be attributed to the higher temperature of Manfredi site, which may have increased the mineralization rather than the formation of organic matter. Management conditions of Manfredi soil were similar to soils of other sites (Nuñez Vázquez et al., 1996), which allow to infer that not differential soil degradation processes occurred in Manfredi soils which may account for its lower YOM contents. These results also indicate that the positive relationship between silt + clay and YOM cannot be longer valid in sites with mean annual temperatures higher than 17 °C, while it seems to be valid for HOM.

The correlations between HOM and YOM and "silt + clay" of REFERENCE and CULTIVATED soils were not parallel at any "silt + clay" interval, indicating that variations of both fractions with "silt + clay" were different in both management types. The linear regressions between both HOM and YOM with "silt + clay" presented larger slopes for REFERENCE than for CULTIVATED soils. This indicates that fine-textured soils can lose larger amounts of both organic fractions than coarse-textured soils. Nevertheless, the differences amongst slopes of YOM–silt + clay models of REFERENCE and CULTIVATED soils were higher than the same slopes of the HOM–silt + clay models. This indicates that losses of YOM can be higher than of HOM in fine- than in coarse-textured soils. This can be related with the higher susceptibility of YOM to mineralize due to its low association with the finest soil particles. HOM is a more stable organic fraction, as it is associated with finer size particle fractions which accumulate in finest aggregates (Hassink, 1995).

The explanation of HOM and YOM variations of REFERENCE soils remained low even when the index "silt + clay MAP/MAT" was used instead of "clay + silt" as independent variable (Table 3). This indicates that a low combinated influence of silt + clay, temperature and precipitations on the accumulation rate of YOM and HOM of REFERENCE soils exist. The high dependence of YOM from the variable plant cover can explain the lack of correlation between this fraction and the edaphic and climatic variables. A higher dependence of HOM from precipitations and temperature were expected here, having into account that the interaction of these climatic variables with soil texture defines the long-term accumulation rates of organic carbon in soils of the Central Plains (Burke et al., 1989). Probably, in our case, the sampling method of the soil (the first 20 cm) produced a dilution or a concentration of HOM, changing the relationship of this fraction with the edaphic environment.

The index "silt + clay × MAP/MAT" increased the explanation rate of HOM variations of CULTIVATED soils in relation to silt + clay, rising it from 18%, but only increased 8% the explanation of YOM variations (Table 3). This indicates that, besides soil texture, also temperature and rainfall affected HOM accumulation in CULTIVATED soils. This influence was low for YOM probably because tillage practices increased the interaction between crop residues and the soil.

Though FOM had a tendency to accumulate in coarse-textured soils (Table 2), this fraction was not different between REFERENCE soils and CULTIVATED soils, and it did not correlate neither with "silt + clay" nor with the quotient MAP/MAT or the index "silt + clay × MAP/MAT". This may be produced by the direct dependence of this less decomposed organic matter fraction from the amount of fresh organic rests rather than on the environmental conditions and soil texture.

Values of E4/E6 were lower than 5 in all studied soils (Table 2), indicating that the well humified organic fraction is mainly composed of humic rather than of fulvic acids. Such compounds have large molecular size and high C-contents, but low oxygen, carboxylic groups and total acidity. The E4/E6 values did not correlate neither with "clay + silt" nor with the quotient MAP/MAT or the index "clay + silt MAP/TAM", which indicates that the qualitative composition of the humified fractions have not a direct relationship with soil texture or by climatic conditions. As a consequence of cultivation, a residual accumulation of more complex and recalcitrant organic compounds is to be expected. Because of that, CULTIVATED soils should have lower E4/E6 values than REFERENCE soils, but this effect was not detected in all studied soils.

4. Conclusions

From former results it can be concluded that:

- Cultivation decreases the contents but does not modifies the qualitative composition of the organic matter of soils of the SAP.
- The organic matter of soils of this region is mainly accumulated in coarse size aggregates (100–2000 μm) (58%) and to a lesser extent in fine aggregates (< 100 μm) (36%), and water-floatable organic matter (5%).
- Silt + clay have a positive influence on SOM, YOM and HOM. This effect was more pronounced in CULTIVATED than in REFERENCE soils as a consequence of the lower spatial variability of plant residues present in CULTIVATED soils.
- Precipitation affected positively and temperature negatively YOM and HOM contents in interaction with silt and clay. Their effects were more pronounced on HOM.
- The positive relationship existing between silt + clay and both SOM and YOM seems to be not longer valid in sites with mean annual temperatures higher than 17 °C.
- E4/E6 quotients and the floatable organic matter did not show significantly relationships with the climatic conditions, nor management type and soil texture. E4/E6 values lower than 5 in all studied soils only indicated that humic rather than fulvic acids predominate in the well humified organic fraction of the studied soils.
- Potential losses of total-, young-, and humified-organic matter can be larger in fine- than in coarse-textured soils, reaching 54.3 Mg C ha^{-1} in fine-textured soils and to 35.7 Mg C ha^{-1} in coarse-textured.
- Probable changes of soil texture by wind erosion will modify absolute contents of SOM, YOM and HOM, while modifications of temperature or precipitation regimes will affect HOM more.

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