CO_2 Emission from soil affected by crop rotation systems under no-till

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Introduction

The agriculture is one of the main sectors responsible for the increase in the CO_2 concentration in the atmosphere. The conservation management under no-till can help mitigate CO_2 emissions by increasing the amount of plant residues on the soil, crop rotation, and by slowing the decomposition rate of plant residues, which favors the organic matter accumulation and C sequestration (Stewart et al, 2009; Chung et al., 2008). It is important to develop high yielding cropping systems with low CO2 emissions.

Objective

The aim of this study was to determine the CO2 flux during the soybean cycle in a long-term experiment affected by crops rotations under no-till.

Materials and Methods

The experiment was conducted in split plots arranged in complete randomized blocks with four replications in soil Typic Rhodudalf. The plots consisted of species grown in the fall-winter, and the split plots consisted of spring crops, grown before sowing soybean (*Glycine max* (L.) Merril) in the entire area. The crop rotations (Table 1) were repeated annually since 2003.

Table 1. Crop sequences of the experiment~~v~~

Fall-Winter (April to August)	Spring (September to November)	Summer (November to March)
Sunflower	Millet	Soybean
Sunflower	sorghum-sudangrass	Soybean
Sunflower	Sunn hemp	Soybean
Sunflower	Fallow/chiseling	Soybean
Triticale	Millet	Soybean
Triticale	sorghum-sudangrass	Soybean
Triticale	Sunn hemp	Soybean
Triticale	Fallow/chiseling	Soybean

Measurements of CO_2 emissions were taken in the days 1, 2, 3, 8, 15, 30, 60, 90, and 120 after soybean planting (11/13/2013). Right after soybean planting, PVC collars with 12-cm high and 20-cm wide were installed in the plant rows with the lower edge buried 3 cm in the soil. Emissions of CO_2 were determined using a portable IRGA, LI-8100A (Licor, 2007). The device was configured to measure each CO_2 flux in 120s, with 15s to perform a pre-purging, 15s for a post-purging, and 90s for the CO_2 readings, with one reading per second. At the time of each CO_2 flux measurement, soil temperature and moisture were assessed 5 cm deep in the soil using a Pro Check with a 5TM sensor (Decagon Devices).

After desiccation of the spring crops two samples of the plant residues were taken randomly from each subplot using a 0.5 m x 0.5 m wooden frame and dried at 60ºC. Soybean was harvested on 04/13/2012 and the samples were threshed mechanically and grain yield was corrected to 13% moisture.

The results of the experiments were subjected to ANOVA ($p<0.05$) and the mean values were compared by the t test (LSD) ($p<0.05$). Pearson correlation was run on the results of CO_2 fluxes and soil moisture and temperature.

Results

Table 2. Soybean yield and residues quantity of spring crops

	Soybean yield (kg ha^{-1})			
	Spring crops			
Fall-Winter	Millet	Sorghum-sudangrass	Sunn hemp	Fallow/chiseling
Girassol	1356 aA	1643 abA	1736 bA	1604 abA
Triticale	1629 aA	1757 abA	2003 bA	1898 b B
DMS	291			
	Plant matter (kg ha^{-1})			
Girassol	4266 bA	4250 bB	3747 bA	1896 aA
Triticale	4187 cA	3627 bA	4125 bcA	2897 aB
DMS	550			

Mean values followed by different letters in the column differ among themselves by the t test (LSD) at the level of 5% probability.

Results

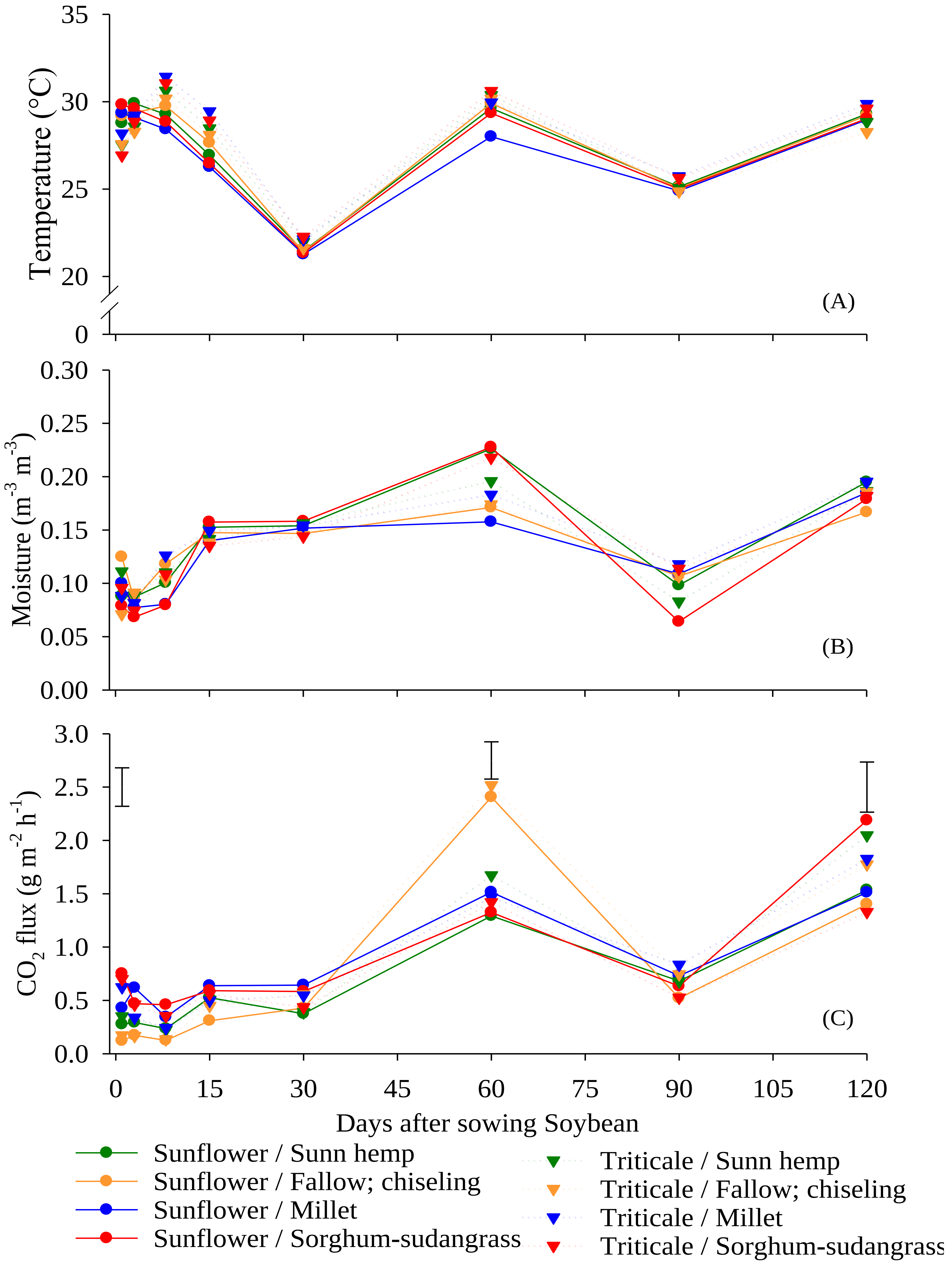

Figure 1. Temperature (A), soil moisture (B) and CO_2 flux (C) at 1, 2, 3, 8, 15, 30, 60, 90 and 120 days after sowing of soybean in accordance with different crop sequences. *Vertical bars correspond to the LSD at 5% probability.

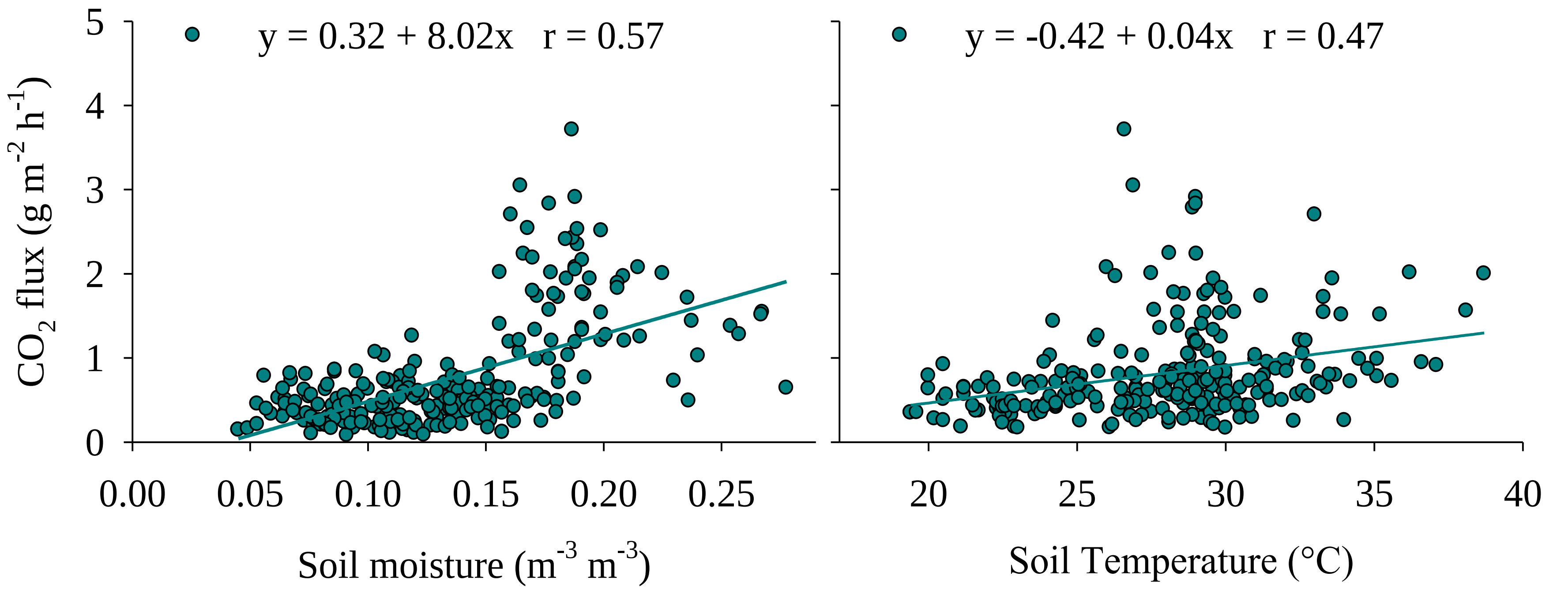

Figure 2. Pearson correlation between the CO_2 flux and soil moisture (A) and soil temperature (B).

Conclusion

It was observed that the sunn hemp resulted in higher production of soybean and reduced CO_2 emissions relatives during cultivation.

The CO_2 emission was positively correlated with the increase in temperature and soil moisture

The largest peaks of CO_2 emission were observed at 60 days after sowing of soybean with fallow/chiseling treatments.

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