MONITORING OF CO2 FLUX AND CONTRIBUTION FOR COMPONENTS IN THE SOIL-PLANT SYSTEM IN A GRASSLAND FROM NORTHEASTERN MEXICO

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INTRODUCTION

It is known, that in the last decade the change of land use and silviculture have contributed in a significant manner in the net emissions of CO2 to the atmosphere (IPCC, 2007). However, is not quite clear the magnitude of the contribution of each individual ecosystem, and even, it is least known the components contribution of the separate action of the soil-plant system (Rochete, 1999; Kuzyakov, 2002).
Recentlly Qui et al (2007) used a dark gas exchange fix chamber to measure total respiration, also the microbial and radicular from a grassland dominated by *S. balcalensis* and from bare soil, condition obtained by cutting the aerial part of the plants the day before the sampling, it was found that maximum spoil respiration occurred in July with a value of 6 g CO_2 $m^{-2}d^{-1}$.

Base on the above, the purpose of this research was to asses the role of the agroproductive systems from extensive semiarid condition in the FCO_2 dynamics.

MATERIALS AND METHODS

This investigation was carried out in the autumn 2006, at Rancho "Los Angeles", municipality of Saltillo, Coah., México. This is a farm dedicated to the Charolais breed production, in a total surface around 6700 has. The site location is 25º 6.650' N and 100º 59.413 W, in the sub province called Gran Sierra Plegada, located at north of the Physiographic Region Sierra Madre Oriental, as could be seen in the Figure 1.

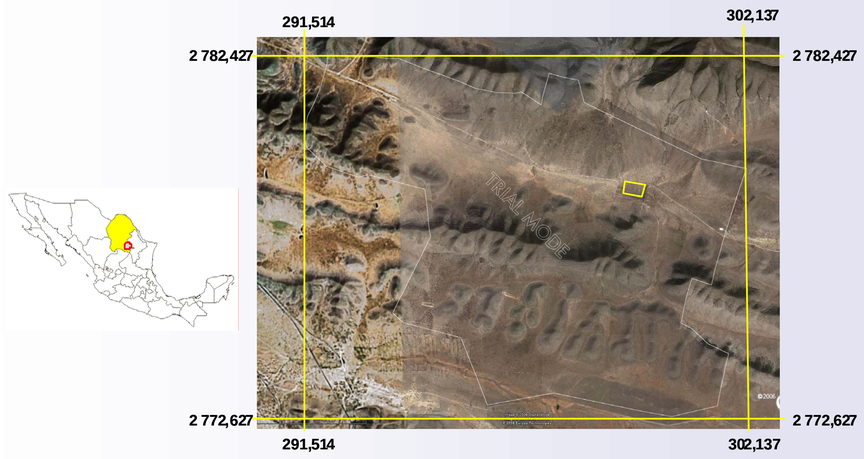


Figure 1. Field where was put the monitoring system (UTM coordinates)

In the grazing lot were experimental plots were established, the gramineae were not dominant spices due to this lot had been also used to establish winter forage crops like oats (*Avena sativa*) and barley (*Hordeum vulgare L.*), so other families as: *Laminaceas*, *Chenopodaceas, Euphobaceas and Asteraceas*.

The monitoring of FCO_2 and separation of components were made in the next order: in the first plot the monitoring of FCO_2 was made during space of 21 days under not disturbed soil-plant system, this condition was defined as total flux monitored or FCO^2_{NT}; in a second plot, the measurements of FCO^2 was made during 18 days, where the condition of the plot was that the present vegetation was eliminated, with a chisel plough with delta wings at 25 cm depth. This condition of the system where vegetation were removed by vertical tillage was defined as FCO_{2SVT} the flux was monitored directly from the tilled soil. In a third plot the native vegetation was removed using a disc plough, to a depth of 25 cm. The measurements of CO_2 flux in this condition of bare soil defined as FCO_{2SCT} was made for 27 days. The Figure 2, illustrates the condition of the second and third plot where the two types of tillage were carried out.

Figure 2. Exclusion of the vegetal cover by VT (left) and CT (right)

RESULTS AND DISCUSSION

The results that will be discussed correspond to the first step of an investigation about the measure and evaluation of energy and mass flux under different conditions of soil management and season of the year. The temporal elimination of the vegetation at the soil surface and the exposition of the root system to the action of environmental factors, allowed to have an exclusion of the vegetal cover and its root system, like can see in the Figure 3.

Figure 3. Exclusion vegetation effect. Aboveground (left) and root in the profile view (right).

Figure 4, shows a flow chart for the analysis for the energy and mass flux from the data collected at the experimental plots.

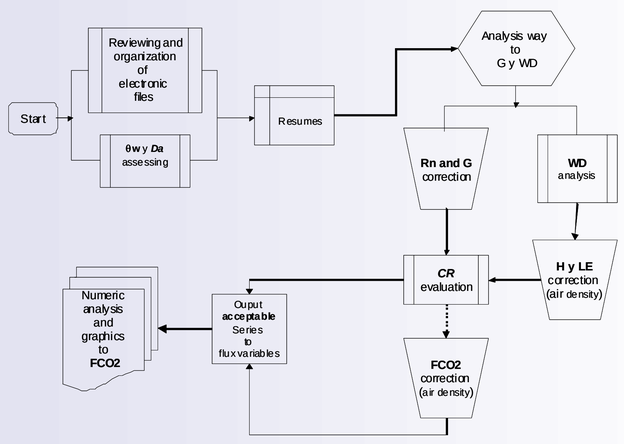


Figure 4. Diagram to analysis for energy and mass flux

As a result of the use of both tillage method it could be observed a significant change in the FCO2 typical behavior, which is showing by next graphics:

Fig. 5. In the reference plot where was not disturbed by the tillage, was measured the FCO2 as the total respiration. In this phase, as can be seen for the day number 294, had a typical behavior represented for assimilation diurnaland nocturnal release.

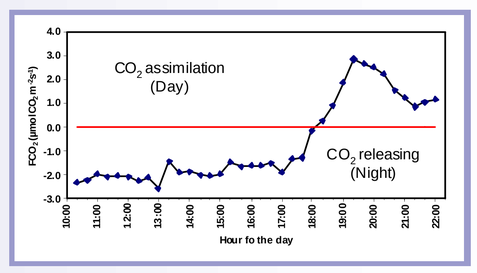


Fig. 6. As it can be seen the maximum value of 2 mmol CO2 $m^{-2}s^{-1}$, occurred at 14:00 h, this behavior is represented by the curve as a constant release during day and night, from the soil without vegetation observed at day 316, two days after VT.

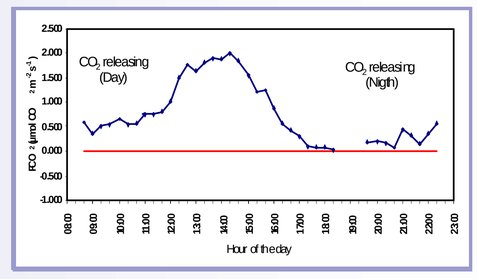
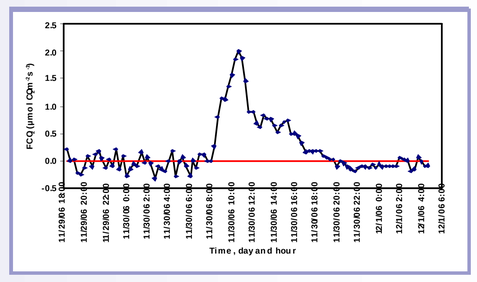


Fig. 7. Here, can see a frequent variation in the releases of CO_2 from the soil, the maximum value registered was almost same to 2 mmol CO2 $m^{-2}s^{-1}$ and values of assimilation of less than 0.5 mmol CO_2 $m^{-2}s^{-1}$. This flux was observed from the day 333 to 335, between two and fourth days after CT.



The results showed that under the predominant climatic conditions at Autumn 2006, when separating the components of the soil-plant system from the CO_2 total flux monitored (FCO_{2tm}), the more important contribution came from the soil in both tillage methods used were for FCO_{2sLV}=66 % and FCO_{2sLC}=74 %. This results are similar to reported for other autors (Scow, 1999; Pumpanen et al 2003; Qi et al, 2007).

CONCLUSIONS

It was possible to establish the importance that vegetation has (where not gramineae are dominant) in the sequestration of carbon. The rhizosphere in the described soil condition for the experiment contributes with 26 to 34 % of the total flux of CO_2. Both soil tillage methods used promotes the liberation of CO_2 to the atmosphere, this is particularly important when land use have to be changed or when tillage is performed early in the season 4 or 6 months before the rainy season as it is the case in the region.

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LITERATURE CITED

IPCC, 2007. Climate Change 2007: Climate change impacts, adaptation and vulnerability. Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report.
Kuzyakov Y. 2002. Separating Microbial Respiration of Exudates from Root Respiration in non-sterile soils: a comparison of four Methods. Soil Biology & Biochemistry, 34: 1621-1631
Pumpanen J, Ilvesniemi H, Hari P. 2003. A process Based Model Predicting Soil Carbon Dioxide Efflux and Concentrations. Soil Sci. Soc. Am. J. 67: 402-413
Qi YCh, Dong Y, Liu J, Domroes M, Geng Y, Liu L, et al. 2007. Effect of the Conversion of Grassland to Spring Wheat Field on the CO2 Emission Characteristics in Inner Mongolia, China. Soil and Tillage Research. 94: 310-320
Rochete P, Flanagan LB, Grgorich EG. 1999. Separating Soil Respiration into Plant and Soil Components Using Analyses of the natural Abundance of Carbón-13. Soil Sci. Soc. Am. J. 63: 1207-1213
Scow MK. 1999. Soil Microbial Communities and Carbon Flow in Agroecosistems. Ed. Academic Press, Editado por Jakson,