www.cnrs.fr

NATIONAL PRESS RELEASE I PARIS I 15 JANUARY 2013

Reconciling agronomic production, water-saving and soil preservation

Unexpectedly, some crops such as maize or rapeseed have been found to act as carbon sinks, extracting CO_2 from the atmosphere. However, others like sunflower and silage maize are carbon sources. These are the main conclusions of a study carried out by a research team from the Centre d'études spatiales de la biosphère (CESBIO, CNRS / Université Toulouse III - Paul Sabatier / CNES / IRD). Over seven years, researchers measured the carbon and water fluxes of two experimental field plots. Their results show that the environmental impact of agriculture can be reduced by the right cropping practices, making it possible for agriculture to reconcile environmental and agronomic objectives. This work was published in *Agricultural and Forestry Meteorology* on 15 January 2013.

The water consumption of a crop and its soil carbon sequestration capability have become essential criteria for sustainable agriculture. This is why the CESBIO researchers sought to measure carbon and water use efficiency for three main European crops: wheat, silage maize (for the production of animal feed) and sunflower. They selected two plots located in the French *départements* of Gers and Haute-Garonne and equipped them with instruments to measure agronomic and meteorological variables (light levels, temperature, soil water content, etc.) and fluxes of CO_2 and water between the atmosphere and the agroecosystem (the cultivated field).

To assess the water and carbon "accounts" of these cultivated plots, two indices were calculated. The first, a conventional index in agronomy, analyzed the amount of biomass produced and exported for each plot per unit of water consumed. The second, an environmental index, was much more innovative: it measured the amount of carbon lost or captured on the plot per unit of water consumed. This index covered net CO_2 flux, carbon imports due to organic fertilization, and exports due to harvest. In other words, it determined whether a crop was a sink or source of carbon. These analyses were carried out over several years of crop cultivation and also took into account any periods when the soil was left bare (uncultivated).

From an agronomic perspective, cultivation of silage maize provides the best return, by producing up to 1.3 grams of carbon per liter of water consumed, against 0.65 grams for wheat, and 0.2 grams for sunflower. However, from an environmental perspective, wheat, which has a longer cycle, captures more carbon in the soil, sequestering up to 1 gram of carbon per liter of water consumed. By contrast, (short cycle) sunflower and silage maize have a negative balance: they cause soil carbon impoverishment and thereby become net producers of greenhouse gases.

www.cnrs.fr

This work shows that the right cropping practices (choice of crop species, presence of intermediary crops, mulching, etc.), production methods and ultimately, dietary habits, make it possible to reduce the environmental impact of agriculture.

The researchers plan to study how these indices are impacted by the introduction, between two main crops, of intermediary crops (mustard, faba bean, etc.), which can capture the soil's mineral resources and make them available for the following crop. It is likely that this practice would increase CO_2 capture, but reduce the availability of water resources for subsequent crops. These hypotheses will be tested within the framework of the GHG-Europe and ICOS [1] European projects, which aim to provide a long-term understanding of the global carbon cycle and greenhouse gas emissions from different plant covers in Europe.

Flux tower installed in the middle of a maize crop, equipped with analyzers and sensors for measuring fluxes and meteorological variables. © Eric Ceschia

System for measuring CO_2 and water fluxes by the turbulent fluxes method, comprising a three-dimensional sonic anemometer (right) and a high frequency infrared analyzer (left). © Eric Ceschia

Bibliography

Crops' water use efficiencies in temperate climate: Comparison of stand, ecosystem and agronomical approaches. Tiphaine Tallec, Pierre Béziat, Nathalie Jarosz, Vincent Rivalland, Eric Ceschia. *Agricultural and Forestry Meteorology*, 15 January 2013.

Contacts

Researchers I Tiphaine Tallec I T +33 (0)5 61 55 85 78 I tallect@cesbio.cnes.fr
Eric Ceschia I T +33 (0)5 61 55 85 29 I eric.ceschia@cesbio.cnes.fr
CNRS press officer I Priscilla Dacher I T +33 (0)1 44 96 46 06 I priscilla.dacher@cnrs-dir.fr

[1] Integrated Carbon Observation System