Prato Sesia
Novara (Italy)

Biochar application in a short rotation coppice

The aim of this study was to assess the C sequestration potential of biochar under field conditions, using continuous soil respiration monitoring and periodic isotopic ($\delta\ ^{13}CO_2$) measurements.

In particular, this study assessed:

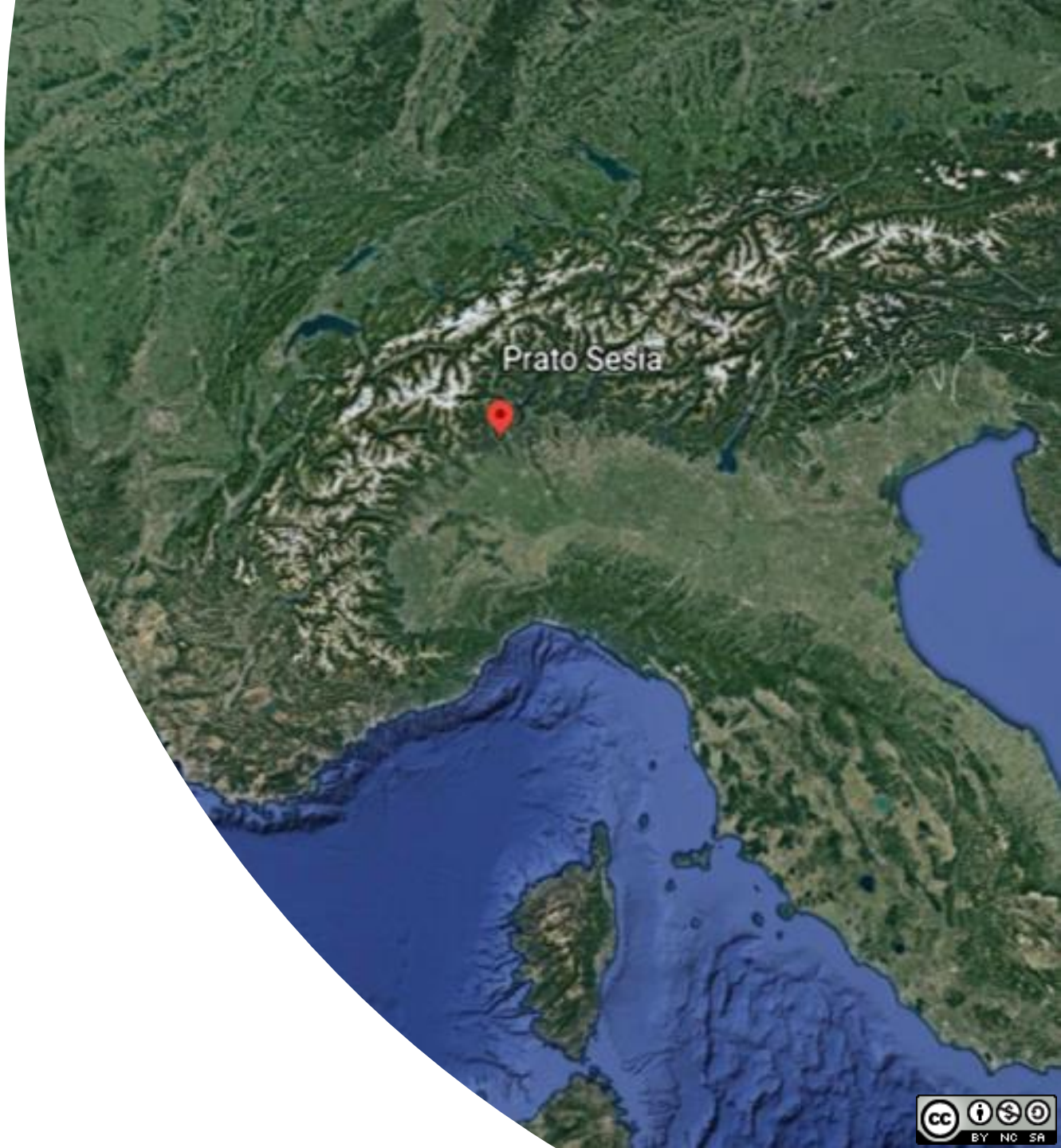
- The stability of biochar in field conditions,
- The effect of plant roots on biochar stability
- The effect of biochar on original soil organic matter (SOM) decomposition.

To achieve these aims a field experiment was carried out in italy in a short rotation coppice systems.

This study supports the carbon sequestration potential of

Biochar and highlights the role of root activity on biochar decomposition, questioning the applicability of laboratory incubation studies to assess biochar stability.

The experiments were undertaken in spring 2012 and ended in november 2014.



Experimental site

Poplar (*Populus x Canadensis* Mönch, Oudemberg genotype) SRC plantation with a 2-year rotation period, located in Prato Sesia (Novara) (45° 39′ 32.2812″ N; 8° 21′ 16.8339″ E). The plantation was established in the spring of 2010 and coppicing was undertaken in the spring of 2012 before biochar application. The soil is sandy loam (12% clay, 34% silt, 54% sand) with a pH of 5.4. Climate in the area is temperate with warm summer; average annual temperature is 12 °C and average annual precipitation is 1500 mm

Biochar and its application in the field

The biochar used in the two experiments was produced from maize (*Zea mays* L.) silage feedstock pellets at 1200 °C under atmospheric pressure with a residence time of 40 min in a gasification plant (©A.G.T. – Advanced Gasification Technology s.r.l., Cremona, Italy). The biochar was distributed (30 tons/ha) by hand and incorporated into the first 15-cm soil layer by rotary hoeing on March 30th 2012. A completely randomized design with two treatments (biochar (B) and control (C)) and four replicates (plots) per treatment was used.

MEASURED PARAMETERS

AIR

- Total and heterotrophic soil respiration measured in biochar-treated and control plots. Soil CO_2 efflux was measured in three plots per treatment using a closed dynamic soil respiration system with 12 automated chambers (Uniud-SR system).
- Isotopic signature ($\delta\ ^{13}C$) of the respired CO_2.

SOIL

- Soil temperature (*T*) at 10 cm depth was measured (107 temperature probes, Campbell Scientific, Logan UT, USA).
- pH.
- Soil water content between 0 and 18 cm was recorded every 30 min (CS-616 water content reflectometers , Campbell Scientific, Logan UT, USA).
- Soil organic C content and bulk density
- Soil organic carbon stock and soil biochar content (two times: T0 and end of the experiment).
- Biochar dynamics: biochar degradation in soil and priming effect on native soil organic matter
- Soil enzymatic activity and microbial biomass.
- Microbial community (16S and ITS DNA sequencing).
- Mineral nitrogen leaching.

OTHER

- Plant productivity: total aboveground woody biomass production and leaf litter production.
- Air temperature, humidity and rainfall were measured with a meteorological station.

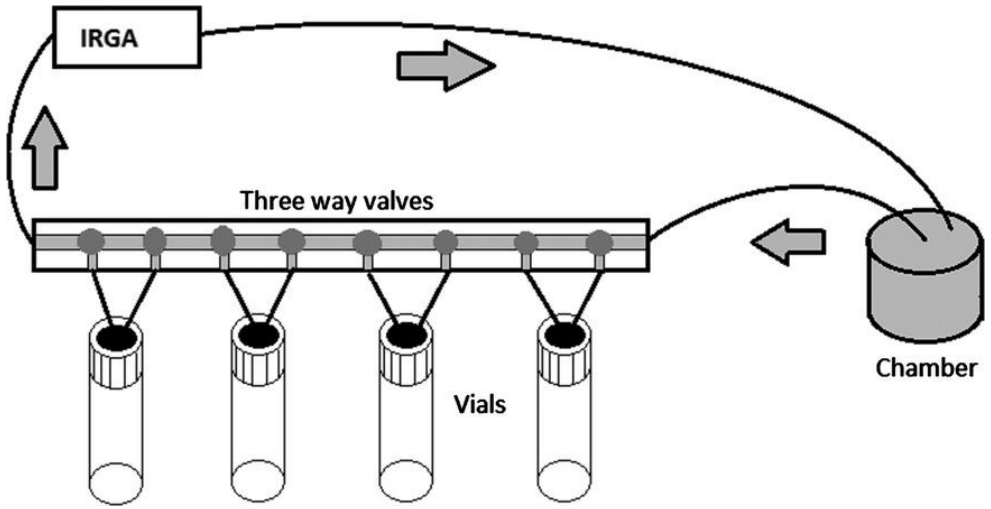
PLANNED ACTIVITIES

Soil respiration measurements

The trenching method was used to measure Rh and RhB (heterotrophic respiration biochar). In each plot and root exclusion subplot, chambers were installed to measure Rtot and Rh, respectively.
Missing or discarded data were gap-filled according to the model proposed by Qi & Xu:
$R = aT^b \times SWC^c$, where *R* is the soil CO_2 efflux (total or heterotrophic), *T* is the soil temperature (°C) and SWC is the soil water content (%).

Isotopic measurements and Keeling plots

The isotopic signature ($\delta\ ^{13}C$) of the respired CO2 was periodically assessed using the Keeling plot method. Manual sampling of respired CO2 followed by isotopic ratio mass spectrometer analysis (IRMS) and direct on-line sampling were used and compared at both sites.
The figure illustrates the scheme of the sampling system used to collect CO_2 emitted from the soil.



Biochar decomposition and priming effect on SOM

The fraction of CO_2 respiration derived from the biochar decomposition (f_B) was calculated for both $R_{tot}B$ and R_hB using a mass balance approach

PRESENTATION OF THE WORKING GROUP

The study was carried out by the Forest Ecology Group of the Free University of Bolzano (Italy) (https://www.unibz.it/), with the participation of Istituto per le Piante da Legno e l'Ambiente (I.P.L.A. S.p.a.) (http://www.ipla.org/). IPLA provided the field on which the experiment is taking place and helped in the biochar distribution and incorporation in soil and other operations in the field.

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CONTACTS

Maurizio Ventura: maurizio.ventura@unibz.it
Giustino Tonon: giustino.tonon@unibz.it