

Constraints and solutions for the design of a long-term Ecotron experiment to study long term effects of climate change on agro-ecosystems

The aim of the next Terra-Ecotron experiment, ECO³, is to assess short term and long term effect of the climate change on the crops and on the agro-ecosystem in general. This requires to follow the plants development and to record the evolution in soil biology, chemistry and hydrology during a period of eight years. But there are few, high, Controlled Environment Rooms (CERs) available and about 2 m² in each. The question of the experimental design is thus of utmost importance. Three points will be considered, the size and number of lysimeters, the samplings and the climates.

Two lysimeter sizes are available: one main lysimeter or nine smaller cubic ones. The main ones are 1,5 m depth, enough to be realistic with most crops and thus suitable for long term experiments. The smaller cubes have so far been proven realistic only for fast development crops with limited rooting such as grass or broccoli. Selecting the main ones comes at the expense of soil conditions, only one can be studied. But taking into account a border effect of 5 to 10 cm, the available area of the main one is 30 % to 330% higher. They were favoured since they give the possibility for plants and soil samplings while an area could be preserved to assess the final yield.

Some parameters can be followed by non destructive measurements such as chlorophyll fluorescence, 3D imaging, or in-situ root imager. For others proxies such as soil electrical conductivity can be used. But for the soil microbiology, soil chemistry and plant reference measurements, plant, soil or soil solution samples are required. The paper presents a repartition of around 160 measuring and sampling spots, covering epigeal parts, the roots, soil samplings for the chemistry, hydrology and microbiology, spatially and in time. This takes into account the three instrumented profiles, the root imagers, the border and an area for the harvest.

Finally, the selection of the meteorological conditions was a choice between either a comparison of climates with repetitions or a gradient approach to fit models on the data and try to find tipping points. While the former may return more sound statistics about two particular conditions, the latter gives better results for the trends, to deal with non linear responses, for the possibility to cover both the inter-annual variability and the climate change drift. The proposed selection process of the eight time series (8 CERs) of eight years is described.