ROTHAMSTED RESEARCH

CONFERENCE PROGRAMME

# THE FUTURE OF LONG-TERM EXPERIMENTS IN AGRICULTURAL SCIENCE

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RothC model was used for simulation soil organic carbon (SOC) stocks in 7 Russian long-term experiments founded in 1933-1980 with mineral and organic fertilization. Crop sequences include alternation of cereals, row crops and grasses, four experiments have crop rotations with bare fallow field. Actual weather data and yearly carbon input through crop residues estimated from crop yield and above ground biomass production were used as input data. RothC satisfactorily simulated the observed changes in SOC on Podzol, Albeluvisols and Chernozem, as evaluated through the root mean square error, coefficient of determination and the mean difference. However, in the absence of clear trend, RothC turns out to be less sensitive to the observed interannual SOC dynamics. For sandy Podzol 1.1-1.3 Mg C $ha^{-1}yr^{-1}$ annual C input was required to maintain initial C level, while for loamy Albeluvisols necessary rates were 1.4-2.0 Mg C $ha^{-1}yr^{-1}$. Inputs of 2.6-2.9 Mg C $ha^{-1}yr^{-1}$ were required to maintain soil C on Chernozem. If C input in long-term was inadequate to maintain SOC it leads to consistent decrease of resistant plant material. Preferable effect of agronomic practices on active C pools leads to possibility of C sequestration only in a short-term and makes it highly yield-dependent. Simulation of SOC dynamics for plots with no fertilization and the lowest SOC stock revealed that above ground NPP input is sufficient for maintaining constant SOM stocks after conversion to a grassland for forage production and returning FYM in the same plot.

## Crop production systems and soil organic carbon: What are the effects on crop production?

Valentina Rubio[1], Roberto Díaz-Rossello, Andres Quincke[1]

1 Instituto National de Investigación Agropecuaria, La Estanzuela, Colonia, Uruguay

Understanding the impact of different systems on soil quality and productivity is essential for the decisions makers to predict agronomic, economic and environmental outcome of agricultural operations. Soil organic carbon (SOC) is an important indicator for assessing the sustainability of cropping systems, as it modulates soil physical, chemical and biological properties, and ultimately crop productivity (Tiessen et al., 1994). Different relationships between SOC and crop yield have been established, but few studies proposed a SOC critical level for soil productivity (Bingham, 2001). We review results gathered from a long-term experiment installed in 1963 at INIA (Uruguay) to evaluate surface SOC (0-15 cm) evolution under different production systems; and to quantify the impacts of SOC losses on wheat (Triticum aestivum) and barley (Hordeum vulgare) yields.
The soil is a Silty Clay Loam Typic Argiudoll, with an observed 2.2% SOC at the start of the experiment (Moron and Sawchik, 2002). Substantial increases and decreases of SOC occurred throughout 54 years due to 7 contrasting soil management systems. A total of 456 yield records were analyzed along with climatic, management and soil variables. We estimated a critical SOC level for 95% of maximum yields at 2.35%. This SOC content represents 78% of the maximum level that can be physically protected in the soil, estimated from soil texture (Hassink et al., 1997). Present studies on the relationship of SOC with different soil properties will be used in order to better understand the critical level of COS.

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