Geophysical Research Abstracts,
Vol. 11, EGU2009-2290, 2009
EGU General Assembly 2009

Impact of afforestation on peroxidase activity and iron ions in soils

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Oxidation-reduction reactions play a key role in ecologically important biogeochemical processes in soil and influence on soil chemical and physical properties. For understanding of processes in soil system the direction of oxidation and reduction processes is needed. Researches were carried out in the afforestation as biogeochemical barrier and adjoining cultivated field located in the Agroecological Landscape Park in Turew (40 km south of Poznań, West Polish Lowland). This afforestation was created approximately 200 years ago and includes mainly of *Robinia pseudacacia*. It is 2 kilometres long and 36 meters wide. The accumulation of organic matter level achieves a depth of 15 cm. Times of sampling were collected from June to November in 2008 from the layer at 0-20 cm depth. Five soil samples from each site were pooled together to give the so-called average mixed sample.

The peroxidase activity in soils was determined by Bartha and Bordeleau method, ferrous ions by phenanthroline and ferric ions by thiocyanate method. The dissolved organic carbon and a total organic carbon were estimated using analyzer TOC-5050A facilities, Solid Sample Module SSM-5000A, Shimadzu, Japan.

As is well known, the role of enzymes in coupling reactions leading to polymerization is limited to the oxidation of the substrates. Peroxidase catalyzes the oxidation of phenols and aromatic amines in the presence of hydrogen peroxide as an electron acceptor in the reactions. This study showed that the peroxidase activities were higher in the soils under afforestation (from $14.16\cdot10^{-4}$ to $126.16\cdot10^{-4}\mu\text{mol}\cdot\text{h}^{-1}\cdot\text{g}^{-1}$) than under cultivated field (from $0.76\cdot10^{-4}$ to $2.75\cdot10^{-4}\mu\text{mol}\cdot\text{h}^{-1}\cdot\text{g}^{-1}$) during whole period of sampling.

Its many chemical conversions are due to its two valence states, ferrous and ferric ions as well as the range of oxidation-reduction potentials associated with transition in various iron-containing compounds. It was observed that the concentrations of total iron ranged from 7.78 to 17.96 $\text{mg}\cdot\text{kg}^{-1}$ in the soils under afforestation and from 2.48 to 10.98 $\text{mg}\cdot\text{kg}^{-1}$ in the soils under cultivated field. This investigation revealed that the content of ferrous ions (from 1 to 64%) and ferric ions (from 3 to 71%) was higher in the soils under afforestation than in the soils under cultivated field in the most periods of sampling.

Dissolved organic matter in soil solutions plays a crucial role as a carrier for a variety of components, ranging from nutrients and trace elements to toxics. The soils under cultivated field resulted in a lower concentrations of dissolved organic carbon (from 0.34 to 0.52 $\text{g}\cdot\text{kg}^{-1}$) then the soils under afforestation (from 1.11 to 3.39 $\text{g}\cdot\text{kg}^{-1}$).

It is known that although soil organic matter only tends to form a small percentage of the mass of the soil, it has a very great influence on soil chemical and physical properties. Our results showed that the total organic carbon concentration ranged from 19.82 to 65.16 $\text{g}\cdot\text{kg}^{-1}$in the soils under afforestation and from 5.50 to 7.04 $\text{g}\cdot\text{kg}^{-1}$ in the soils under cultivated field.