DESCRIPTION FOR THE GENERAL PUBLIC

Nitrogen is one of the most important plant nutrient for crop production, which determines the size and quality of crop yield. Legumes have the ability to take nitrogen from the soil and from the air through a process of biological nitrogen reduction and make it available to the plant. Crop residue of legumes incorporated into the soil are gradually mineralized, and nitrogen compounds are available for plant uptake. The main objective of the proposed research project is to analyze the transformation of organic nitrogen compounds (formed by faba bean during biological reduction of nitrogen) in the soil and to determine its quantities in subsequent plants grown during the first (winter wheat) and second (triticale) year after faba bean, as well as to test the inhibitory properties of pentachlorophenol in the biological nitrogen reduction process.

A field experiment is planned to be conducted, which will take into account the impact of natural, variable environmental conditions on the tested parameters. The samples (plants and soil) will be taken several times during growth and development of subsequent plant, which will allow comprehensive analysis of transformation of nitrogen compounds and their uptake by plants, as well as the formation of persistent connections of carbon and nitrogen in the soil. After faba bean emergence, ammonium sulfate ($(NH_4)_2SO_4$) with 95% enrichment of ^{15}N at. will be applied. Isotope dilution method will enable to determine the amount of nitrogen derived from the atmosphere (%Ndfa) and from the fertilizer by faba bean plants, and the contribution of biologically reduced N by faba bean in wheat and triticale plants, and contribution of ^{15}N isotope in organic nitrogen fractions. Various nitrogen compounds will be separated (amino acids, amides, amino sugars) as well as nitrogen fractions easily-, difficult- and non-hydrolyzing, and carbon compounds (fulvic and humic acids).

Activity of microorganisms after introduction of crop residues into the soil will be determined on the basis of enzymes participating in the nitrogen, carbon and phosphorus cycles, and respiration activity. Furthermore metabolic diversity of bacteria and fungi on the basis of utilization of different carbon and nitrogen (including amino acids, amides, amines and amino sugars) substrates will be determined. Microbial genetic diversity (ammonia oxidizing archaea) will evaluate using molecular based techniques: terminal restriction fragments length polymorphism (t-RFLP) and denaturing gradient gel electrophoresis (DGGE). These methods are based on characterization of the microbial diversity through the analysis of nucleic acids (DNA) extracted from environmental samples. Ammonia oxidizing archaea are responsible for nitrification process, in which they provide nitrogen mineral forms to plants.

Faba bean with nodulation process hampered by pentachlorophenol (insecticide) is planned to be used in the experiment. This compound at very low concentrations (of the order 10^{-5} M) inhibits the process of legume infection by symbiotic rhizobia through inhibition of signal exchange between plant and bacteria. Use of pentachlorophenol will enable to test the usefulness of plant with suppressed nodulation process as a reference plant in studies on biological reduction of nitrogen instead of the commonly used cereal plants.

The planned research topics result from the need to complete studies on the biochemical transformation of organic compounds of carbon and nitrogen present in the crop residues introduced into the soil during subsequent plant growth and development. In addition, the project will enable the expansion of knowledge on the amount of nitrogen reduced by faba bean used by subsequent plants (cereals) under field conditions, especially in the second year after the cultivation of faba bean.

Furthermore, the planned studies result from the need to increase the use of natural sources of nitrogen in agriculture and reduction of nitrogen fertilizers use (due to nitrogen loss through leaching and emission, high prices of nitrogen fertilizers) and increase contribution of legumes in disposition of crops. In Poland, contribution of legumes in disposition of crops is very low (approx. 1.2%). Introduction of legumes into crop rotation reduces the use of mineral fertilizers by up to 20-25% and increases yields. Faba bean selected for this experiment has a high production potential, it has a high protein content in seeds (26-32%), and in Poland prevails favorable climatic conditions for its cultivation. Determination of contribution of biologically reduced N by faba bean in subsequent crops will help in the future to establish the balance of nitrogen on farms and to estimate the amount of nitrogen fertilizers used in agricultural production, which significantly affects the economics of nitrogen fertilization and environmental protection.