

Plantations of fast-growing woody plants, such as willow and poplar, are a renewable energy source and an alternative to fossil fuels, but they also play a number of important roles in the environment. These include protection from erosion and amelioration of physicochemical properties of soils. Previous studies on short rotation woody plants have focused mainly on the yield of such plantations. Various methods of fertilisation have been used to increase their yield, since plantations are set up on marginal soils, of low quality and usability for edible crop cultivation. However, issues related to how fertilisation impacts the rate and level of carbon accumulation in plants and soil are also important from an environmental point of view, since carbon is one of the main elements in the plants' structure and the most important component of organic matter in soil, while at the same time (as CO₂) it is the main cause of the greenhouse effect. It is noteworthy that the accumulation of carbon is affected not only by the plant type and the form and rate of fertilisation, but a significant role is also played by weather conditions and the soil.

Therefore, **the aim of this study** is to determine the yield and to develop a model of carbon transformations in new willow and poplar cultivars as well as in soil fertilised with mineral and organic fertilisers at various rates in the north-east of Poland. The main objectives include determination of the content of carbon in plant biomass and in the humus horizon of soils on which the experiment will be conducted as well as in the organic fertilisers used (digestate from a biogas plant).

The study will be based on a field experiment conducted at the Teaching and Research Station in Łężany, near the village of Leginy in the province of Warmia and Mazury in the county of Kętrzyn. A combination of four factors will be applied, which include: the plant species, the application of fertilisers (both organic and mineral), the fertilisation rate and the harvest cycle. Digestate from a biogas plant will be used as the organic fertiliser and will be tested before each planned application in the experiment. Biomass samples will be collected for laboratory tests at the end of the growing season; their aim will be to determine the carbon content in wood and in bark. Moreover, the bark-to-wood ratio and the moisture content will be determined. The soil will be tested before and after the plant growing season in order to determine: total organic carbon, humus content, available potassium, phosphorus and magnesium as well as the total nitrogen and pH.

The results will provide an opportunity to broaden the knowledge on the effect of the application of digestate in the cultivation of fast-growing trees on carbon sequestration and to develop a model of carbon transformations at the plant-soil level.