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## P1 – Spatial and temporal variation of plant water status and growth of black locust (*Robinia pseudoacacia* L.) in agroforestry systems

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Short-rotation forestry and agroforestry systems have the potential to become an ecologically valuable and economically profitable land use alternative on marginal lands. Therefore, our project focuses on determining the water demand for biomass production of black locust in the Lusatia region (Eastern Germany). The area is characterized by relative low annual rainfall (560-600 mm/yr) and drought periods during spring and summer. Black locust (*Robinia pseudoacacia* L.) is planted in short rotation plantations as well as in agroforestry systems at reclaimed post-mining sites of the opencast mining area "Welzow Süd" and on a conventionally managed field near the town Forst (both study sites are located about 120 km to the south of Berlin). Due to mining activities the ground water table in "Welzow-Süd" is below 100 m, while on the field site in Forst the ground water table is about 2 m below the soil surface. Because of the water accessibility directly affecting the yield, it is crucial to identify the spatial variation of the soil water availability and its influence on black locust growth. The main question of this study is how the drought periods affect black locust's growth and recovery and about the drought mitigation effect obtainable by an accessible water table. The growth rate is estimate monthly by measuring the maximum high and the trunk diameter at 10 and 130 cm. Furthermore, several trees are equipped with dendrometers to record their diameter increment in daily intervals. The pre-dawn water potential for selected trees is evaluated periodically and used for quantifying the plant water stress and related to the growth pattern. Water availability and microclimatic condition are monitored continuously. Information gathered from the field data at the end of the vegetation period will be used to develop a growth model to link the soil water availability and plant water status with the growth rate of the trees.

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## P2 – Impact of drought stress on photosynthesis, transpiration and growth of black locust (*Robinia pseudoacacia* L.)

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Nowadays, there is an increasing interest in black locust (*Robinia pseudoacacia*) for the production of biomass for bioenergy in short-rotation plantations. As a pioneer tree species black locust grows under a wide range of site conditions and is known to be relatively drought tolerant compared to other temperate, deciduous tree species. In Central and Eastern Europe *Robina* is cultivated in a continental climate with an annual precipitation often below 600 mm. However, the native range of black locust in Northern America is classified by a humid to sub- humid climate with a mean annual precipitation of 1020 to 1830 mm. In order to evaluate its growth and ecophysiological performance to drought stress, we conducted an drought experiment. Two sets each with 13 seven year old cuttings of black locust were cultivated in 65 liters plastic pots at the von-Thünen-Insitute in Hamburg-Lohbrügge. The drought

stress treatment was irrigated with water amounts between 0.75 to 2.0 liters per day subject to the respective climatic conditions. The well-watered plants were watered each day with not less than 4 liters. The $H_2O$ and $CO_2$-gas exchange of leaves was measured with a minicuvette system and chlorophyll fluorescence was monitored with a pulse-modulated fluorometer Walz-PAM-2100. Stem circumferences above ground level of the pots and in breast height were determined at the beginning and at the end of the drought experiment. Net photosynthesis and transpiration was reduced by drought due to stomatal closure. To minimize transpiration on plant level leaf area was reduce by drastic leaf fall. Increasing temperature and vpd increased transpiration significantly from 0.68 to 3.6 mmol $m^{-2}$ $s^{-1}$ only in the well-watered plants, while in drought stressed plants it is 0.39 to 0.48 mmol $m^{-2}$ $s^{-1}$. Mean electron transport rates ranged from 71-105 µmol $m^{-2}$ $s^{-1}$ in drought stressed plants to 113–136 µmol $m^{-2}$ $s^{-1}$ in the well-watered plants. The diameter growth of the drought stressed trees was reduced by 42%.

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## P3 – Influence of nitrogen fertilization on photosynthesis and leaf nitrogen content of leaves of poplar and willow plants in short rotation plantations

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The demand for bioenergy plants and renewable raw material will increase in the next decades. The sustainability of their production depends on conservation and appropriate use of natural water and nutrient resources in the respective ecosystems. The efficient use of nitrogen is important for maintaining or increasing biomass yields and reducing environmental impacts in short-rotation plantations. In our experiment, we identified the effect of nitrogen fertilization on chlorophyll content, leaf nitrogen content and photosynthetic performance of poplars (*Populus maximovizcii* × *P. nigra* clone max 4) and willows (*Salix viminalis* clone Inger) growing at different nitrogen levels (0, 25, 50 and 75 kg N/ha year) in a field trial at the Institute for Agricultural Engineering in Potsdam-Bornim (Germany). Photosynthetic performance of single leaves was determined with a pulse-modulated fluorometer. Furthermore, three leaves were selected for photosynthetic light dependency measurement. Chlorophyll content of individual leaves were measured with a Yara-N-tester and related to the measured electron transport rate. A mixed sample of leaves were dried and analysed with an element analyser for their carbon and nitrogen contents. Mean electron transport rate (ETR) of poplar leaves showed a high variation ranging between 69.7 +/- 22.4 and 125.6 +/- 30.5 µmol $m^{-2}s^{-1}$, whereas, in willows, ETR was between 145.6 +/- 38.1 µmol $m^{-2}s^{-1}$ and 186.2 +/- 20.8 µmol $m^{-2}s^{-1}$. In poplars electron transport rates linearly related to the chlorophyll content as measured with the Yara-N-Tester. However, no significant influence of the nitrogen treatment on photosynthesis, and chlorophyll and nitrogen content could be observed for both tree species.