Geophysical Research Abstracts
Vol. 19, EGU2017-17344-2, 2017
EGU General Assembly 2017

Implications of soil heterogeneity on growth performance of fast-growing trees under marginal site conditions - an ecophysiological perspective

Maik Veste (1,2), Christian Halke (1), Dieter Schmitt (2), Dario Mantovani (1), Reiner Zimmermann (2), Manfred Küppers (2), and Dirk Freese (1)

(1) Brandenburg University of Cottbus-Senftenberg, Chair of Soil Protection and Recultivation, Cottbus, Germany (maik.veste@icloud.com), (2) University of Hohenheim, Institute of Botany, Stuttgart-Hohenheim, Germany

The integration of fast-growing trees and hedgerows has been proposed in order to improve the environmental performance of agricultural systems and to provide woody biomass for bioenergy. Due to the current increase of bioenergy, strong interests are emerging to use marginal lands for short-rotation forestry. Especially in Lower Lusatia (Brandenburg, Germany) large areas of reclaimed post-mining sites are available for the cultivation of short-rotation coppies and agroforesty systems. The dumped overburden material has little or no recent soil organic matter, low nutrient content and low water holding capacity. Our study aim was to evaluate the effects of small-scale spatial and temporal variations of edaphic conditions on plant water relations, photosynthesis and biomass production of black locust (Robinia pseudoacacia) and poplar (Populus spp.) on marginal lands. Particularly, on dumped soils in the post-mining area, due to the adverse edaphic conditions, the stem growth was drastically reduced during summer drought below the critical pre-dawn water potential value of -0.5 MPa. But also on agricultural fields soil depth and soil water availability are the key factors determining the biomass production of poplar and black locust. A reduction of soil N availability as a result of low soil nitrogen content or drought induce nodulation and biological nitrogen fixation (BNF) in Robinia in order to sustain the required nitrogen amounts for plant growth. In our experiment the nodule biomass increased in combination with a decrease of the δ15N values of the leaves under extreme drought stress. Under field conditions the percentage of nitrogen derived from the atmosphere in black locust varies 63% – 83% and emphasized the importance of nitrogen fixations for tree growth on marginal lands. Our investigation under different edaphic conditions and soil water availabilities showed clearly the ecophysiological and morphological plasticity of the investigated tree species and its implication for growth and biomass production.

References

Mantovani D, Veste M, Böhm C, Vignudelli M, Freese D, 2015. Drought impact on the spatial and temporal variation of growth performance and plant water status of black locust (Robinia pseudoacacia L.) in agroforestry systems in Lower Lusatia (Germany). iForest 8 743-757

Mantovani D, Veste M, Boldt-Burisch K, Fritsch S, Koning L, Freese D, 2015. Carbon allocation, nodulation, and biological nitrogen fixation of black locust (Robinia pseudoacacia L.) under soil water limitation. Annals of Forestry Research 58 (2), 259-274.

Veste M, Staudinger M, Küppers M 2008. Spatial and temporal variability of soil water in drylands: plant water potential as a diagnostic tool. Forestry Studies in China 10(2), 74-80