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Influence of soil bioengineering measures on river systems - Shading potential of Salix purpurea

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Soil Bioengineering measures have different effects on river systems: Flood protection for the housing, settlement and economic areas of humans, soil protection and the restoration of regulated and degraded rivers. Positive ecological effects are based on the development of the used plants and result in the shading of the water body. Shading can reduce the incident solar radiation up to 95%, which impacts the physical and chemical parameters of the water and therefore the water quality. Shaded areas show a lower temperature and the oxygen uptake capacity is higher. Consequently the daily variations of temperature and those of oxygen content are definitely lower. Shading benefits riverine ecological conditions, especially in small rivers with a maximum width of 10m. According to this fact the biological activity varies in these different areas. The Water Framework Directive (WFD) aims to achieve a good ecological potential and good surface water chemical status for all surface waters. Widely constant shading with riparian vegetation is the potential natural plant cover condition and plays a key role by the implementation of the WFD. The aim of the present study is to determine the relationship between density and spatial distribution of biomass of riparian vegetation (Salix purpurea) and the incident solar radiation energy reaching a shaded water surface.

The transmission properties of riparian vegetation with various densities have been investigated. This was tested in a model experiment using a standardized frame: A "hedge" of Salix purpurea, an often used willow for soil bioengineering measures, was constructed. Transmitted solar radiation was measured on an area of 1 m^2 using global radiation and photosynthetic active radiation (PAR) sensors. After each measurement 10% of the branches were removed in two different ways. Method one: pruning the hedge homogeneously over the whole area and method two: removing the willows from one side. The density of the hedge was determined additionally by leaf areas and hemispherical photographs. The experiment was repeated on three following days between 11 am and 2 pm.

The analyses of the results show that the two pruning methods influence solar radiation in different ways. Different amounts of the solar radiation are transmitted through the willows. On all three days method one, pruning the hedge over the whole area, diminishes more of the global radiation and the PAR than method two where the willows were removed from one side. For example after removing 50% of the branches method one reduces the radiation by 71% (PAR 70%) whereas method two just by 48% (PAR 50%). The transmittance is exponentially rising with lower densities. Over 70% of the leaf area is in the upper half of the branches which therefore absorb and reflect more solar radiation than the lower parts.

The conclusion can be drawn, that method one leads to better results and should be used for ecologic reasons when planning, planting and maintaining soil bioengineering measures at rivers.