Proceedings of the 7th International Conference on Functional-Structural Plant Models, Saariselkä, Finland, 9 - 14 June 2013. Eds. Risto Sievänen, Eero Nikinmaa, Christophe Godin, Anna Lintunen & Pekka Nygren. http://www.metla.fi/fspm2013/proceedings. ISBN 978-951-651-408-9.

Between- and within-tree shading in mixed stands: shoot-level simulation

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Highlights: Between- and within-tree light transmission is simulated with ray casting method in reconstructed mixed stands consisting of Scots pine and silver birch.

Keywords: crown architecture, light transmission, self-shading

Light interception of foliage is dependent on between- and within-tree shading. The more light is transmitted through the neighbours, the more the light conditions in a tree crown are determined by the structure of the tree itself. We analysed light transmission in reconstructed mixed stands with varying age and density with ray casting method using the LIGNUM model (Sievänen et al. 2008). To reconstruct the stands consisting of Scots pine (*Pinus sylvestris* L.) and silver birch (*Betula pendula* Roth.) with 50% mixture, we used LIGNUM to reproduce 3D structural tree models that correspond to shoot level configurations of real individual trees grown in mixed forest stands (Lintunen et al. 2011). Radiation calculations were based on incoming radiation (direct and diffuse PAR) from 161 sky sectors, whose relative brightness was derived from standard overcast sky. Radiation transmission to the shoots of the target pine at different heights was analysed separately for transmission through the surrounding stand and through the target tree itself. Results show that self-shading reduces the amount of incoming light more than the neighbours apart from the sparse crown bottom of trees (visible as "L"-shaped self-transmission curve in Fig. 1). In sparse stands, self-shading has larger role than in the dense stands as expected.

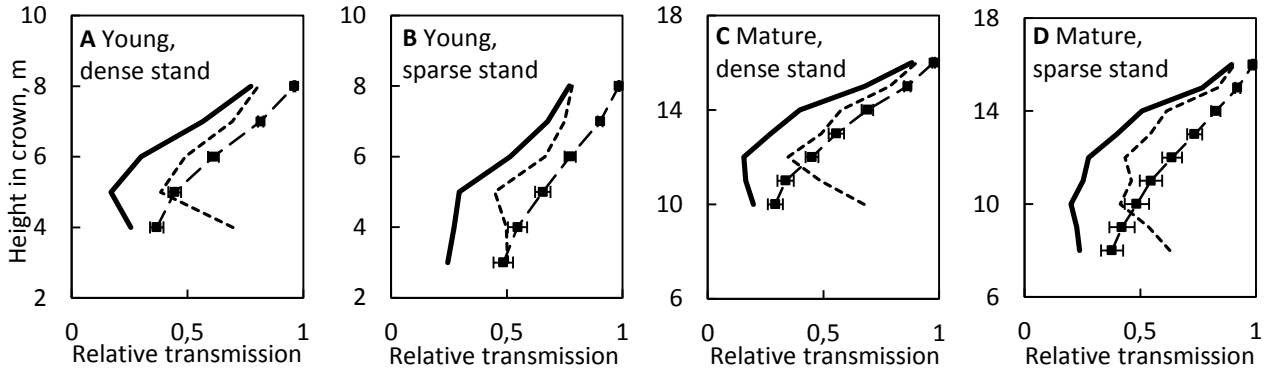

Figure 1. Transmission of radiation through the neighbors (average and 95% CI of ten repetitions; squares with vertical bars), through the target pine (dashed line) and both together (solid line) at different stands. The stands consist of a circular plot (r = 20m) surrounded by a homogeneous border forest. Inside the circular plot, reconstructed trees are situated randomly.

LITERATURE CITED

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