THE WATER REGIME OF SILVER (*BETULA PENDULA* ROTH) AND KARELIAN (*BETULA PENDULA VAR. CARELICA*) BIRCHES UNDER SUFFICIENT AND LIMITED SOIL MOISTURE CONDITIONS

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The main goal: To compare the intraspecific parameters of water regime of the silver (*Betula pendula* var. *pendula*) and Karelian birches (*Betula pendula* var. *carelica*) with normal and abnormal development of trunk tissues growing both in plantations and under natural conditions.

Study area: The field measurements were provided at several forest experimental sites of the Forest Research Institute of Karelian Research Center of RAS in Karelia, Russia (61°45′N, 34°20′E) in period from 2008 to 2011 (Fig. 1).

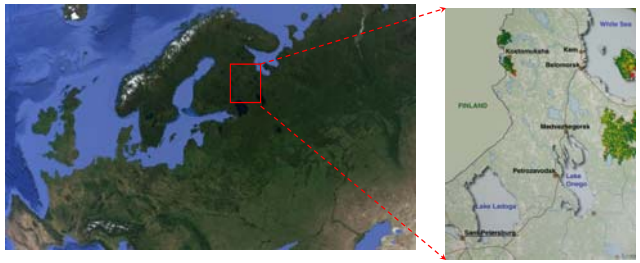

Fig. 1. Geographical location of the research areas

Material and methods: For the experimental study several three-, five- and seven-year old trees of the silver and Karelian birches growing at selected experimental plots were selected. The Karelian birch is a specific form of the silver birch and it is characterized by structural abnormalities (Fig. 2) of trunk tissues (thickenings on the trunk, the marble-like pattern and figured wood) that results in considerable reduction of number of xylem vessels and increase of parenchyma cell number (Novitskaya, 2008).

The transpiration rate of the leaves (E) was determined using the portable photosynthesis system Li-6400XTP (Li-Cor, USA). Leaf water potential of photosynthesizing leaves (Ψ, MPa) was measured using the pressure chamber. Amount of available water in leaves (WC_f), water deficit (WSD) and saturating leaf water content (WC_s) were calculated using the following equations: $WC_f = W_f - W_d / W_d$ ($g_{water}\ g^{-1}_{dry\ weight}$), $WSD = W_s - W_f / W_s - W_d$ (%), $WC_s = W_s - W_f / W_d$ ($g_{water}\ g^{-1}_{dry\ weight}$), where W_f and W_d – fresh and dried leaf biomass, W_s – weight of the leaves at saturation.

Fig. 2. Trunk wood of the silver birch (A) and Karelian birch (B)

Results: Comparisons of WSD and WC_s of three and five years old silver and Karelian birches showed that the difference between both tree forms increased with increase of tree age and degree of structural abnormalities of trunk tissues of Karelian birch (Fig. 3). The Karelian birch has increased parenchyma and significant amount of water probably can be additionally stored there. The difference between tree forms increase also with growth of plant water deficit. Such effect is observed in both seasonal and daily patterns of WSD and WC_s.

The largest differences between of WSD and WC_s of both tree forms were observed at the afternoon and at the end of growing season (from middle of August until September). WSD и WC_s of the Karelian birch were some smaller than the silver birch values probably due to availability of some additional "water source" that has the Karelian birch in the bark parenchyma.

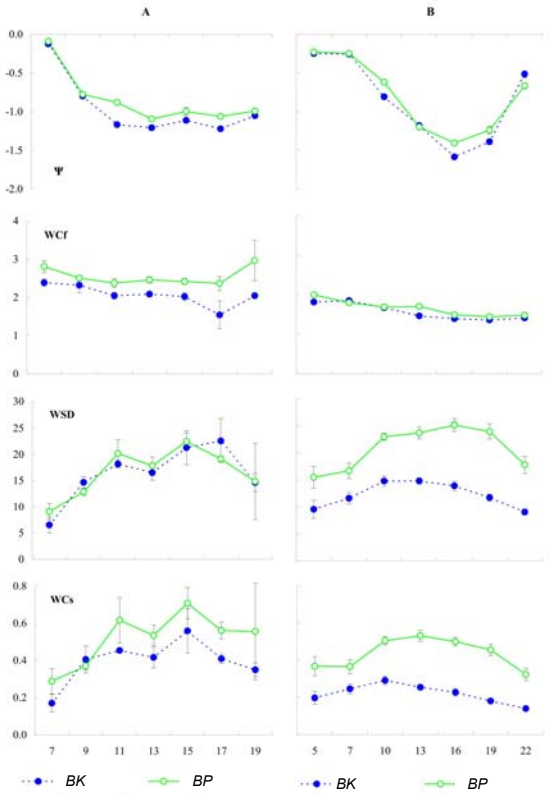

Fig. 3. Daily variations of water potentials of foliated shoots (Ψ), water content (WC_f), water deficit (WSD) and saturating water content (WC_s) of leaves of three- (A) and five-year (B) old silver (BP) and Karelian (BK) birches.

Analysis of seasonal pattern of E of seven years old birches showed that the daily E of the silver birch is some higher ($p < 0.05$) than E of the Karelian ones (Tab. 1). Comparisons of E of both tree forms under stressed soil moisture conditions showed that the silver birch is characterized by a higher decrease of E mainly due to higher reduction of leaf water content (Fig. 4). It can be also explained by higher water storage capacity of the Karelian birch due to its specific features of assimilation mechanisms and xylem structure. Comparison of water potentials of both birch forms didn't reveal any significant differences. However, it was shown also that the Karelian birch has usually lower values of Ψ than the silver ones.

Tab. 1. Seasonal variation of mean daily transpiration rate of the leaves (E, $mmol\ m^{-2}s^{-1}$) of the silver and Karelian birches

Date	The silver birch	Karelian birch
1 June	1.88 ± 0.05	1.52 ± 0.04
30 June	1.31 ± 0.04	1.63 ± 0.06
27 July	2.74 ± 0.10	2.15 ± 0.07
9 August	1.69 ± 0.04	1.52 ± 0.03

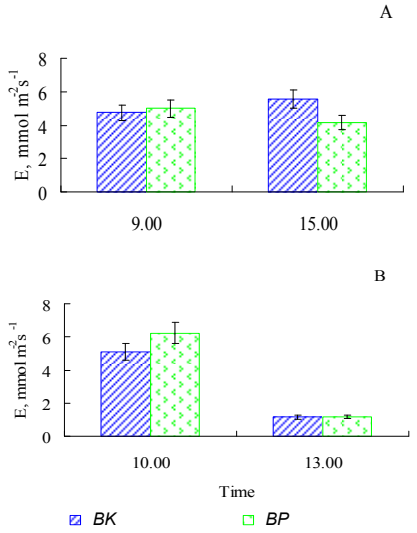

Fig. 4. Transpiration rate of the leaves (E) of the silver (BP) and Karelian (BK) birches in the morning and daytime under sufficient (A) and limited soil moisture conditions (B)

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