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The relationship of hydrological properties of tree crowns with washing up polycyclic aromatic hydrocarbons

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Two species of coniferous trees (Taxus bacata L.; Abies alba L.) were tested for their capacity to retain rainwater on their surface under the influence of various degrees of pollution with commonly occurring aromatic hydrocarbons. Samples of branches were obtained from various places in the crown, in various locations in Krakow (southern Poland; 50 ° 05’01.2 "N 19 ° 56’57.5" E), after the winter period, when air pollution is the highest, and the pollution was washed away in the laboratory as a method of intensive rainfall simulation under controlled conditions. The content of 18 aromatic hydrocarbons, wettability, surface free energy (SFE) and canopy water storage capacity were tested before and after washing.
The aim of the study was to show how the hydrological properties of branches change at different degrees of pollution with hydrophobic aromatic hydrocarbons.
The analysis of influence of needle surface quality on the value of surface free energy focussed on the comparison of total free energy and its polar and dispersive component. A comparison of SFE values obtained from the van Oss-Good model using three measuring liquids (water, diiodomethane and glycerol) revealed significant differences in the values between the top and bottom sides of the needles. In the polluted needles the difference was 39.68% in favour of the bottom side, and after the washing process 33.74% in favour of the top side. After washing the needles, the share of the polar component clearly decreased. The effect of the change in polarity was a decrease in water storage capacity from 28 to 24% of the total rainfall simulated in the laboratory for both species jointly and an increase of the water drop slope angle on the upper surface of the needles from an average of 60° to 77°, which is equivalent to a decrease in hydrophobicity.
Changes in hydrological properties are associated with a decrease in the average content of PAHs on needles from 1670 to 1437 [μg kg-1], which results from washing the pollution off the needles. In terms of species, Taxus bacata L. responded more intensively to needle surface washing by changing its water storage capacity but it was also a species more severely polluted by PAHs.