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Experimental study on determining factors of canopy interception using artificial Christmas trees

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Evaporation of canopy interception (CI) is a major component of water balance in forested areas. Theoretically, the evaporation amount is dependent on the tree height, i.e. aerodynamic roughness. Nevertheless, the theory does not always explain the observed results and the observational fact that CI during rainfall is proportional to the rainfall intensity makes the problem paradoxical (Murakami, 2006). The objective of this study is to try to find the determining factors of CI in terms of the stand structure using artificial Christmas trees that is easy to modify the height and tree density.

Two kinds of artificial Christmas trees were used: a) 65 cm high with the maximum canopy diameter of 30 cm, and b) 150 cm high with the greatest canopy diameter of 75 cm. We set those trees on three trays and left them outside to measure CI using natural rainfall. Artificial trees a) were set on Tray #1 and #2 measuring 178-cm-square. Artificial trees b) were fixed on Tray #3 with a size of 360-cm-square. Tray #1 was a control and the stand structure was unchanged throughout the experiment, i.e. tree height was 65 cm with 41 stems on the tray. Three experimental runs were conducted; Run #1 and #2 were to compare the effect of stem length (tree height) on CI. Run #3 was to evaluate the effect of thinning. The initial number of trees on each tray was 41 (Run #1 and #2), and it was reduced to 25 after thinning for Tray #2 and #3 (Run #3). At Run #1 tree heights of Tray #2 and #3 were 90 cm and 150 cm (original), respectively, and at Run #2 and #3 they were 120 cm and 240 cm, respectively. In Tray #1 canopy interception rate (IR, the ratio of CI to gross rainfall) was constant (12.1% to 13.3%). IR increased with tree height for each tree, i.e. a) and b). In Tray #2, i.e. tree a), IR increased from 19.7% to 22.8% after thinning, while in Tray #3, i.e. tree b), it diminished from 20.0% to 13.8%. Preliminary analysis showed that hourly CI is clearly proportional to hourly rainfall for a certain rain event in Tray #2, but this trend is not always obvious. Besides micrometeorological factors, the similarity of the stand structure alone is not enough to explain IR; the actual size of canopy and/or the space among the canopy that concerns the size of eddy may governs the CI.

Reference:
Murakami, S. 2006: A proposal for a new forest canopy interception mechanism: Splash droplet evaporation, Journal of Hydrology, 319, 72-82.

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