UNIVERSITY OF WEST HUNGARY

FOREST LITTER INTERCEPTION INVESTIGATION IN THE SOPRON HILLS

Theses of doctoral (PhD) dissertation

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Introduction

The long-term researches are decisive in the cognition of hydrological processes occurring in the forest ecosystem. Such researches are conducted in the experimental forest catchment based in the Hidegvíz Valley. The aim of this work is to define litter interception by linked to the above mentioned.

The litter interception is the amount of water retained by the litter cover. The amount of the retained water is closely related to the extent of the storage capacity of the litter. By the quantification of litter-interception we could see the accurate picture of the role of litter played in water cycle of the forest.

The litter-interception could be the precisious parameter of the run-off models and climate-change models, moreover, by the use of this factor we could gain a more complexed knowledge on the water-cycle of the forest stands.

Data and methods

The present work introduces the results of the litter-interception research covering the period between 2003-2008, where we have analyzed the litter interception of the following three species: sessile oak (*Quercus petraea*), beech (*Fagus sylvatica*) and spruce (*Picea abies*).

During the initial phase of the examination the research technique conducted of the determination of the water content and the dry weight of the litter collected from given sized area. In some cases the situation of the surrounding trees was also recorded. This technique was later on replaced by a weight measurement-based method, developed by the author, to eliminate the errors due to the territorial variability of the litter.

By the examination of the composition of the litter, the share of the litter component was determined in the function of dry weight and water content, that outlined the importance of the litter components in the research.

The dissertation outlines the litter-interception by the modified functions developed to describe canopy interception in the studied stands. The author has examined the influence of the antecedent precipitation on the water content of the litter by different models.

Theses

1. The author has worked out a new technique – called the framed measurement -, to measure litter interception. This method helps to reduce the difficulties of the determination of litter interception due to the territorial variability of the dry weight of the litter – by the measurements at identical places. The method, based on weight measurement alteration, occurs at fixed locations with constant litter weight, therefore the consecutive data could be compared with each other. The essence of the method is that possibly undisturbed litter samples are put in closed frames, covered by fly screen at all sides, and the weight of the samples is recorded regularly. The fly screen eliminates certain disturbing impacts (falling and carrying away of leaves, disturbing of the surface), however it does not obstruct the constant liaison with its environment. The technique could be automatized, therefore could reduce the work demand of the method.

2. The candidate examined the connection between the litter dry weight and the moisture content using the litter-collection method. Discovered that there was no significant difference between the species regarding their attribution on effective water storage capacity in unit weight. The specific maximum storage capacity depends rather on the dry weight of the litter than its species. According to the calculations of the author, one kilogram litter is able to store 2.1 – 2.2 litre of precipitation.

3. The Author has defined the ratios of the levels of litter components and their share of the total moisture content of one square-meter on litter level in the cases of beech (B) and sessile oak (KTT).

   Determined, that the outmost part of the dry weight of the litter lever conducts of leafs (KTT: 79%; B: 63%), that also make a significant share of the water content of the litter level (KTT: 84%; B: 66%). In the territory it could be found in a relatively even distribution, therefore for the examination, together with the thin twigs its dry weight portion in case of KTT was 13%, regarding B it was 16% (the water content portion was 7% in KTT, 15% in B). The presence of the crops was only noteworthy in case of beech stand, that also formed part of the sample with 7% of water content portion and 4% of dry weight portion.

   Describes moreover that the dry weight share of the random occurrence of thick branch category was significant regarding beech stand with a data of 17%, it was less, 4% on sessile oak; the water content proportion was 12% on beech and 7% on sessile oak.

   The herbaceous plants represented a significant 5% of the dry weight and 7% of the water-content regarding the sessile oak stand. Regarding the beech stand, the quantity of examined green herbs and fungus with sporophore was infinitesimal in the studied aspect of dry weight and water content.

4. The author applies the formulas developed for canopy interception as a base of her modified equations to calculate litter interception. The formulas have been parameterized and their reliability has been tested.

The candidate found the Merriam-formula as the most suitable regarding the case of sessile oak and beech.

The author, by considering the antecedent moisture conditions and leaving the above Merriam-formula as the base calculation method, has developed a new, improved formula that has been parameterised based on the research period and the examined species (beech, sessile oak).

5. The author has quantified the desiccation of the water content of the litter, and has investigated - based on inland publications- the antecedent precipitation index reported (API for 5, 10, 20 and 30 days) and calculated with linear correlation, that is also used in run-off models. Discovered that the solution by using linear weights is not accurate as the excretion is not linear either. Came to conclusion that the use of exponential weights could be reasonable, therefore has adapted the Jakeman-Hornberger model for the case of the litter cover, that describes the desiccation considering the temperature. By the usage of the above, the author determined that the above formula correctly describes the desiccation of the moisture content of the litter.

Application of the results

The living- and dead-plant materials retrain part of the precipitation that land on the forest substance. The candidate has examined the role of the litter in this process.

The author has developed a new method based on weight-measurement for the regular field measurements of the moisture content of the litter. The method could be adopted widely could be manufactured at a low cost.

By the use of the developed formula for litter interception, in which we define the moisture content of the litter prior to precipitation events by the consideration of the antecedent precipitation index, the impact of the temperature, the precipitation quantity and the temporal distribution of the precipitation change could be simulated for the litter interception loss.

According to the above, we could estimate the impacts of climate change and the changes of the hydrological conditions occurred in relation to the reforestation (for example as the changes occurring during the preparatory cutting of natural reforestation).

The statement of the second theses allows the estimation of maximal storage capacity. This estimation is applicable in case of the smaller resolution models, as the storage capacity could be given in view of the litter dry weight, regardless of the species.

Publications relating to the topic of the dissertation

Reviewed publications

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