The occurrence and effect of the stem rot on wood basic density in European aspen (Populus tremula)

Ieva Jaunslaviete, Jānis Liepiņš, Alise Bleive, Loreta Zaķe, Toms Sarkanābols, Elvis Fjodorovs, Jānis Donis, Valters Samariks, Āris Jansons
Latvijas Valsts mežzinātnes institūts "Silava"
aris.jansons@silava.lv

When estimating the biomass and carbon stocks of aspen stands, it is assumed that all trees are healthy, without signs of damage. However, in reality, this is not the case, which means that the trunk biomass and, therefore, especially the carbon stock of trees is overestimated. The occurrence and distribution of stem rot in stands of different ages affect wood quality and value, however, this effect on stem biomass and thus also obtainable wood products had not been quantified before. Wood density is an important indicator that characterizes both wood strength and several deformation indicators, such as bending strength. Similarly, wood density data are also needed to determine significant changes in stem biomass and to characterize biomass under the influence of rot. Additionally, higher wood density always indicates higher carbon accumulation.

Material and Methods

The occurrence of decayed trees in aspen stands was determined by increment cores, sampling 4140 trees altogether across Latvia. For detailed inspection, the sample trees were selected with the resistograph Rinntech RESISTOGRAPH® R650. Each tree in a sample area of 500 m2 was drilled in three directions from the bark to the center, forming an imaginary equilateral triangle. If the presence of a rot was found, the tree was selected. Altogether 60 sample aspen trees from 8 stands were analyzed to characterize the distribution of the rot. Decayed tree trunks were divided into 1m long segments and trunk cross-section discs were obtained for characterizing the area occupied by the rot and its density. The wood density analysis was performed following the previously developed methodology (J. Liepiņš et al., 2017). Decayed wood is divided into two groups: 1) discolored wood - spots of a darker color begin to appear in the wood or it has already completely changed its original color; 2) spongy rot – there are obvious changes in the wood structure. When the decay of the wood is over, a cavity is formed.

Results

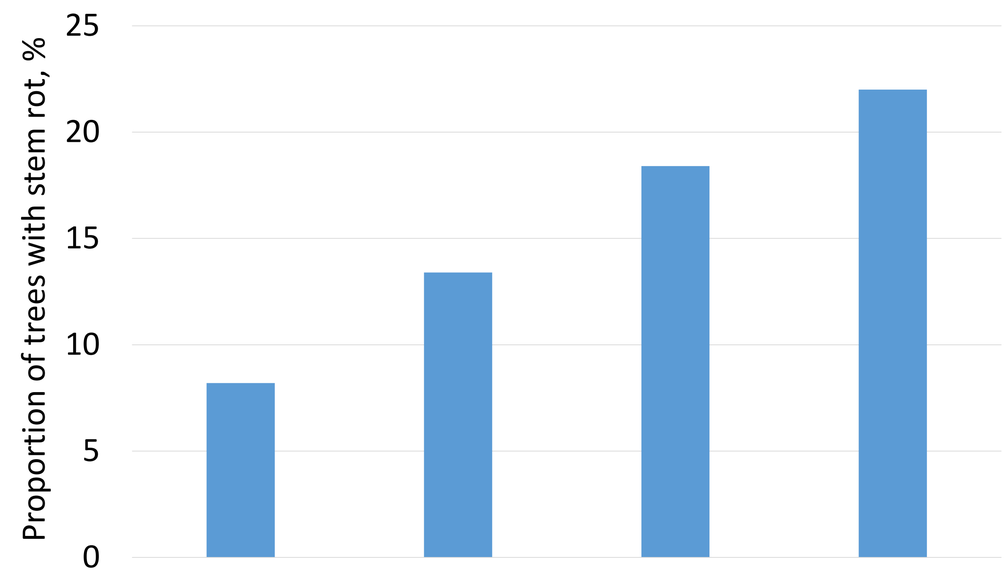
The proportion of aspen with stem rot was very variable between stands, significantly affected by tree age, and increased from 8.2% in young stands to 22.0 % in over-mature.

While searching for sample trees, the presence of spongy rot was detected in an average of 50.6% of growing trees, in individual plots the number of rotten trees ranged from 0% to 91%. About 32% of the affected trees had already formed a smaller or larger cavity. No significantly lower density was observed for discolored wood compared to undamaged wood, while the density of spongy rot has decreased almost twice. The length of the rot column in the affected aspen reached an average height of 19.4 m, while the diameter of it at stump height was 21.5 cm. Aspen has the lowest density in the middle part of the trunk. It is in this part of the trunk the rot most often develops primarily. Decayed aspens like this often develop aphids on the surface of the trunk, which produce spores and continue to infect other trees.

Conclusions

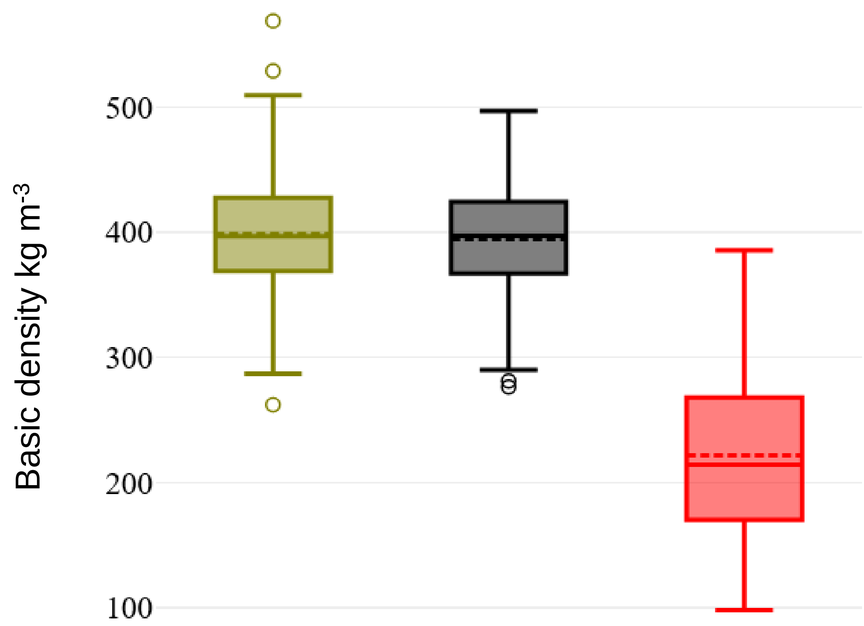
Our study quantified the significant variation of stem wood basic density for different types of decay within European aspen stems. The preliminary results of this study suggest that the decrease in wood density due to internal decay must be taken into account in the stem biomass calculations, especially in mature and over-mature stands, which is an important step in reducing the uncertainty in the estimation of forest biomass and carbon stocks.

As for the management – our study clearly demonstrates the need to shorten the rotation period to increase the outcome of valuable assortments and thereby maximize the carbon sequestration in wood products. Biodiversity maintenance needs to be ensured while leaving ecological trees and set-aside areas, not with longer rotation periods.



Occurrence of aspen trees with stem rot

Determining the prevalence of internal stem decay by the cross-section discs.



Mean basic density (kg m^{-3}) values for intact wood and two types of rot (decay).

Funding
This research was funded by ERDF project "Tool for assessment of carbon turnover and greenhouse gas fluxes in broadleaved tree stands with consideration of internal stem decay" (ERDF No. 1.1.1.1/21/A/063).