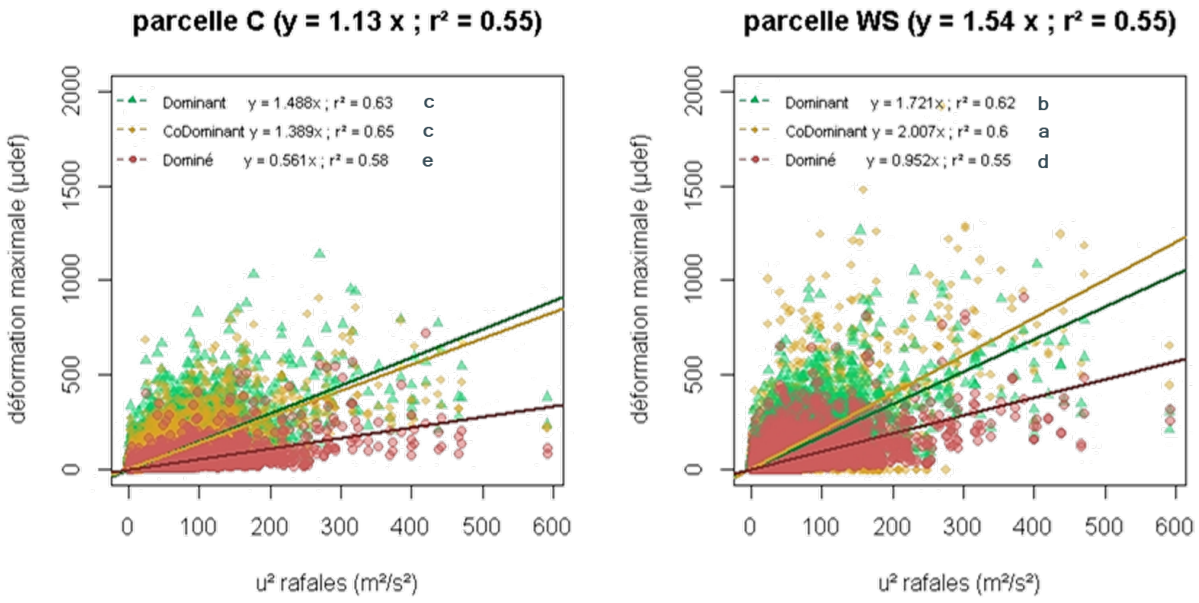
QuaPla



Mechanical resistance against wind and wood quality of Douglas from wide-spaced plantations

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Thematic actions concerned: : *WP1* *WP2* *WP3* *WP4* *Transversal*

Context —

In the present context of global changes, forest will face increased intensity and frequency of wind storms (Baatsen et al., 2014) together with changes in silvicultural practices aiming to lower the tree stem density to increase the forests' resistance to drought (Bottero et al., 2017). Wide-spaced forests may be obtained by an increase of thinning operations or by decreasing the initial planting density. However, every thinning is followed by a period of mechanical vulnerability that highly increases damages in the forest in case of strong wind (Wallentin and Nilsson, 2014). This vulnerability is transitory because wind sways triggers through the perception of mechanical strains the thigmomorphogenetic syndrome (Moulia et al., 2015). This adjustment of growth and morphogenesis ensures a progressive increase in mechanical resistance of the tree against wind loads. Acclimation is strong mainly in young trees. Therefore, we may hypothesize that trees exposed to the wind from their young stages (wide spaced plantations) will exhibit higher resistance against wind compared to trees submitted to successive thinning in latter stages of their growth. On the other hand, higher wind exposure in the young stages in trees growing in wide spaced forest will likely lead to lower wood quality due higher proportion of juvenile wood.

Objectives —
Assess the gain/loss in wood quality and in the resistance against wind in Douglas fir forest issued from innovative sylviculture (low initial planting density) compared to common sylviculture (regular thinning).

Approaches —
Two 50yrs-old Douglas-fir plots submitted to contrasted sylviculture (low initial planting density vs frequently thinned plot) were used for the study. Six trees of different social status were samples in each plot. First, strain regime was followed in both plots during two months to quantify perceived mechanical signals. After this monitoring phase, trees were pulled out in order to measure the anchorage strength. We measured the biomass distribution, the stem shape and collected samples for stem analysis and wood structure and mechanical properties characterisation.

Key results — (presented as separated bullet points)

- The present study offers the first quantification of the canopy shading effect (difference in the mechanical strain perceived by trees of different social status).
- Surprisingly, mechanical strains perceived by trees in the low initial density plot were higher compared to the strain perceived by trees in the thinned plot.
- Widely spaced trees exhibit lower wood density and higher ring width in the basal part of the stem (below DBH) while MFA is only higher in supressed trees.

Main conclusions including key points of discussion —
Higher mechanical strains perceived by trees in the low initial density plot indicate that exposure to wind sways in young stages do not lead to not better acclimation to wind at the stem level. Considering that the anchorage strength does not differ in both treatments, trees in wide-spaced plot exhibit indeed lower mechanical safety against wind. Basal part of the stem in trees from wide spaced plot contain higher fraction of juvenile wood with lower density and, in supressed trees, higher MFA.

Perspectives —
Our study points out the potential limits of mechanosensitive acclimation for trees from widely spaced plantation that may be linked with the contrast between the behaviour of a tree as a part of a structure in contrast with the behaviour of an isolated tree. This question should be addressed in future studies. In terms of wood quality, the wide spaced trees exhibit higher fraction of juvenile wood that should be considered in scenarios about the wood supply scenarios for future.

Valorization —
Poster : Noyer, E., Constant, T., Ningre, F., Seifert, T., Dlouha ; J. ***Impact des différents itinéraires sylvicoles sur les sollicitations mécaniques perçues par les tiges de Douglas : snapshot à 50 ans.*** *10eme journées scientifiques du GDR Sciences du Bois, 17, 18 et 18 novembre 2021. Montpellier*

Papers in preparation:
J. Dlouha, T. Constant, M. Fournier et al. : ***Beyond the perception of wind only as a risk factor: importance of mechanobiology for forest ecology and management.*** *Opinion paper for Annals of Forest Science*

*J. Dlouha & T. Alméras****: Rethinking the adaptive value of the tree size, allometry and wood properties in the wind resistance strategy: up-scaling functional trade-offs.*** *New Phytologist*

Leveraging effect of the project—
Renewal of the collaboration with Freiburg University (Prof. Thomas Seifert group). One German student performed his training period in summer 2022.