

Clermont-Ferrand, 12/8/2024

Dear Editor

Thank you for your review of 3/09/2023 of our preprint submitted initially 1/07/2023:

title: "Some aspects of beech biomechanics: juvenile wood properties, sapwood pre-stress and growth forces"

authors: JULLIEN Delphine, LIU Shengquan, LOUP Caroline, GRIL Joseph, THIBAUT Bernard

Based on your suggestion and the comments of the reviewers, the new version has been drastically reorganized. The focus was given to the radial variation of properties. Due to the impossibility to estimate the radial variations of the initial maturation strain from the measured properties, all biomechanical aspects had to be removed from the paper.

Consequently, the title and author list have been modified as follows:

title: "Radial variation of some wood properties in European beech"

authors: JULLIEN Delphine, LIU Shengquan, LOUP Caroline, ALMERAS Tancreède, GRIL Joseph, THIBAUT Bernard

Now, as suggested, we stick to a classical structure with a short state of the art in the introduction, and the new focus and title clarify by themselves the difference with our previously published paper on the subject.

The reply to the comments by the two reviewers is given below. We hope that this new version will be considered acceptable, so that the information will be made available to our scientific community.

Best regards

Joseph Gril



*Reviewed by Régis Fichot, 25 Jul 2023 15:24*

Review of the paper ‘Some aspects of beech biomechanics: juvenile wood properties, sapwood pre-stress and growth forces’ by Jullien et al.

The manuscript investigates radial variation in a couple of wood traits mostly related to biomechanics (e.g. specific gravity, modulus of elasticity or specific modulus, maturation stress/strain) in trunks from 86 beech trees originating from 9 ‘natural’ forests across 5 European countries. Overall, the authors report radial patterns typical of those commonly observed for planted trees and show that pre-stress is independent of growth, whereas posture control is not.

As a side note, I am not a specialist in wood biomechanics. Since I cannot comment specifically on the theory behind, my comments remain probably very general and are mostly related to manuscript structure and readability from my understanding of the paper. Hope this is still useful to the authors.

The paper has merit with measurements performed on more than 1000 wood rods sampled from wood logs obtained on 86 adult beech trees varying from 70 to 200 years spread across 9 forest in Europe. However, in its present form, I think the paper suffers from several limits that the authors should consider. I also think the paper would benefit from language editing and a table of abbreviations would probably be a good idea considering the large number of traits and abbreviations used.

**The English has been checked, and a list of notations and abbreviations has been added**

I found the structure of the paper awkward in several instances. For instance, the introduction is very short while followed by, as written by the authors, a state of the art related to spatial variation in wood properties. Besides, the choice was made to merge results and discussion (although results are not discussed in this section and there are no references) while another section is later called discussion and conclusion (and there is actually no conclusion in this section). I would recommend reshaping the whole ms structure as I do not see any reason why not following a typical layout (intro / MM / results / discussion and conclusion) and I think it actually does not require that much work.

**The paper structure had been drastically modified, and is now organized in a more conventional way.**

I think the relevance of the paper is not sufficiently well presented and the paper suffers from a lack of clear objectives. The state of the art feels a bit disconnected from the work, at least it does not lead up to clear objectives and a clear rationale as it should do. There is one hypothesis stated at the end of this section (L. 149 – 151) but the rationale is not easy to catch.

**The objective of the paper has been simplified and clarified. It is now focused on the radial variation of wood properties. Biomechanical aspects have been removed, because the data needed to estimate the initial growth stress/strain along the radius (e.g., L shrinkage, MFA...) were not available in this campaign. The title has been modified accordingly.**

In my opinion, the paper also suffers from a lack of precision and statistics. There are numerous examples of sentences like ‘There was a large majority of...’ (L. 204) or ‘Globally there were no noteworthy difference...’ (L. 211) or ‘Globally there is not significant difference...’ (L. 230) or ‘... no clear difference could be observed...’ (L. 242). The radial patterns observed between N/S directions, wood colour, trees or plots are not discussed in the light of statistical tests such that the affirmations above feel assertive without any proof. I guess there are tools available to compare patterns and/or trends that would strengthen the choices and comparisons made.

More systematic statistical analysis has been made.

The number of figures is too high but this can be easily remedied by suppressing several unnecessary figures such as Fig. 2, 3 and 5. For Fig. 2 and 3, from my understanding these come from the literature; I think there is no need to keep them as long as patterns (and what they imply) are explained in the introduction. Fig. 5 serves as an example to illustrate N/S asymmetric patterns; I do not think this deserves necessarily a figure.

The number of figures and tables has been reduced a bit. Former Figures 2 and 3, now 1 and 2, have been kept because, even if the data values come from the literature, they are presented in a way that is consistent with the results of the paper.

Still related to figure, I think Fig. 10 and 11 are not up to standard quality. I believe these figures can be improved through a different choice of symbols, lines, grids, etc...

Hopefully sufficiently improved now.

The discussion is far too short considering the length of the results, with very few references. While the authors should streamline the results to be more to the point and aligned with statistics, I also think the authors should rework and strengthen the whole discussion so that findings are put in a broader literature context and the reader can see the relevance of the findings. Since the work seems to have benefited from a widespread network of forests across Europe, I actually expected the discussion to address underlying questions related to forest management, competition, climate, etc... Although this is noted at the beginning of the discussion, it is not discussed.

The discussion has been extended to some extent.

Specifics:

- L.42: (bud role). Pls consider changing to ‘through bud activity’ or something similar.

N/A

- L.43: (cambium role). Pls consider changing to ‘through cambial activity’ or something similar.

N/A

- L.43-45: I did not get the sentence, pls reword.

N/A

- L.56: unnecessary considering my comments above about reshaping the introduction section.

N/A

- L.59: secondary growth performed by living wood cells. What is meant here by living wood cells? Meristematic cells? I think the sentence should be reworded, as you probably mean cell differentiation endured by cambium derivatives instead of secondary growth, which in my opinion does not refer to the same process. Need to be more specific. In addition, programmed cell death does not apply to all secondary xylem cells (e.g. parenchyma ray cells).

Text has been changed: Secondary growth is performed by living wood cells in the cambial zone: stem cells of cambium itself and daughter cells (Raven et al 2007, Savidge 2003, Déjardin et al 2010, Thibaut 2019) It consists of the following successive steps: division of the cambium stem cells into daughter cells; expansion of daughter cells until the end of primary wall formation; thickening of the fibre (or tracheid) cell walls until the end of secondary wall formation; lignification of the whole cell wall, including the compound middle lamella; programmed fibre and vessel cell death.

- L.64: basic wood features are achieved. Such as what?

Text has been changed: During this cambial activity mechanical wood features are achieved.

- L.69: basic growth descriptors. Pls remove the word 'basic'.

N/A

- L.71:  $\Delta r$ . Definition is missing.

N/A

- L.87: delete Savidge in the parentheses.

done

- L.89: .... Pls change to etc...

done

- L.101-107: I assume this whole paragraph would need one or several references.

N/A

- Fig.2 inset on specific modulus: there is a typo to specific (specidic).

Done

- L.123: and so what?

Text has been changed: The same pattern applies to Eastern cottonwood (Fig. 2)

- L.141: see data for poplar. What data? Do you mean Fig. 3?

N/A

- L.144: longitudinal shrinkage is a good parameter in case of reaction wood. A good parameter for what?

N/A

- L.149-151: besides I did not get the rationale for the hypothesis, one-sentence paragraphs should be avoided.

N/A

- L.154: such reference to projects should not be indicated in the text but kept for acknowledgements.

suppressed

- L.158: from the 9 plots. Stick to the same terms (the plots are referred to forests before).

We used 'plot' everywhere for that meaning

- L.219 and thereafter: the text switches to mainly present tense while past tense was generally used before.

We stucked to past tense.

- L.231 and elsewhere: allowable. Pls change to possible.

done

- Fig.7 inset on specific modulus: pls delete one parenthesis.

done

- L.254 and elsewhere: such description falls short considering there are no stats or indexes that come in support.

We agree. It is only a mean profile with high level of variations shown by standard deviation on the graphs. Moreover in some cases the pattern is opposite to the mean value

- L.266: I do not think comparing interindividual variation between traits based on standard deviation is incorrect since traits do not have the same units. In this case, relative variation such as coefficient of variation should be used.

done: in the table, the Coefficient of variation was actually given in the table

- L.277: why is that interesting?

N/A

- L.341: GSI. Unless I am mistaken, the definition is missing.

N/A

- L.347: were gathered in the same sheet (maturation). This is probably related to the fact that I am not a specialist, but I did not get the sentence.

N/A

- L.351: Cirad 2015. Pls change to the authors of the report.

N/A

- Table 10: typos (probably due to pdf export) for  $\alpha_m$ ,  $\sigma_m$  and  $\Delta F$ .

N/A

*Reviewed by anonymous reviewer, 22 Aug 2023 13:02*

The sampling used in the present paper is the same as in the paper by Jullien et al. (2013) where the original biomechanical measurements (GSI distribution) in relation with the tree morphology were analysed. It seems to me that the present paper does not really bring new insights into the beech biomechanics, the hypothesis of the possible trade-off between the posture control and pre-stresses does not seem very relevant for such big trees with very low tilt angle (DBH of 60cm, 33m tall). The original data presented in the paper concern mainly the material properties and their variability. I would recommend to stress the paper to this focus and re-analyse the data as follows:

i) Partitioning of the variability (comparison of different sources of variability: plot vs tree vs radial position vs radial orientation) of different properties investigated ;

ii) Radial pattern analysis; relation with the tree morphology (data presented in the previous paper), growth speed (relation between figure 10 and 11) might be interesting as well to explain differences in the radial variation pattern in different plots;

Introduction and discussion should be revised to fit to this viewpoint and hypothesis clearly explicated. I would recommend an update of the literature references concerning the radial variation patterns focusing more on hardwoods – works by Plourde et al., Bossu et al., Longuetaud et al., Purba et al. and likely others should be included.

We have modified the paper structure drastically. it is now focused on the radial variations of wood properties, as reflected by the new title. The suggested references were included in the discussion.