

Clermont-Ferrand, 12/11/2024

Dear Editor of PCI / Forest and wood science,

We uploaded in HAL a 3rd version of our preprint on European beech, previously entitled “Radial variation of some wood properties in European beech”, with a new title and modified author’s order:

Title: The diversity of radial variations of wood properties in European beech reveals the plastic nature of juvenile wood

Authors: ALMERAS Tancredè, JULLIEN Delphine, LIU Shengquan, LOUP Caroline, GRIL Joseph, THIBAUT Bernard

These changes reflect a complete reworking of the analysis carried out on the same data, mainly in response to the opinion expressed by the two reviewers that the classification of radial property profiles lacked objectivity.

We hope that this new approach will meet with their approval and would like to take this opportunity to thank them for their careful reading and stimulating reaction.

In addition to the data associated with the work, the Excel file deposited in free access on the Zenodo platform (<https://zenodo.org/records/8103568>) contains various worksheets and macros developed for the analysis, accompanied by an explanatory sheet.

Best regards

For the co-authors

Joseph Gril

## Review by Régis Fichot, 30 Sep 2024 15:11

### # General

I already served as a reviewer on the previous version of the manuscript. The authors have completely reworked the paper and have taken into account, wherever applicable, most of my comments. The manuscript is now considerably shorter and easier to read, focusing only on the radial patterns of three main wood properties that is ring width, specific gravity and specific modulus. I still have a couple of minor comments (see below), hope this is useful to the authors.

Thanks a lot for your useful comments.

- I feel the objectives still could be made clearer at the end of the introduction, with a couple of hypotheses based on the literature that would facilitate the reading and the analysis of the results regarding the main findings.

This has been done in the new version of the introduction

- The authors used the present tense most of the times for the writing; I suggest using the preterit to stick to standards.

Done

- Regarding the decision rule to attribute UP, DOWN or FLAT radial patterns (Table 3 in the results section): it seems like the decision was made visually unless I am wrong. I think it would be better/less subjective if the decision was based on some kind of metric. Why not use the significance and the sign of spearman's rank correlation coefficient to decide? Or something else?

Thank you for this suggestion. The whole paragraph on radial pattern have been totally changed by using metrics and statistical analysis.

- Regarding the presentation of global mean radial patterns on L.242 to 247: I found it too vague and/or not exactly representative of what is drawn in figures. I would suggest rewording a bit these sentences so that it fits closer to the trends presented in the figures. For instance, what does mean "RW decreases regularly" L.242 while ring width clearly does not follow a linear trend and reaches a plateau after approx. 14/15 cm? Same comment for SG, it does not seem to "decrease thereafter" but it shows instead a more complex pattern. For SM, not sure the "then decreases regularly" is applicable, not sure the slight decrease can be considered actually significant.

You are right and the new version have tried to enhance the presentation

- I think Fig. 9 is still not up to standard quality. Maybe remove the symbols so that the trends are more visible. A better choice of contrasting colours might also help.

The figure is suppressed

- The discussion still might be a bit improved. I found the main findings directly gained from the data not clearly visible; as such, it rather feels like a sum of findings from the literature (with the exception of the last paragraph). This might be reworked without too much work.

The discussion chapter was also seriously rewritten, thanks to the suggestions of readers

#### # Misc.

- The young modulus (MOE) appears in the Materials and methods section L.164 while it is not presented before in the introduction (only specific gravity and specific modulus are presented). Later on, MOE is sometimes omitted (e.g. Table 2, Table 3, Fig. 5, Fig. 6) but sometimes presented (e.g. Table 4 to 7, Fig. 9). A couple of words on the usefulness and/or relevance of MOE, besides SM, would be welcome.

This was done in the introduction and MOE was no more presented in results tables. In fact, MOE is an important technological property for wood, but it is the product of SG and SM and its variation depends on the two basic mechanical indicators that can be regulated independently during wood growth.

- Table 2: pls add the name of the parameters in the legend and indicate what the numbers from the ANOVA refer to.

#### Done in the new text

- Table 2: consider changing the symbol for non-significant effects by ns to stick to standards.

#### Done in the tables

- Table 4: it would be nice to have some kind of error (e.g. SE, confidence interval...) associated with the means presented.

#### This table is suppressed

- Fig.9: why not indicate specific gravity here, instead of density, since every other figure presents specific gravity?

#### This has been corrected, only SG is kept

- Table 6, 7 and 8: only two digits for correlation coefficients are enough. Pls also consider adding asterisks (corresponding to significance levels) next to coefficients instead of indicating the significance in the legend. Also, what kind of coefficients (Pearson's, Spearman's)? Pls indicate.

#### This has been done, Spearman model is used

- L.327, TRP: pls consider recalling the meaning of TRP here at the beginning of the discussion.

#### This has been done in the new version of discussion

- L.341-343: this seems out of context and should be incorporated somewhere in the discussion.

The discussion about red heartwood was placed in the beginning of the chapter.

## Review by anonymous reviewer 1, 17 Sep 2024 08:51

Review: Radial variation of some wood properties in European beech

Authors stressed the topic of the paper on radial variations in beech wood properties that makes it more consistent and highlight better the originality of the study. However, some improvements in the presentation and analyses are to my opinion still necessary before publication. First, in the result section authors are jumping from the analysis of mean values and sources of its variation to analysis of radial variation patterns which results in redundancies. Result section should be streamlined and some figures removed. Figure style should be homogenized. Considering the analysis presented, some statistical assessments are missing, I do not think that visual assessments are sufficient. Further, discussion should concern all results or results that are not discussed should be removed from the paper.

Thanks a lot for your useful comments. We have decided to change globally the presentation, based on your remarks and believe that this improve the text

Title: I think that the originality of the paper is to look at three different sources of the wood properties variability: stand site with different forest management, radial position and circumferential position. It would be nice if the title could better reflect these aspects.

Yes, the title should be changed. After the global rewriting, we chose the following title: *“The diversity of radial variations of wood properties in European beech reveals the plastic nature of juvenile wood”*

### Abstract

L15 First sentence is blurry, please rephrase.

Abstract was rewritten

L17 Objectives of the study should be introduced more clearly – analyze the variability of the radial pattern variation in function of the stand but also radius orientation?

Done in the new abstract

L19 aspects of juvenility: Specify or rephrase

Modified in the new abstract

L23 more or less constant: I do not think we can accept this type of assessment, stick with statistical evaluation

You are right, statistical evaluation is used in the new version of the paper

L25 I am not sure we can assign the observed variability to differences in mechanical experienced by trees. It displays the plasticity of wood properties in relation with growth conditions in general and for sure mechanical environment of the tree is very important parameter. But to my opinion, data collected in the present paper do not allow mechanistic explanation of observed variations.

We agree with you that the variability displays the plasticity of wood growth in relation to both ontogenetic signals and external constraints such as the mechanical environment. We consider only growth adaptation in the making of wood that influence the mechanical behaviour of the tree trunk which can be measured afterward on timber from the tree.

## Introduction

The introduction has been rewritten, accordingly to your remarks

L59 Authors present ring width as a mechanical wood trait which is not straightforward, please explicit the link, it would help the comprehension. However, can be really ring width introduced as a mechanical trait at the material level alongside with other wood properties?

You are right and this is better explained in the new version of the introduction. “For a trunk of a given height, the rigidity against lateral wind forces depends on trunk diameter (related to *RW*) and on wood modulus of elasticity (*MOE*) which is the product of *SG* and *SM*” In mechanical computation, geometry (section area and second moment of inertia) is as important as the material mechanical properties, and the mechanical plasticity of wood growth appears both in the geometry (ring width) and in the indicators of mechanical properties (*SG* and *SM*)

L67 I am struggling with the definition of juvenility used in this paper: authors defined juvenility purely as an effect of cambial age while the origin of juvenile transition is widely discussed in the literature (presence/absence of living crown, age or diameter) and basically biological origin is not known.

This was corrected in the new version of the introduction

I think in this paper authors basically discuss two possible origins of the radial variations of wood properties: the effect of cambial age per se (that is one possible definition of juvenility among others) with a mechanical functional definition of juvenile transition related to the tree diameter and experienced mechanical environment. I think that wider definition of juvenility should be introduced and positioning of the paper clarified. Mechanical viewpoint is generic and may also explain the variations in properties around the tree circumference or between stands clearly pointing the limits of the juvenility based on the cambial age hypothesis.

You are right and the new introduction tries to answer to your remark.

L69 I think that reaction wood, its characteristics, location in the tree and impacts of silviculture on its occurrence should be clearly introduced in this section. Further, forestry papers on this topic should be also cited alongside more theoretical studies (for example Dassot et al. 2015).

We have tried to clarify the question of posture control that can be managed by the occurrence of reaction wood in the more difficult situations but also by normal wood with a strong asymmetry in deformation maturation between the two sides of a stem.

L94 I do not think the whole panels of figures is necessary for introduction, explanation of expected trends is sufficient. Figure presenting the relationship between the specific modulus and microfibril angle may be introduced in the material&methods section to justify the choice of measured parameters.

We have reduced the figures

L112 historical context – This wording may be misleading, please rephrase

Done

L120 At the end of introduction, objectives and hypothesis tested in the study should be clearly introduced.

Done

### Material and Methods

L125 If available, it would be nice to have more information about the plots (rainfall, wind speed, soil type). Further, sampling of trees in the stand should be described – both, dominant and suppressed trees are considered or only dominant trees? Do they cover the whole range of presented diameters in the stand and if yes, what is the variability in diameters?

Done

L131 20°C & 65RH in general yields equilibrium moisture content close to 12%?

Suppressed

L174 Does ‘core’ effect correspond to ‘rod’ effect?

Things have been clarified in the variance analysis

### Results

L193 I do not feel comfortable with this part of analysis based on visual observations. I think that the significance and importance of the slope should be assessed for each South or North profile and a clear limit for asymmetry should be given, of course the limit will be arbitrary but at least it is quantified and identical for all profiles. Further, extension of the variability in term of distance to pith would be interesting to model. It would help for quantitative discussion of these original results and would also improve the analysis at the stand level (Figure 9).

All this chapter has been totally modified according to your remarks

L203 Table – Percentage of symmetry are lacking for specific modulus?

MOE is suppressed in the analyses

L203 It is a bit surprising that the stand 2 located on mountain slopes does not represent a high asymmetry contrary to stand 8, how do you explain that?

The diameter rod is always oriented north/south but the dissymmetry, if present, can be in another direction. This dissymmetry can also be linked to dominant winds.

L210 Authors are using both terms, specific gravity and density in the result section (Table 3 vs Table 4), please select one and use it throughout the text.

Done, SG is used

L217 There were no systematic difference between the Northern and Southern samples: how did you test it? On mean values or on trendlines? Please specify. I think it should be evaluated as a parameter affecting the trendline (in function of radial position) and considering that the symmetry ratio is of 70%, it would be surprising that the effect is not significant?

This was done by variance analysis. Direction is not significant but many radial profiles differs from north to south in each tree

L232 no noteworthy difference could be observed – this statement is based on visual assessment? If yes, I would recommend to use a statistical test instead. Further, I do not think that Fig. 7 is necessary (or you can move it in annex), test on mean values will be sufficient for this point.

Fig 7 and many others disappeared as the chapter was totally rewritten

L251 Some strange characters in the figure legend.

No more relevant

L262 These plots are very interesting because they display variations of trendlines between stands however the figure is difficult to read. One option to improve could be to fit colors to the forest management type.

This was rewritten and the figures were changed

L265 Global results – the term global is not very precise. Some results from this section are already present before, the others should be incorporated in the section dealing with the variability sources before the results about trendlines as both deals with variability of mean values at the stand, tree or rod level.

This parts are modified and put in other place

L270: Data from Table 5 are already presented in Fig. 8, I don't think that this Table is necessary. Results on the coefficient of variation may be mentioned in the description of Fig. 8.

Fig.8 is suppressed

L284 tree dimension – number of trees?

Changed

L294 Table 8 deals with a relationship between measured properties with the idea about structure-function model which is not really introduced in the paper previously and not discussed neither. Explicit better or remove.

This is better explicated in the beginning of the paragraph

L299 wood properties per tree – > per plot. These results are in the Figure 9 already, can be removed.

Fig.9 removed

L310 Same comment as for Table 8. Correlation does not mean causality (L307). 0.1% level is not generally used for the significance of statistical tests, why to use this level?

You are right. MOE is suppressed. Significant results are noted more classically by \* or ns

### Discussion

Results about the variance components are not discussed. Results about relationship between measured parameters neither.

Done in the new discussion chapter

L318 For softwoods...Please rephrase the sentence, it is not very clear.

Done

L325 Plourde et al. (2015) reported the relation between the inner wood density and variation expected (increase, decrease or no variation), what is expected for a medium density wood as beech?

This is taken into account. Beech is more similar to high initial density (0.7)

L333 I think the discussion about the interlocked grain trendline is out of scope or the relation should be explained.

Right, suppressed

L341 This is experimental choice and should be noted in material and methods section.

Done

L346 (Germany, France) – Forgotten text?

Corrected

L351 No information about thinning intensity is given in the study so it is difficult to related difference in the mean ring width at the plot level with the type of forest management. For example, soil properties or type of climate will be also important. Be less assertive.

You are right, we do not have all this information. The small number of plots and their great diversity is not favourable for such an analysis. But this diversity is useful to highlighting the adaptative part of juvenility.

L357 This result is not at the right place and should not end the discussion section.

Right, we put the discussion about red heart in the beginning of the discussion.

### Conclusion

I think that conclusion could be improved to fit better with results (please follow the same plan as for results and discussion above – mean values and partition of variation at first, radial variation patterns after) and discussion.



Done

L368 This is not discussed in the previous section. Typical for intraspecific variations of MOE.

Suppressed