

Root hydraulic properties: an exploration of their variability across scales

Juan C. Baca Cabrera¹, Jan Vanderborcht¹, Valentin Couvreur², Dominik Behrend³, Thomas Gaiser³, Thuy Huu Nguyen³, Guillaume Lobet¹

Decision Letter Round 1:

February 6, 2024

Dr. Juan C Baca Cabrera
Forschungszentrum Jülich GmbH
Juelich
Germany

RE: Root hydraulic properties: an exploration of their variability across scales

Dear Dr. Baca Cabrera:

Thank you for submitting to Plant Direct. All required reviews have been returned and we have now finished our evaluation of your manuscript. In light of the reviewers' and editor's comments, further revisions are needed before the paper can be accepted for publication in Plant Direct.

Please view the editors' and reviewers' comments below and use their suggestions as a guide while you work on your revision.

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Please note that, in addition to publishing reviewer comments, the author's responses to review

comments will also be published alongside the final version of the paper. If you would not like the author's responses to be published, please contact the editorial office at plantdirect@wiley.com.

Thank you very much for giving us an opportunity to review your work. I look forward to receiving the next version.

Sincerely,

Ana Fortes

Ana Fortes

Editor, Plant Direct

----- Editor comments:

----- Reviewer comments:

Reviewer #1:

The authors presented a detailed analysis on the variation of hydraulic properties of root among different plant functional types, species and within species. The study is extremely valuable and can help us predict the potential effects of climate change on the environment and agriculture while allowing scientists to explore solutions. This study can also help propel the use of artificial intelligence for smart farming thus conserving water and fertilizer. The study is sound; however, I was wondering if the authors could mention that the samples used for measuring hydraulic properties of root segments were living or dead. Such considerations are important and should be mentioned and considered during analysis as they will have a dramatic effect on mechanical and physiological properties of root.

It will be helpful if the authors can orient the readers on the anatomical and physiological factors that can affect hydraulic properties of root. It is important to discuss the strengths and weaknesses of the study in the discussion/conclusion section and how this work can be improved or extended so that it can be applied in solving challenges in environment and agriculture. Finally, it is important to mention the anomalies and their potential explanation (such as vastly different reports within same species or plant functional types).

Reviewer #2:

The abstract needs to be supported by valuable information

It is best to conduct experiments to supplement the lack of results, including trees and shrubs

Methods:

There are many details in the methods, and some of them were not discussed in the results section

Results:

Figure S1: Focuses on the root length of 3 cereal crops and one legume crop, and trees and shrubs are not touched upon.

It is better to write the title of the research to include specific plants that have been discussed in detail

Statistical analysis

Where are the test results? Skewness, one sample t test , r correlation and geometric averages

Attachment: [Reviewer 2 Review Attachment 1 - 02-06-2024 07:24:37](#)

Decision Letter Round 2:

March 5, 2024

Dr. Juan C Baca Cabrera

Forschungszentrum Jülich GmbH

Juelich

Germany

MSID: 2023-01390R1

MS TITLE: Root hydraulic properties: an exploration of their variability across scales

Dear Dr. Juan Baca Cabrera:

I am pleased to inform you that your manuscript "Root hydraulic properties: an exploration of their variability across scales" has been accepted for publication in Plant Direct.

Your article will appear online in the next available issue of Plant Direct. To ensure your article gets published as quickly as possible, please pay attention to the steps detailed below. We have found that most of the delays happen at this stage, especially at the payment stage, so please respond as quickly as possible when prompted.

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Thank you again for your contribution to Plant Direct. If you have any questions, feel free to contact the editorial office at plantdirect@wiley.com .

Sincerely,

Ana Fortes

Ana Fortes

Editor, Plant Direct

----- Editor comments

----- Reviewer comments:

Author Response:

2023-01390: "Root hydraulic properties: an exploration of their variability across scales"
by Juan C. Baca Cabrera, Jan Vanderborght, Valentin Couvreur, Dominik Behrend, Thomas Gaiser, Thuy Huu Nguyen, Guillaume Lobet

For review - Response to reviewers' comments

We wish to thank the reviewers for the comments and detailed recommendations. All comments were insightful and helped us to sharpen the science and to improve the presentation of the work, and we have revised the manuscript accordingly. In what follows, we explain point by point our responses to the reviewers' comments.

With these changes, we hope that the paper will become acceptable for publication in Plant Direct

With best regards,

The authors

Item #	Reviewer 1	Authors' response
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1	<p>The authors presented a detailed analysis on the variation of hydraulic properties of root among different plant functional types, species and within species. The study is extremely valuable and can help us predict the potential effects of climate change on the environment and agriculture while allowing scientists to explore solutions. This study can also help propel the use of artificial intelligence for smart farming thus conserving water and fertilizer.</p>	<p>We thank the reviewer for the appreciation of the work</p>
2	<p>The study is sound; however, I was wondering if the authors could mention that the samples used for measuring hydraulic properties of root segments were living or dead. Such considerations are important and should be mentioned and considered during analysis as they will have a dramatic effect on mechanical and physiological properties of root</p>	<p>Yes, we agree that this information is important for a better understanding of the results. Unfortunately, most studies did not explicitly mention if the analyzed samples corresponded to living roots, death roots or both. Considering that most of the studies corresponded to young plants and seedlings, we assumed that the measurements were performed using living roots. To avoid ambiguities, we added to LL 138-140 that: "The root hydraulic properties data corresponds to measurements in living root tissues, unless explicitly stated otherwise in the original publications." Also, we added to the conclusion section this point as a shortcoming of our analysis (LL 589-593) and mentioned the need for studies on the role of root senescence/death on Krs development (LL 607-608).</p>
3	<p>It will be helpful if the authors can orient the readers on the anatomical and physiological factors that can affect hydraulic properties of root.</p>	<p>We had already briefly mentioned the role of anatomy in the original manuscript (LL 349-352 and 466-467 in the original manuscript, now LL 362-365 and 483-484). We decided not to add a new section about this topic in the already very long result/discussion section, to keep focus on the discussion points for which we had enough supporting data. But, following the reviewer's advice, we mentioned in the conclusion section as a shortcoming of our study, the fact that we did not analyze the role of anatomical factors on root hydraulic properties variability (578-580). And we enumerated some key anatomical factors and the corresponding literature (LL 580-585).</p>
4	<p>It is important to discuss the strengths and weaknesses of the study in the</p>	<p>In the conclusion section, we added a whole new section describing the main limitations</p>

	<p>discussion/conclusion section and how this work can be improved or extended so that it can be applied in solving challenges in environment and agriculture</p>	<p>of our study, including: (i) we had to exclude from our analysis the effect of several environmental factors on root hydraulic properties variability (LL 571-576); (ii) we did not analyze the role of anatomical factors (LL 578-585); (iii) the analysis of the relationship between age and Krs did not include data on shrubs and trees (LL 585-589); and (iv) we made the assumption that all data corresponded to living roots, which could be misleading (LL 589-593). Furthermore, in the original manuscript we had presented a list of new studies that could build up on our review (LL 555-566 in the original manuscript, now LL 596-607). In the revision, we added a new topic to the list regarding the role of root senescence/death on Krs development (LL 607-608) and made an appeal to interested researchers to use the review and the database for the planning of future studies addressing the mentioned research gaps (LL 608-611).</p>
5	<p>Finally, it is important to mention the anomalies and their potential explanation (such as vastly different reports within same species or plant functional types)</p>	<p>Yes, the reviewer is right. There is indeed vast variation in root hydraulic properties within PFTs or even within species, and we precisely explained some of the factors determining this variability throughout the original manuscript. Therefore, we do not consider extreme differences within PFTs or species to be caused by anomalies, but rather to reflect the expected range of variability. Consequently, we decided not to add a specific section on this topic, to (i) avoid confusion; and (ii) not make the result/discussion section even longer that it already is. But we added to the result section a sentence about the large range of variation of Krs that was observed within several species, and a reference to a previous meta-analysis (Meunier et al. 2019, <i>in silico</i> Plants) in which such a behaviour had already been reported for maize (LL 249-252).</p>
	<p>Reviewer 2</p>	
6	<p>The abstract needs to be supported by valuable information</p>	<p>We added the following information to the abstract:</p> <ul style="list-style-type: none"> • Number of species and studies included in the review (LL 7-8).

		<ul style="list-style-type: none"> • p-values of the effects of environmental stress (L 13), driving force used for measurement (L 15) and root system age (L 16) on root hydraulic properties. • Edited LL 18-20 to explicitly state that the computer simulations were performed with crop species.
7	Methods: There are many details in the methods, and some of them were not discussed in the results section	<p>Following the reviewer’s recommendation, we checked the method section in detail and added the following information to the result section:</p> <ul style="list-style-type: none"> • A reference to the database where all original data has been stored (L 238), • results on data skewness (LL 241-242), • a reference to the plant functional type classification (LL 245-246), • a sentence about what the “drop in accuracy” metric stands for (L 306) • description of the data included in the analysis of the relationship between root system age and Krs (LL 513-516) <p>The added information should improve the clarity of the result and discussion section, without making it too complex. We would prefer to avoid including further methodological details in this section, as the result/discussion is already quite large, and it shouldn’t become a repetition of the method section.</p>
8	Figure S1: Focuses on the root length of 3 cereal crops and one legume crop, and trees and shrubs are not touched upon.	<p>We assume that the reviewer refers to Fig. S2. Indeed, this figure does not include shrubs and trees. The reason for this is the lack of sufficient data for trees and shrubs that would allow an analysis of the relationship between Krs and root system development for these plant functional types (see also LL 215-217 and 513-516). This is also the reason why we included in the title of section 3.2.4 that the relationship we investigated corresponded to crops and grasses, only.</p>
9	It is better to write the title of the research to include specific plants that have been discussed in detail	<p>We are not sure if the reviewer refers here to the title of the manuscript or of Figures 5-7. In this regard, we decided to maintain the title of our manuscript, as it reflects the</p>

		<p>scope of our study, i.e. to obtain a general overview of the variability of root hydraulic properties across different scales (including root hydraulic property types, PFTs, species, experimental treatment, etc.). But, to avoid ambiguities, we edited the legends of Figures 5-7 by adding the PFTs of the species included in the analysis.</p>
10	<p>Statistical analysis: Where are the test results? Skewness, one sample t test , r correlation and geometric averages</p>	<p>We added the following results:</p> <ul style="list-style-type: none"> • Skewness value for each root hydraulic property (LL 174-176, 241-242) • P-values of the one-sample t- tests of (i) the response of root hydraulic properties to the driving force used for measurement (Figure 3 and L 414); and (ii) the response of root hydraulic properties to drought stress (Figure 4 and LL 470-472) and AQP inhibition (Figure 4 and LL 474-476). • R² value of the relationship between root system age and Krs (L 517) <p>The geometric means were already presented in the original manuscript (Figure 2 and Section 3.1).</p>