HESS-2023-12
Title: The degree and depth limitation of deep soil desiccation and its impact on xylem hydraulic conductivity in dryland tree plantations
Author(s): Nana He et al.
MS type: Research article
Iteration: Revision

Comments from handling editor:

Dear Xiaodong Gao, Nana He and co-authors,

thank you for your efforts addressing the moment of the reviewed and myself. The two reviewers of the first round gave very positive feedback and are completely or mostly satisfied with the result. Only small changes are requested by reviewer #2.

In this round, another reviewer #3 entered. The round of invitation to review ended, before any reviewer with expertise in plant hydraulics was called. I am very happy that reviewer #3 added their perspective in this round. Naturally, those are more substantial comments, because the reviewer just entered. They are very constructive suggestions, which I invite you to implement.

Regarding my editors comments, thank you for responding also to those. I still have one main concern stated below this message.

I wish you much success with implementing the suggestions and look forward to the revision. Sincerely,

Anke Hildebrandt

Response: Thank you very much for your time and constructive comments on our paper. We have read through the comments carefully and responded to all comments point by point as follows. Concurrently, the relevant parts of the manuscript have also been modified and/or corrected in a revised version. We hope that the revisions in the manuscript and our accompanying responses will be sufficient to make our manuscript suitable for publication in *Hydrology and Earth System Sciences*.

Regarding the editor comment (3), I have a main concern specifically regarding the

second part, where I stated “Also, next you state that you consider depth limitation, e.g. maximum rooting depth, is reached at the depth where the difference in soil water content between control and plantation is zero. I agree that this may be interpreted as the maximum root water uptake depth. But if this depth cannot be detected, this means it is located deeper than the deepest measurements? If this is correct, it would be good to state this explicitly in this section.”

Here I am still not sure I follow the procedure. Maybe this is related to a misunderstanding in how the depth limitation is defined? I was expecting it to relate to how deeply the ecosystem takes up water? This is in line with the first part of your response:

“It is considered that the depth limitation has been reached when the difference of SMC in the plantation and its’ control is not statistically significant ($p>0.05$).”

If I understand correctly, this is the depth, where the difference between SMC in the plantation and its’ control ceases to be statistically significant ($p>0.05$). That depth I would interpret as the maximum uptake depth of the ecosystem. Maybe this is what is meant?

But next you state that “However, if the difference is always significant ($p<0.05$), it indicates that the maximum root water uptake depth has not been reached.”

If I understand correctly, by “always” is meant “over the entire measured profile”.

This is where I perceive a logical break. If control and planation are different over the entire measured profile, I would interpret this as the root water uptake in the plantations reaching deeper than the measurement depth. In other words the actual uptake depth cannot be assessed. I do not see how the maximum root water uptake depth comes into play or why in this case there is no depth limitation.

If by “depth limitation” you mean “root water uptake depth”, I propose to simply change the wording. Also, in this case please state that the uptake depth cannot be assessed with the proposed procedure, if exceeded the measurement depth, as in Fig.

5f.

The idea of “root depth limitation” is an essential part of the message of the manuscript and therefore urge you to have another look at this and reconcile this.

Response: Thank you very much for your valuable comments and suggestions. The depth limitation, as mentioned in the introduction (“the maximum depth from which trees are able to extract water”), refers to the maximum water uptake depth of the ecosystem. The sentence of “However, if the difference is always significant (p<0.05)” indicates that the depth in question has not reached the maximum root water uptake depth of the planted trees. This paired sample *t*-test works only when the maximum root water uptake depth has been reached, thus, we have not yet determined the maximum root water uptake depth for the *R. pseudoacacia* plantation in the Mizhi site. For clarity, we have revised the Section 2.3.3 as follows (Lines 252-257).

“If the difference of soil moisture content in the plantation and its’ control becomes not statistically significant (p>0.05) at a given layer, it is defined that the maximum RWU depth is reached. On the other hand, if it is always statistically significant (p<0.05) along the whole measured profile, this indicates the maximum RWU depth exceeds the measurement depth.”

Finally, we would like to continue to use the word “depth limitation” instead of “maximum root water uptake depth”. On the one hand, the “depth limitation” has been clearly defined in the text, i.e., refers to the maximum depth of root water uptake. On the other hand, “depth limitation” is simply a more concise word compared with “maximum root water uptake depth”, and matches up with “moisture limitation”. Thanks all the same for your suggestion.

Some editorial remarks

I agree with one re-occuring remark of reviewer #2, which states that there are too many similar acronym used in the text. I propose omitting them in the text as much as possible,

maybe differentiating the naming a bit to allow distinguishing them easier and in any case adding a table where all are listed and specified.

Response: Thanks for your suggestions. We have minimized the use of abbreviations as much as possible and added the Table 4 in the revised manuscript to illustrate as follows.

Table 4. List of acronyms included in the study, with definition and units.

Acronym	definition	Units
Soil properties		
DSMD	Deep soil moisture deficit	-
DSM	Deep soil moisture	grav-%
PWP	permanent wilting point	grav-%
SOC	Soil organic content	g kg^{-1}
Research objects		
LOP	China's Loess Plateau	-
M. pumila	*Malus pumila* Mill. (Apple trees)	-
R. pseudoacacia	*Robinia pseudoacacia* L. (Black locust)	-
SD	Average of straight-line distance between three trees and their controls	m
Plant properties		
PH	Average plant height	m
BD	Average basal diameter	cm
DBH	Average diameter at breast height	cm
CD	Average crown diameter	m
NPLC	Native percentage loss of hydraulic conductivity	%
K_{ini}	The initial branch xylem hydraulic conductivity	kg s^{-1} MPa^{-1}
K_{max}	The maximum branch xylem hydraulic conductivity	kg s^{-1} MPa^{-1}
RWU	Root water uptake	mm
Environmental conditions		
VPD	Vapour pressure deficit	kPa
MAP	mean annual precipitation	mm
Data analysis		
RDA	Redundancy analysis	-
95%CI	95% confidence interval	-

Please use the units grav-% (gravimetric soil water content in %) everywhere, where you refer to soil water content and permanent wilting point in the manuscript (including where they are introduced, as well as where equation are explained or in tables, figures and their captions). This reminds the reader of the units, but also helps distinguishing ratios, like SMD or RR, from actual physical units like SMC.

Response: Thanks for your suggestion. The unit grav-% has been applied at relevant parts throughout the manuscript.

Comments of Anonymous Referee #2:

Line 22. No unit?

Response: This represented the deep soil moisture deficit, which is a dimensionless ratio. Thus, it has no unit.

Line 48: perhaps there is no need to use an acronym throughout the paper...especially because it's very similar to DSM and therefore potentially confusing.

Response: Thanks for your suggestion. We have removed the abbreviation for “DSD” from the entire text.

Line 101: This sentence should come after you explain how you extracted the data and from where.

Response: We agree. We have adjusted the order of expression as follows (Lines 107-113).

“34 peer-reviewed publications were selected for analysis based on the aforementioned criteria. The original data were either clearly obtained from tables in the selected papers or directly extracted from the intuitive figures in those papers using GetData Graph Digitizer (version 2.24, http://getdata-graph-digitizer.com). In all, we retrieved a total of 11980 observations from 258 soil profiles, covering 83 sites across four provinces or municipalities (Fig. 1), and the specific information is shown in Table 1.”

Line 102: these are the papers that were selected based on the 5 criteria?

Response: Yes. To avoid confusion, we have modified this section as follows (Line 107).

"34 peer-reviewed publications were selected for analysis based on the aforementioned criteria."

Line 131: ?? Just sampling is enough, I think.

Response: Our sampling plan is based on literature data analysis to verify whether there is similar moisture limitation on both black locust and apple plantations. Furthermore combining literature data can show extensive moisture and depth limitations in tree plantations across space and time on the Loess Plateau.

Line 207: And so? Did you solve the issue?

Response: Yes. Weighted meta-analysis requires standard deviation data when calculating the weights of individual observations. We use unweighted meta-analysis to avoid this problem in this study.

Line 221: Another acronym very similar to the previous ones.

Response: We have replaced all abbreviations for "SMD" in the text to "soil moisture deficit".

Line 266: Another acronym very similar to the previous ones.

Response: We have removed the abbreviation about SMD in the revised manuscript.

Line 278: This sentence does not read well, please fix it.

Response: This sentence has been rewritten as follows (Lines 298-300).

"We combined the extracted (Fig. 4a and b) and measured (Fig. 4c-f) data to explore

the moisture limitation of deep-layer soil desiccation."

Line 278: Oh no, more acronyms!

Response: We have minimized the use of abbreviations in this section as much as possible (Lines 342-354). In addition, we have compiled all the abbreviations used in the text into Table 4 (as shown above) and placed it in the revised manuscript.

"Based on all extracted and measured data, including soil moisture deficit, soil moisture, soil texture (clay, silt), and fine root dry weight density along with ERA5-Land meteorological data (*MAP*, mean annual temperature, relative humidity, *VPD*), the RDA was used to analyze the key factors that determine the moisture and depth limitations of deep-layer soil desiccation (Fig. 6). The RDA showed that the explanatory variables (soil properties, meteorological variables and plant characteristic) account for 67.7% of the total variation of soil moisture and soil moisture deficit. soil moisture deficit was significantly (p<0.01) positively correlated with *VPD*, and negatively correlated with clay, silt, relative humidity, mean annual temperature, and *MAP* (Fig. 6a). The clay, *VPD*, silt, relative humidity, and fine root dry weight density provided statistically significant (p<0.01) explanations for the distribution of soil moisture deficit and soil moisture (Fig. 6b), the clay content determines the lower limit of water that plants can uptake through its adsorption of water molecules. Thus, soil texture and climatic conditions were the main factors leading to the limitations of deep-layer soil desiccation in different regions. However, the relationship between *MAP* and soil moisture deficit was not significant, which may be due to the *MAP* of each region weakened the differences of precipitation in each sampling year."

Line 366: And the highest?

Response: Both the lowest and highest soil moisture content that plants can absorb are determined by *VPD* and soil water availability. Therefore, we have made the following modifications to this sentence (Lines 398-400).

"This indicates that the amount of soil moisture absorbed by plants is determined by *VPD* and soil water availability, which is mainly affected by the precipitation and soil structure (Wu et al., 2015)."

Line 432: this is a new one!

Response: We have removed the abbreviation here.

Comments of Anonymous Referee #3:

General comments:

In the present manuscript the authors are investigating how two planted tree species (Robinia pseudoacacia and Malus pumilio) in water-limited areas on the Loess Plateau are influencing deep soil desiccation and whether they experience moisture or rooting depth limitations. The study found that deep soil moisture deficit (DSMD) reached a level close to the permanent wilting point (PWP) under trees aged 24-28 years, indicating moisture limitation. The maximum depth of soil moisture use was 18.0-22.0 m and over 25 m for R. pseudoacacia in the drier site. Furthermore, the authors compared native loss in xylem hydraulic conductivity of branches between sites when moisture and depth limitations were reached, which they interpret as indicating the potential for tree mortality.

Overall, I agree with the previous reviewers on the base of general interest of the topic and collected data to the hydraulic community. The quality of the data collection and analysis seems sounds and the manuscript is well structured and has a general good reading flow with minor phrasing issues.

I would have some concerns regarding the measurements of the PLC (which was the native xylem embolism rate in this study) and the conclusions drawn from them. I was surprised to see the reported values being so high for both Robinia and Malus reaching nearly 95% in some cases. For R. pseudoacacia one possible reason could be that its wood is classified as ring-porous, meaning they have large early-wood vessels and

much smaller late wood vessels. Thus, PLC can have a high seasonal variability. And generally, these species are conductive mainly in the last 1-2 year-rings even in branches (here the authors collected current year branches which is a good approach). But also this means that maximum vessel lengths are longer than the segment lengths (3-5 cm) used in the XYL'EM measurements. As a consequence, open vessels are very likely. This may introduce artefacts when measuring conductivity as the Kmax after flushing can be very high with these open vessels being filled with fluid. The method has been applied to this kind of short segment on ring-porous species before (e.g. Wang et al 2014),

but I would be a bit more cautious on the result interpretation. Usually it is assumed that a loss of conductivity >88 % can be the point of no return for angiosperm xylem. For example, the PLC values obtained using the same method for highly impacted and nearly dead Eucalyptus trees were in the range of 80-90%, with most species having much lower values (Nolan et al. 2021).

Response: On the whole, the high *NPLC* of *Robinia pseudoacacia* and *Malus pumila* plantations are related to the extreme drought, including meteorological and soil drought, in 2021 experienced by planted trees of the Mizhi. Nolan et al. (2021) showed that trees with most, or all, of their foliage dead exhibited high rates of native embolism (78–100%). In fact, there was a large-scale canopy die-back (>80%) phenomenon in *R. pseudoacacia* plantations when sampling before the rainy season in 2022 (Figure S4). Another reason for the high value of *NPLC* may be due to the fact that the segment lengths (3-5 cm) used in the XYL'EM measurements may be shorter than the maximum vessel lengths of planted trees, which leads to artefacts in the measurements. Thus, we will consider the vessel length of different tree species when using the XYL'EM method to study the *NPLC* of planted trees in the future, to obtain more accurate *NPLC* values. We have supplemented the discussion as follows to rigorously explain this result (Lines 448-454).

"Thus, the embolism in the conduit accumulated continuously as the water pool became exhaustible causing the severe and large-scale canopy die-back (Fig. S4; Arend et al.,

2021). Even though the *NPLC* value of *R. pseudoacacia* plantation may be higher due to the sample length (3-5 cm) in the XYL'EM measurement is shorter than the maximum vessel length, the result is consistent with trees with most, or all, of their foliage dead exhibited high rates of native embolism (78–100%) (Nolan et al., 2021). This indicates that mature (>24 year) plantations on the LOP are already facing a great risk of dieback and even death in semi-arid regions similar to Mizhi."

Then I have some minor issue with the discussion of hydraulic conductivity and some not precise or incorrect literature citations. See specific comments below:

Specific comments:

- L14: While abstract is linguistically not wrong here, I would use extract instead.

Response: Thanks for your suggestion. We have changed "abstract" to "extract" (Line 14).

- L17: the limitation

Response: We agree. We have revised it (Line 16).

- L17+18: twice unclear, you can vary it and rephrase the first sentence as it is formulated not precisely. Do you mean the thresholds for water uptake and moisture content at which soil desiccation occurs are not yet determined? For example: The specific limitations to root water uptake both in relation to soil moisture content and deep-layer soil desiccation (DSD) depth are still not well determined.

Response: Thanks a lot for your valuable suggestion and we agree. The text has been edited (Lines 16-17).

"The specific limitation to root water uptake both in relation to soil moisture content and deep-layer soil desiccation depth are still not well determined."

- L19: Therefore, we studied

Response: We agree. It has been edited in the text (Line 20).

- L22: which is close

Response: We agree. It has been edited in the text (Line 24).

- L31: NbS is used only once and the acronym is not necessary. I agree with the comments of reviewer2 as to the use of acronyms more sparingly to enhance reading flow.

Response: We agree. We have deleted the "NbS" and revised many abbreviations in the article (Line 32).

- L44: Considerable studies

Response: We agree. The text has been edited (Lines 45-46).

- L50: Our/the knowledge about variations .....remains restricted. (But it is a long sentence and the authors could consider splitting it)

Response: We agree. The sentence has been rewritten (Lines 51-55).

"Although soil desiccation of different degrees has been widely reported in the above citations, the knowledge about variations in the lowest moisture of deep-layer soil desiccation that limits growth (hereafter "moisture limitation") and/or the maximum depth from which trees are able to extract water (hereafter "depth limitation") for different species and in different climate zones remains restricted. This is critical to estimate the amount of available soil water storage in deep soil and to predict the fate of planted trees based on soil water availability."

- L61: Why only aboveground?

Response: Because the aboveground part is relatively intuitive and easy to monitor, current research on the impact of deep soil desiccation on the growth of plantations is mostly focused on the aboveground part. However, in reality, the impact of deep soil

desiccation on the growth of plantations should be on the whole plant. Therefore, we have made the following modifications to this section (Lines 63-64).

“The occurrence of soil desiccation in deep layers can greatly affect the growth and eco-physiological traits of the planted trees.”

- L69-71: I would prefer to use resistance of the xylem against embolism formation here. Furthermore, this sentence is cited not completely correct, Fuchs et al. 2021 did not work in plantations and they used xylem water potential at 50% loss of hydraulic conductance (P50) as measure of resistance of the xylem against embolism formation and not PLC. Further they did not find observed an increase in embolism resistance with declining water availability – actually the opposite with observed trait variability was neither driven by climatic nor soil water availability, but instead cite other studies who did observe this trend (Schuldt et al., 2016; Stojnic et al., 2018). The study by Liu et al. 2020 is model–data fusion approach to evaluate the terrestrial evapotranspiration response to soil moisture and VPD and mentions also only P50 as hydraulic trait to evaluate the efficacy of the model.

Response: Thanks for your suggestion. By far, there are few studies on the change of xylem embolism resistance with water availability for plantations on the Loess Plateau. Zhang et al. (2020) studied percentage loss of whole-plant hydraulic conductance (PLK) of *Robinia pseudoacacia* plantation along the precipitation gradient on this region, but it also based on the result of model simulation. Therefore, we have cited the research conclusions of European beech from Schuldt et al. (2016) and Stojnic et al. (2018) to illustrate, and we have revised the description and references here as follows (Lines 71-73).

“Moreover, resistance of the xylem against embolism increases with a decrease in water availability, leading to a reduction in xylem hydraulic conductivity and even hydraulic failure of the European beech (Schuldt et al., 2016; Stojnic et al., 2018).”

References:

Schuldt, B., Knutzen, F., Delzon, S., Jansen, S., Mueller-Haubold, H., Burlett, R., Clough, Y., and Leuschner, C.: How adaptable is the hydraulic system of European beech in the face of climate change-related precipitation reduction? New Phytol., 210, 443–458, 10.1111/nph.13798, 2016.

Stojnic, S., Suchocka, M., Benito-Garzón, M., Torres-Ruiz, J.M., Cochard, H., Bolte, A., Cocozza, C., Cvjetkovic´, B., de Luis, M., Martinez-Vilalta, J., Ræbild, A., Tognetti, R., and Delzon, S.: Variation in xylem vulnerability to embolism in European beech from geographically marginal populations, Tree Physiol., 38, 173-185, 10.1093/treephys/tpx128, 2018.

Zhang, Z., Huang, M., Yang, Y., Zhao, X. Evaluating drought-induced mortality risk for Robinia pseudoacacia plantations along the precipitation gradient on the Chinese Loess Plateau, Agr. Forest Meteorol., 284, 107897, 10.1016/j.agrformet.2019.107897, 2020.

- L71: It should be mentioned somewhere here or in the methods that is it the native percentage loss of hydraulic conductivity (NPLC) from empirical or actual hydraulic conductivity the authors are investigating and not the theoretical or potential one which is derived from wood anatomical features.

Response: We agree. We have added it in the Section 2.2.3 and changed “PLC” to “NPLC” in the revised manuscript (Lines 165-169).

“In order to explore the influence of deep-layer soil desiccation to the native percentage loss of hydraulic conductivity of planted trees across different sites, while collecting soil moisture, six current-year branches with 18-20 cm in length and 2-5 mm in diameter were cut off in the morning from apple and black locust trees, age of which reached the moisture limitation of deep-layer soil desiccation; and three trees with similar growth status were selected as repeats for each site.”

- L74: Own/new observations

Response: We agree. We have revised it (Line 77).

- L77: depend on the tree species; drought-resistance (without capacity), which is based

on their water-use strategy under drought stress. Then from my point of view a part is missing here linking the drought-strategy to loss of hydraulic conductivity. The authors mean the (semi-)permanent loss of the conductive pathway caused by embolism formation in xylem as far as I understand. This needs to be explained somewhere.

Response: Thanks for your comment. We have revised it as follows (Lines 80-85).

"Our hypotheses were that the moisture and depth limitations of deep-layer soil desiccation depend on tree species, as they differ in drought-resistance, which is based on their water-use strategy under drought stress (Gessler et al., 2020). Because drought stress causes the formation of gas emboli and blockage of xylem conduits in woody plants, leading to a sharp decrease in xylem hydraulic conductivity (Gauthey et al., 2021). Therefore, we also hypothesize that the xylem hydraulic conductivity of planted trees is greatly reduced when moisture and depth limitations are reached due to low soil water availability in deep layers."

References

Gessler, A., Bottero, A., Marshall, J., Arend M.: The way back: recovery of trees from drought and its implication for acclimation, New Phytol., 228(6), 1704-1709, 10.1111/nph.16703, 2020.

Gauthey, A., Peters, J.M.R., Lòpez, R., Carins-Murphy, M.R., Carins-Murphy, C.M., Tissue, D.T., Medlyn, B.E., Brodribb, T.J., Choat, B.: Mechanisms of xylem hydraulic recovery after drought in Eucalyptus saligna, Plant Cell Environ., 45, 1216–1228, 10.1111/pce.14265, 2022.

- L136: limitation is indicated

Response: We agreed. We have revised it (Line 144).

-L154: It could be mentioned more prominently that the study measures native xylem embolism and compares these values between sites.

Response: Thanks for your suggestion. We have supplemented it as follows (Lines 165-169).

"In order to explore the influence of deep-layer soil desiccation to the native percentage loss of hydraulic conductivity of planted trees across different sites, while collecting soil moisture, six current-year branches with 18-20 cm in length and 2-5 mm in diameter were cut off in the morning from apple and black locust trees, age of which reached the moisture limitation of deep-layer soil desiccation; and three trees with similar growth status were selected as repeats for each site."

- L155: In which season were the samples collected, was it the peak of the dry season?

Response: The samples were collected from April 9 to May 6 2022, which is consistent with peak time of dry season.

- L155: The replicate number was 6 x 3 (trees per plantation) x 3 (locations) so n_total= 54. This should be also added in the figure header. Were this upper-canopy sun-exposed branches?

Response: Thanks for your suggestion. We have added sample size information in the title of the figure (Line 372). We cut off branch samples from southern crown of planted trees, thus, these branch samples were upper-canopy sun-exposed branches.

- L156: at the tree age when the plantations reached the moisture limitation

Response: We agree. We have revised it (Lines 166-168).

- L158: After bringing

Response: We agree. We have revised it (Line 170).

- L159: under water

Response: We agree. We have revised it (Line 171).

- L161: What do the authors mean by avoiding water spilt?

Response: If the low pressure is too high, it will wash away part of the embolism in the branch xylem, so that the water in the conduit will overflow quickly, resulting in the

initial xylem hydraulic conductivity is relatively high. Therefore, in order to avoid water overflow (namely, water spilt) and measure the accurate initial xylem hydraulic conductivity, we set the low pressure within the range of 0.5-1 kPa.

- L171: with roots

Response: We agree. We have revised it (Line 183).

- L174: What is the unit, is the fine root dry weight density expressed by cm3 of soil volume?

Response: The fine root dry weight density is g m^{-3}, which was added in the text (Line 186).

- L243: I am missing a bit more details on the test statistics for PLC calculations. Were all samples treated as independent? Or were the data averaged per branch and/or tree?

Response: This study takes the average value of six branches as the *NPLC* value for each tree, and then uses the values of three trees as independent samples for statistical analysis. For clarity, we have added the following additions to this text (Lines 260-263).

"Least significant difference *post-hoc* tests in SPSS 22.0 software package (SPSS 22.0, SPSS Institute Ltd., USA) was used to analyze the significant differences in *NPLC* of current-year branches of planted trees in different sites (takes the average of six branches as the *NPLC* for *per* tree, and three duplicate trees was treated as independent in statistical analysis)."

- L249: I understand the need for some acronyms, but the APO and BLF are new ones to the reader and have the same lengths and form as acronyms for places or variables. Maybe the authors can consider to use R. pseudoacacia and M. pumila instead.

Response: Thanks for your suggestion. We have uniformly changed all abbreviations for apple trees and black locusts to *M. pumila* and *R. pseudoacacia* throughout the revised paper.

- L258: With the age of plantation

Response: We agree. We have revised it (Line 278).

- L336: This are indeed surprising results, NPLC values for R. pseudoacacia are reported <50% using different methods by e.g. Wang et al. 2014. Could this be a methodological issue?

Response: The main reasons for the *NPLC* differences between the two studies can be explained as follows. First, the study site of Wang et al. (2014) is Yangling in the southern part of the Loess Plateau, with an average annual rainfall of 680 mm. However, our study sites are located in much drier areas with the mean annual precipitation ranges from 578 to 421 mm. Second, the tree age is not clear in the study of Wang et al. (2014), but it should be young or middle-aged trees (10-15 year) according to the tree height (5-7 m). However, the *R. pseudoacacia* in our study site are mature plantations (⩾24 year) with average tree height 12.3 m. Finally, methodological factors may also lead to differences in *NPLC*. Wang et al. (2014) measured *NPLC* by low pressure flow meter (LPFM), and we measured *NPLC* by using the XYL'EM method.

- L349: lowest limitation in this study area?

Response: Here we mean that deep soil moisture content reached the lowest limitation in the study area. The text has been edited as follows for clarity (Lines 379-380).

"DSM has reached its lowest limitations in the study area, seriously threatening the sustainability of tree growth under future climate conditions."

- L354: largest matrix potential = highest or least negative?

Response: Soil matrix potential is expressed as negative values. Generally, the coarser the soil texture, the closer the matrix potential is to 0. Therefore, the larger matrix potential represents the less negative potential, the text has been edited (Lines 384-386).

"When the soil texture is coarser, it has a higher (less negative) matric potential or smaller suction under the same soil moisture conditions (Dexter, 2004), resulting in a higher matric potential gradient around fine roots in areas with less rainfall."

- L356: LRA + MRA Are these necessary acronyms?

Response: We have removed the abbreviations about LRA and MRA in the revised manuscript.

- L360-362: This sentence gives me a bit of headaches and I had to read it several times to get its meaning. Maybe it would be possible to split it up? What is the cause and what is the consequence here, by whom; the soil or the plant?

Response: Thanks for your suggestions. We have revised it as follows (Lines 390-393).

"Thus, the soil with coarser texture has higher K_s when soil starts limiting trees' RWU. Correspondingly, the K_r value is higher in areas with less rainfall, which may be maintained by allocating more biomass to fine roots (Fig. 8), than that in areas with more rainfall."

- L378: This should be the end of the paragraph

Response: We agree. We have revised it (Lines 420-422).

- L395: branch xylem

Response: We agree. We have revised it (Line 431).

- L396: was reached

Response: We agree. We have revised it (Line 432).

- L398: Maybe better to talk about transpiration instead of aboveground metabolism

Response: We agree. We have revised it (Line 435).

- L400: Usually stomata close before embolism formation

Response: We agree. We have revised the description as follows (Lines 433-438).

"The reason for this result is that dried soil seriously restricts the process of RWU, and water absorption of trees is difficult to meet the needs of transpiration, resulting in the leaf stomata close to prevent excessive reduction of water potential (Yang et al., 2022). Subsequently, the water column in the xylem vessels is interrupted as DSM approaches *PWP*, and thus *NPLC* increases during prolonged dry periods (McDowell et al., 2018)."

- L401: I would phrase this more carefully here. How long the planted trees can survive depends mainly on the capacitance within the trees tissue and the water loss. This is in turn related to stomatal control strategy, and after complete stomatal closure on cuticular conductance. And then finally on the NSC storage within the tree = starvation or the point of no return and hydraulic failure of the conducting system.

Response: Thanks for your suggestion. We have revised the description as follows (Lines 437-442).

"Subsequently, the water column in the xylem vessels is interrupted as DSM approaches *PWP*, and thus *NPLC* increases during prolonged dry periods (McDowell et al., 2018). How long the planted trees can survive after this depends mainly on the capacitance within their tissues and water loss (McDowell et al., 2022). And then finally rely on whether the *NPLC* reaches the point of no return or the non-structural carbohydrates stored within the trees are depleted."

- L403: something is missing in the sentence, do you mean: precipitation as well as about time and amount for restoring...

Response: We agree. We have revised it (Line 444).

Tables + Figures

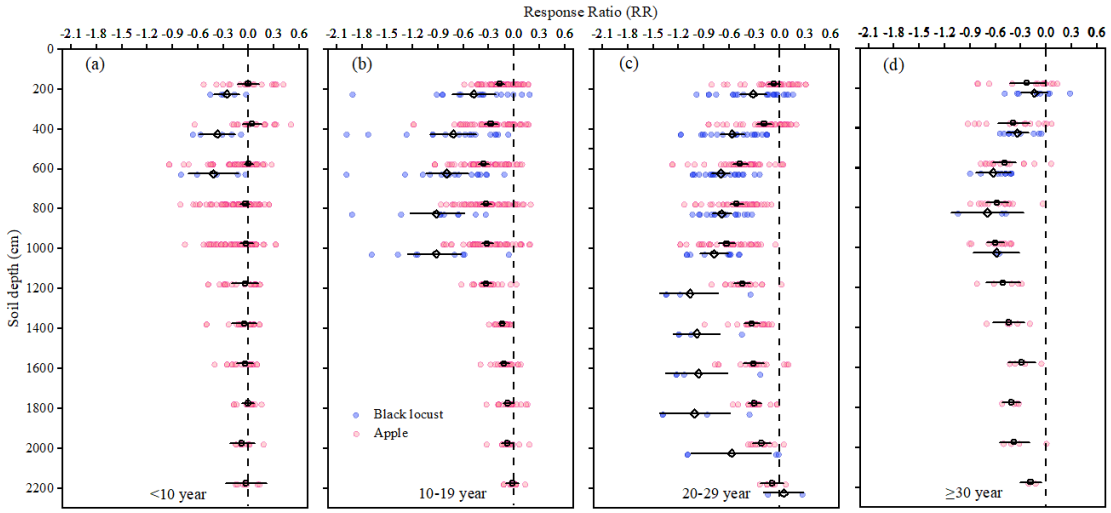
- Table 2: The order of abbreviation explanations should be changed to reflex the order

they appear in the header.

Response: We agree. We have revised it (Lines 160-162).

- Fig 2: It would make the figure easier to read if the x-axis would be labelled <10 yr; 10-20 yr etc.

Response: We agree. We have revised it as follow (Line 275).



Literature

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