General comments

This is a very interesting that focuses on the analysis of deep soil desiccation and its effect on soil moisture supply and tree hydraulic conductivity in tree plantations. This is a topic that fits the scope of this journal and that is of interest for its readership. Overall, the manuscript is well written and organized, and the motivation, scientific gaps, and objectives are clear. However, there are some confused methodological descriptions that make unclear most of the results, weakening the strength of the work. Moreover, data interpretation is not always straightforward, leaving the reader with doubts about the effective role of PWP. Please, find my main concerns and some minor corrections and suggestions below. In the end, I recommend a major revision of this work.

Response: Thanks for your time and constructive comments on our manuscript. The detailed replies point by point to your comments are presented as follows.

Specific comments

- As far as I know, the approach of mixing data extracted from the literature with those collected in the field is quite unusual. Still, I welcome this approach because the two distinct datasets can corroborate each other. However, the presentation of the two dataset is quite confusing and it was hard for me to understand which results refer to data collected in the field and which were extracted by the literature. This holds true for the tables, the figures, and the results presented in the text. All this creates some confusions. I think it's important to well explain this difference for the sake of clarity and to allow the reader understanding where the findings come from.

Response: Thanks for your comment, we will provide a detailed description as shown below for the data sources of the tables, the figures and the results presented in the text, and explain these contents in the title of themselves in the revised manuscript.

Table 1: Sample information used in this study. Data marked with NEP and NSP represent the number of data pairs from the literature and field sampling, respectively.

Table 2: Basic information of the field sampling trees that causes the lowest deep soil moisture deficit (DSMD).

Table 3: Basic soil properties of field sampling sites.

Figure 2 contains 11980 literature extraction data and 4200 field sampling data.

Figure 3 involves literature extraction data of soil moisture from 15-year-old apple orchards obtained in 2002, 2010, 2016 and 2019.

Figure 4 (a) and (b) belong to literature extraction data, and (c)-(f) belong to field measurement data.

Figure 5: The data of 22-year-old apple and cropland (dark green) in Changwu belong to literature extraction data, and other data are field measured data.

Figure 6: Both extracted data from literature and field measured data participate in the redundancy analysis.

Figure 7: The percentage loss of hydraulic conductivity of annual branches of apple (a) and black locust (b) are field measured data.

Figure 8: Regulatory mechanism of the extreme influence of root water uptake (RWU) on deep soil moisture based on both the extracted data from literature and field measured data.

- Moreover, there are some unclear explanations and definitions that hamper a complete understanding of the work and of it's results. See below the specific comments.

Response: Thanks for your comment. We will revise all of them in the new version as follows.

- Sometimes, there are too many acronyms. Some are used several times in the text and become familiar to the reader, and some are very well knows. However, some are not, and an excessive use of acronyms can fragmentate the reading flow and hamper understanding. Moreover, sometimes acronyms are used for the entire term and sometimes not: please be consistent throughout the entire manuscript.

Response: We will complete the full names of all acronyms, such as GPS (Line 135) and SPAC (Line 385) that appear only once; reduce the unnecessary use of acronyms, such as SM (Lines 299, 314-316) and SD (Lines 145-146) for the readability of the article; and delete redundant acronym such as ECMWF (Lines 206-207) in the revised manuscript.

Line 135

"Geographic coordinates (altitude, longitude, and latitude) for each site were obtained using a Global Positioning System."

Lines 145-146

"The straight-line distance between the planted trees and their control was controlled at less than 500 m, and the average straight-line distance of the three replicates was shown in Table 2."

Lines 206-207

"The precipitation, air temperature, and relative humidity of different regions were from the European Centre for Medium-Range Weather Forecasts ERA5-Land reanalysis."

Lines 305-306

"We calculate the difference significance of soil moisture between the plantations and control using the paired sample *t*-test."

Lines 314-316

"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 SMD. SMD was significantly ($p<0.01$) positively correlated with VPD, and negatively correlated with clay, silt, RH, MAT, and MAP (Fig. 6a). The clay, VPD, silt, RH, and FRDWD provided statistically significant ($p<0.01$) explanations for the distribution of SMD and soil moisture (Fig. 6b)."

Line 385

"Probably because the hydraulic path of water transport in the soil-plant-atmosphere continuum is too long."

- The Authors insist a lot on the role of the PWP as an indicator of the degree of moisture limitation for plants. However, the PWP was not directly measured, it can be very variable according to different locations and depth, and DSM is used as a proxy. I suggest making the connection between PWP and DSM clearer and stronger. As far as I understand, the main message of the manuscript lays on this aspect which should be crystal clear to the reader.

Response: Large-scale permanent wilting point (PWP) measurements are infeasible because obtaining undisturbed soil from deep soil is difficult and time-consuming. Soil pedotransfer functions (PTFs) are widely used for PWP estimation (Balland et al. 2008), Studies have established the PTFs for the Loess Plateau based on a large number of measured data and verified its estimation accuracy (Wang et al. 2012; Yang et al., 2020). Therefore, the estimation of PWP based on the PTFs in this study has high accuracy and reliability. PWP is the soil moisture content causing plants wilt, so we use soil moisture content to represent it, and deep soil moisture content (DSM) here is mostly directly measured as either mass or volumetric moisture content. In this study, the relationship between PWP and DSM is mainly reflected in whether PWP is the lowest value of DSM in plantations.

References:

Balland, V., Pollacco, J., Arp, P.: Modeling soil hydraulic properties for a wide range of soil conditions. Ecol. Model., 219 (3-4), 300-316, 2008.

Wang, Y., Shao, M., Liu, Z.: Pedotransfer functions for predicting soil hydraulic properties of the Chinese Loess Plateau. Soil Sci., 177 (7), 424-432, 2012.

Yang, M., Wang, S., Zhao, X., Gao, X., Liu, S.: Soil properties of apple orchards on China's Loess Plateau, Sci. Total Environ., 723, 138041, 2020.

- The language is sometime not appropriate, some sentences are not linear and a bit hard to follow. There are sparce grammar mistakes. I made a few suggestions only (below). I suggest a language review by a native (or very proficient) English-speaker.

Response: Thanks for your help in language. We will revise the manuscript one by one according to your suggestions, and ask native English speakers to edit the language of the revised manuscript.

81. What is the drought-resistance related to? Water use strategy? Root depth? It is important to define this here, I believe.

Response: The drought-resistance refer to the ability of a plant to maintain favorable water balance and turgidity even exposed to drought conditions there by avoiding stress and its consequences. Thus, it related to the water use strategy of different tree species under drought conditions. Of course, shifting the root depth is sometimes also a water use strategy for trees to adapt to arid environments. For clarity, we will modify this sentence in the revised manuscript (Lines 81-83).

"Our hypotheses were that the degree and depth limitation of deep-layer soil desiccation depends on tree species, as they differ in drought-resistance capacity, which refers to the ability of a plant to maintain favorable water balance and turgidity even exposed to drought conditions (Gessler et al., 2020)."

89. What kind of bias? Please explain.

Response: The bias here refers to the phenomenon that the obtained literature cannot

serve the research subject well according to a single screening criterion when selecting the literature. In order to correct that we will amend the statement here as follow in the revised manuscript (Lines 92-93).

"To avoid bias in the literature selection, the following criteria were set to filtrate 718 articles obtained."

111. What does the Authors mean hear with "random errors", and how can they be avoided? Please, explain.

Response: Thank you for your suggestion. Random error here refers to accidental or indeterminate error, which is a mutually compensating error caused by small random fluctuations in a series of related factors during the measurement process. Due to the different sampling years of apple orchards in Changwu and Luochuan from literatures, which may lead to random error in the process of comparative analysis of soil moisture data among tree ages. In order to avoid these random errors affecting the results of this study, we divide them into tree age segments for analysis.

141. This sounds unbelievable to me. I have used a hand auger to get soil samples down to a couple of meters, and only occasionally to 4-5 through a driller. Here the Authors report 25 m! How is that possible? Please, explain.

Response: In order to explore the maximum water consumption depth of the plantation, we insisted on using 15 drill pipes (to reduce the weight of the tool itself, choose a hollow steel pipe) with a length of 2 m to form an auger that could be disassembled on demand. Each 25 m deep soil column required four people to work together and continuously for four days to complete (As shown in following photographs of sampling process).

Figure S4. Photographs of sampling with the auger.

Figure S4. This is supposed to be an important figure for the "story" the Authors tell but it is not very clear to me. What is the response ratio? I did not find any definition. Without understanding the RR meaning it's difficult to grasp the importance of the figure. What do negative and positive values of RR mean? In the caption: what are the "effect sizes". Please, clarify all this.

Response: Thanks for your comment. Response ratio (*RR*, the calculation formula of which is as below) is a unit-free index with positive or negative values indicating either increasing or decreasing soil moisture in response to changes in planted tree age. Thus, a negative value of RR indicates that plantation growth decreases soil moisture, and vice versa increases soil moisture. In addition, the effect size indicates value of *RR*. To dispel this confusion, we will carefully illustrate this information at the name of Figure 2 (Lines 264-269).

" $RR = Ln(X_e / X_C)$

where *RR* is a unit-free index with positive and negative values indicating either

increasing or decreasing soil moisture in response to changes in planted tree age, and X_e and X_c are values of soil moisture under trees and controls for each study, respectively."

Lines 264-269

"Mean effect sizes (indicating the mean value of Response ratio (RR), which is a unit-free index with positive or negative value indicate soil moisture increases or decreases with the older of plantations.) of soil moisture response to plantations' growth on the Loess Plateau are divided into: (a) tree age <10 year, (b) 10 year ≤ tree age<20 year, (c) 20 year ≤ tree age<30 year, and (d) tree age ≥ 30 year. The vertical black dotted lines indicate RR=0. Blue and red dots represent black locust forests and apple orchard RRs, respectively, diamonds and circles represent the mean RR of black locust and apple orchard, respectively, and the error bars represent 95% CI."

Paragraph 3.2. I have some doubts about the definition of SMD and DSMD. I assume that SM is highly variable in space…so, how can we use a control tree as a real control? Should we measure the SM in several control trees? Can you use a more pedological definition of deficit, such as the difference between the actual water content and saturation? The Authors have the soil samples and therefore could perform a lab analysis to determine the porosity of the samples. Moreover, I intuitively understand the difference between SMD and DSMD but this difference was not analytically define. This rises some issue on the use of this metric and the interpretation of the data subsequently presented. Please, clarify well this part.

Response: In our study regions, the age of planted forests is a major factor that affects the degree and depth limitations, but there may be significant differences in the deep soil moisture content (DSM) under the same age of trees in different sampling years. For example, there is a significant difference in DSM between apple orchards aged 15 years in 2005 (rainfall 470 mm) and apple orchards with the same age in 2013 (rainfall 760 mm). In order to minimize this difference, we need to remove the impact of annual rainfall. Considering crops or grasses do not utilize deep soil water below 2 m due to

their shallow roots (Zhu et al., 2016; Gao et al., 2022), they can reflect differences in annual rainfall between different sampling years. Thus, we have used the deep soil moisture deficit (DSMD), which is defined as the relative difference of DSM under given trees and nearby cropland or grassland to better analyze the degree and depth limitations of plantations.

References:

Zhu, G., Deng, L., Zhang, X., Shangguan, Z.: Effects of grazing exclusion on plant community and soil physicochemical properties in a desert steppe on the Loess Plateau, China, Ecol. Eng., 90, 372-381, 10.1016/j.ecoleng.2016.02.001, 2016.

Gao, X., He, N., Jia, R., Hu, P., Zhao, X.: Redesign of dryland apple orchards by intercropping the bioenergy crop canola (*Brassica napus* L.): Achieving sustainable intensification, Glob. Change Biol. Bioenergy, 14, 378-392, https://doi.org/10.1111/gcbb.12916, 2022.

Fig. 8. Is this based on the results of this study or is a more general conceptual figure deriving from what we already know? This is not clear to me. Please, specify.

Response: Fig. 8 is based on the results of this study (parameters in the box on a white background) and concepts from the literature (parameters in the box on a gray background). We will specify this as follows in the revised manuscript (Lines 353-354).

"Based on the results of this study and opinions from literature, Fig. 8 shows the mechanism by which plants regulate the limitation of DSM."

Minor comments and technical corrections

18. I'd add "water" or "moisture" before "limitation".

Response: We agreed. We will add "moisture" before "limitation" in the revised manuscript (Lines 18-19).

21. "minimize the effect…": this is not clear without reading the manuscript. Please explain it or skip it.

Response: We agreed. We will delete "to minimize the effect of climate differences in various sampling years", and supplement the complete concept of deep soil moisture deficit (DSMD) in the Materials and methods section as follows in the revised manuscript (Lines 226-232).

"The effect of different deep-rooted planted trees RWU on soil moisture was expressed as soil moisture deficit (SMD), which is the relative difference in soil moisture for given trees and adjacent cropland/grassland. Due to root distribution of the latter is too shallow (<2 m) to influence the change of DSM (Murphy et al., 2019; Raziel et al., 2018), thus, the soil moisture of grassland/farmland measured simultaneously with that of plantation can be used as background value to eliminate the influence of climate difference, and its' calculation method as shown in Eq. (10). Among them, the SMD of the soil layer below 2 m is the deep soil moisture deficit (DSMD)."

36. Remove "there".

Response: Thank you for your suggestion. We will remove "there" in the revised manuscript (Line 36).

45. Move "in drylands" at line above, after "tree planting".

Response: We agreed. We will move "in drylands" to line above in the revised manuscript (Lines 44-45).

74. Typo/language issues.

Response: Thank you for your suggestion. We will reorganize this sentence as follow in the revised manuscript (Lines 76-77).

"The effect of deep-layer soil desiccation on xylem hydraulic conductivity of planted trees, however, is still unclear, when degree limitation and depth limitation of DSM are

reached."

105. Why "intuitively"? Please, explain.

Response: We mean collecting data directly from the intuitive figures of soil moisture. We will reorganize this sentence as follow in the text (Lines 107-108).

"The original data were either obtained clearly from tables in the selected papers or extracted directly from the intuitive figures."

143. Replace "was" into "were".

Response: We agreed. We will replace "was" into "were" in the revised manuscript (Line 149).

Table 2, caption: Why only those, and not all? Please, explain.

Response: Because these trees with specific age cause the lowest deep soil moisture deficit, namely reach the degree limitation of deep soil moisture in different regions. Thus, we used them as the focus of this study to obtain results related to the depth limitation of deep soil moisture and the percentage loss of xylem hydraulic conductivity, so their basic information is presented.

225-228. "significance": do you mean the possibly significant difference? Please explain. In general, these three lines are not very clear, please explain better.

Response: Yes, the "significance" means the significant difference. To make this section clearer, we will reorganize it as follows in the revised version (Lines 240-245).

"The paired sample t-test in SPSS was used to analyze the significant difference of soil moisture between plantations and their controls. If the difference of them becomes not significant ($p>0.05$) with the soil layer deepening, the consumption of DSM by plantations is considered to have reached the depth limitation. Conversely, if the difference is always significant ($p<0.05$), plantations have not yet reached the

maximum depth of water uptake."

231. Canoco 5. What is this ? Please, explain.

Response: Canoco 5 is software for redundant analysis with production information of Microcomputer Power Ithaca, New York, USA. We will add this information to section 2.3.4 in the revised manuscript (Lines 247-248).

240. Which plantation? Only one of them or both?

Response: Both the two plantations had a biggest effect on DSM appears to be between 20 and 30 years. We will revise the description as follow in the revised manuscript (Lines 257-258).

"Thus, the tree age at which the two plantations had a biggest effect on DSM appears to be between 20 and 30 years."

274. What do the Authors mean by "randomness"? Please, clarify.

Response: Since the apple orchards in Changwu (Fig. 4(a)) and Luochuan (Fig. 4(b)) are collected from literature, in order to avoid errors caused by different sampling years and locations between the data, we divide them into tree age segments for analysis. We will clarify this information as follows in the revised version (Lines 295-296).

"In order to reduce the randomness caused by different sampling years and locations between the extracted data, the data for apple trees with similar ages in Changwu (a) and Luochuan (b) were combined."

Fig. 4, 5, 6 and 7. Are these figures based on field data or extracted data only? Please, specify.

Response: Thank you for your suggestion. Figure 4 (a) and (b) belong to literature extraction data, and (c)-(f) belong to field measurement data; the data of 22-year-old apple and cropland (dark green) in Figure 5(a) belong to literature extraction data, and

other data are field measured data; both extracted data from literature and field measured data participate in redundancy analysis of Figure 6; and the percentage loss of hydraulic conductivity of annual branches of apple (Figure 7(a)) and black locust (Figure 7(b)) are field measured data. We will indicate the data sources in these figures' title of the new version.

307. Here again, "limitations" is vague…I would add "water" or "moisture".

Response: We agreed. We will add "moisture" before "limitations" in the revised manuscript (Line 332).

320-321. Language issues.

Response: We agreed. We will reorganize this sentence as follow in the revised manuscript (Lines 345-346).

"This is ascribed to surface or shallow layer soil moisture, which is usually greatly influenced by rainfall infiltration and evapotranspiration."