

Response letter to comments

Dear Sir/Madam,

Thank you so much for your kind encouragement on our manuscript entitled “*Distinct impact of drought on radial growth at different heights and parts of Populus euphratica in oasis at the hinterland of the Taklimakan desert*” (Forests-2692177) and sending us the review on our manuscript.

We greatly appreciate reviewer for your valuable comments and constructive suggestions. We have carefully addressed these points in our revised manuscript and a point-to-point response to the comments has been detailed in our *Cover Letter*; in which the comments are written in *italics* followed by our responses in **regular** text. In addition, the changes or revision were marked with **red text** in new version of the manuscript.

Now, we are resubmitting the latest vision of our manuscript to you.

Best wishes,

Anwar Abdureyim

Comments:

[1] *The physiological activity of apical branches relatively to lateral branches can be explained by the lower photosynthesis of last ones because of shading. This should be mentioned in Introduction and/or Discussion.*

[Response] Thank you for your comment. We have carefully considered your suggestions and have added relevant analysis to the discussion section.

Drought is one of the most serious challenges facing species and ecosystems. Drought tolerance is related to water relations in plants [67]. Water relations in plants maintain healthy branches, and prolonged drought conditions for plant growth may affect water relations [68]. Stomatal conductance, hydraulic properties, and water status determine water relations in branches [69]. Past studies have shown that hydraulic properties are related to plant drought resistance [70]. The results of this study showed that growth decline occurred in the top and top branches of the stem of *P.euphratica* (Figure 10). And the lateral branches of *P.euphratica* were weaker than the stem in restoring pre-drought growth after drought (Figure 11). This may be related to the sensitivity of water status and water transport efficiency as well as xylem hydraulic conductivity to drought at different heights and in different parts of *P.euphratica* [68], or since the physiological activity of apical branches relatively to lateral branches can be explained by the lower photosynthesis of last ones because of shading. In conclusion, the effect of drought on the dynamic balance between water supply, water status and water transport efficiency of *P.euphratica* is one of the main reasons for the "broke its arm" of *P.euphratica* under future drought stress.

[2] *What was trees age?*

[Response] Thank you for your comment. We added age information for the three trees in Table 1.

Table 1. Information on sampling points. Note: sample size refers to the number of cores collected. For example, ① Indicates 16 cores collected at 8 different heights; ② indicates 16 cores collected at 8 different primary lateral branches. Two cores were collected per height, per lateral branch.

Sample trees	Longitude and latitude	Height (m)	Diameter at breast height (cm)	Canopy (m)	Age (a)	
First tree	38°21'23.19"N 81°51'36.32"E	11.78	39.3	6.47×6.52	50	
Second tree		11.63	41.4	7.09×5.87	60	
Third tree		11.51	48.6	7.43×6.02	56	
Different parts	Stem	Primary lateral branch		Secondary lateral branch		
Sample trees	Sample size	Diameter range (cm)	Sample size	Diameter range (cm)	Sample size	Diameter range (cm)
First tree	16 ^①	10.2~39.3	16 ^②	5~14	14	4~10
Second tree	16	15.5~41.4	16	6~19	12	4~7
Third tree	16	9.4~48.6	18	5~22	22	4~13

[3] *Could you detect sapwood depth from your cores?*

[Response] Thank you for your question. The width of the sapwood can be measured from the core. We believe that sapwood can only provide information on tree growth over a short period of time and that the year cannot be accurately confirmed for sapwood (Possibly a transition zone exists between sapwood and core cells). Therefore, we did not consider sapwood-related elements.

[4] *ALL Figures must be sharpened.*

[Response] Thank you for your suggestion. We have carefully revised and improved the quality of the Figures and tables throughout the revised draft.

[5] *Map subfigures at Figure 1 should be also marked by letters and mentioned in the legend. It would be good either to decrease the scale of upper left map in order to show the location within the whole China or add one more map with the position of Taklamakan within China. In the legend it must be described, what means colors in the right map.*

[Response] Thank you for your suggestion. As your suggestion, we had modified Figure 1.

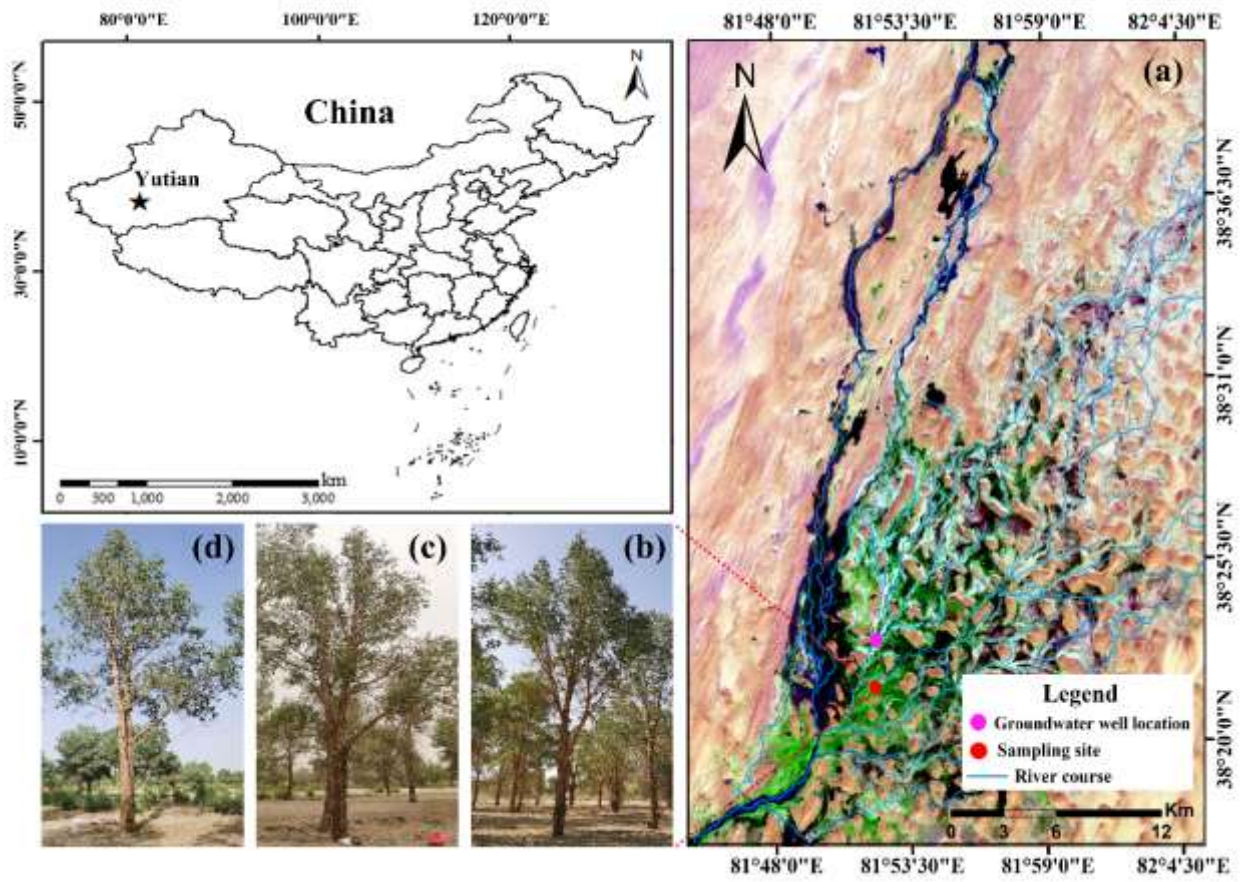


Figure 1. Location of the study sites. (a) Daliyaboyi Oasis, (b) First tree, (c) Second tree, (d) third tree.

[6] Figure 2. X-axis caption is unclear. Do you mean “CUMULATED number of branches”? Per one tree of for all three trees? First order branches or all branches? In any case the final number of 25 does not correspond to any option from Table 1.

[Response] We have changed the figure 2.

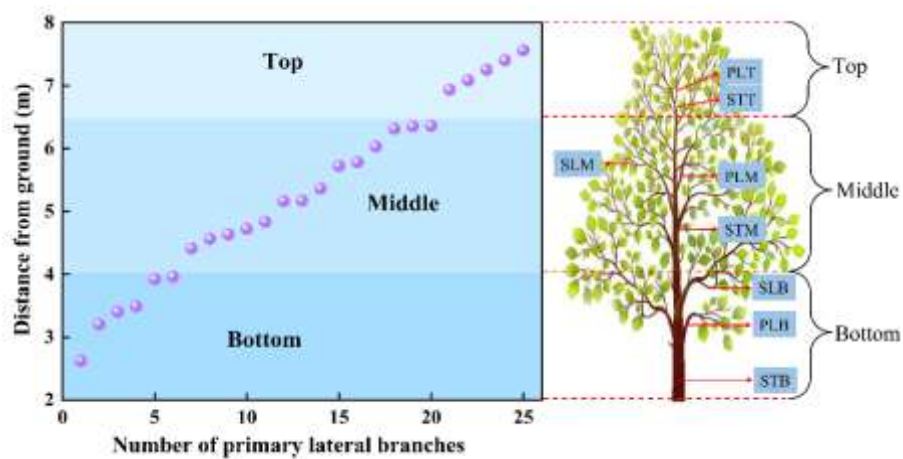


Figure 2. Stem and lateral branches grouped according to the distance from the ground of the primary lateral branches. The number of primary lateral branches: refer to the sum of the number of primary lateral branches of the three trees. The purple color indicates the distance of the primary lateral branches from the ground. STB, STM, and STT represent the bottom, middle, and top of the stem, respectively, PLB, PLM, and PLT represent the primary lateral branches at the bottom, middle, and top of the stem, respectively, and SLB and SLM represent the secondary lateral branches at the bottom and middle primary lateral branches of the stem, respectively.

[7] It would be good to mention the time resolution of Palmer index (1 month?) and maybe to explain how it is defined. If mean precipitation is 10 mm and potential evaporation rate 2480 mm, how it can be that ca. half of years had no drought at all (PDSI>-1, Fig.3)?

[Response] As you suggested, We provide a temporal resolution of 1 month for the PDSI in 2.3. The PDSI is a drought index based on water supply and demand, and is drought when local water supply exceeds demand and wet otherwise. The Kriya River is the only source of water for the oasis, so years of high-water supply and demand (periods of abundance) may result in a PDSI > -1.

Meteorological data for the study area were obtained from grid-point meteorological data from the Royal Netherlands Meteorological Institute data sharing website (<http://climexp.knmi.nl>). Monthly temperature, precipitation (CRUTS4.06 grid point dataset with $0.5^\circ \times 0.5^\circ$ resolution), and Monthly Palmer Drought Index (PDSI) data (CRU self-calibrating PDSI grid point dataset with $0.5^\circ \times 0.5^\circ$ resolution) for 1961-2021 were acquired.

[8] Groundwater depth and SWC were mentioned in the Results, but not in Methods.

[Response] As you suggested, we provide methods related to SWC and groundwater data acquisition in 2.3.

Soil samples were collected by soil drilling method near the plant samples, stratified every 20 cm, 3 replicates per layer until to the groundwater table. The sample was sealed in a tin box for the subsequent measurement of soil water content (hereafter referred to as SWC). Groundwater depth data were obtained from groundwater level monitoring wells in the near of the sample site and include data from 2013-2020.

[9] On Fig. 5a max. annual precipitation is ~4.5 mm (with mean 2.3 mm, line 268) but on Fig. 5b mean precipitation only in July was 9 mm. How it can be?

[Response] Thank you for your question. We reconfirmed the relevant data. Figure 5a shows the interannual data for temperature and precipitation. Figure 5b shows the monthly average data for the period 1961-2021.

Based on monthly mean precipitation, temperature and PDSI data from 1961-2021, annual (average of January through December of each year) and multi-year monthly mean (average of each month in the 1961-

2021 period) precipitation and temperature data, as well as the average of PDSI from April of the previous year through October of the current year, were calculated.

[10] *At Fig. 7a min sample size is 1, whereas you measured 3 trees from 2 sides. How it can be? 2 trees in 1961 did not reach yet 1.3m and one core in 3rd tree was damaged?*

[Response] Thank you for your question. The annual rings data for this study were obtained from three trees in the same locality and averaged over the three trees. Since the three trees were of different ages, one of them was 60 years old and started growing in 1961, while the remaining two trees started growing in 1965 and 1971, respectively. Therefore, 1961 corresponds to a sample size of 1. The sample size here refers to the number of growth rings, a set of data that was automatically calculated by the program when the chronology of the ARSTAN program was created.

[11] *According to Fig. 3 the moisture conditions strongly and continuously improved in the area. So, the decline of growth in the recent years (2010-19) hardly can be explained by drought (what is stated in 4.3), especially taking into account the groundwater is accessible for trees in the area. Maybe the decline of growth can be explained simply by natural aging of trees?*

[Response] Thank you for your question. Maybe the decline of growth can be explained simply by natural aging of trees. However, 4.3 describes the tree in question when growth decline is calculated by means of an annual rotation index for the five years before and after. It is also possible that the accumulation of droughts in the 5 years before and after affected the growth of *P.euphratica*, as can be seen in Figure 3 where mild and moderate drought years existed before and after 2010. On the other hand, the tree rings index (TRI) would have eliminated the age-related signal. Therefore, the discussion in 4.3 can be justified.

[12] *Concerning the difference in growth of different tree compartments, it makes sense to mention pipe model theory (the recent review of it is, e.g., in Lehnbach et al., 2018, <https://academic.oup.com/aob/article/121/5/773/4820933>).*

[Response] Thank you for recommending the literature. We did this by carefully reading the references you recommended and citing this in the relevant section of 4.1.

The differences in tree species and the areas where the trees grow may lead to different resource allocation (exchange) patterns between the stem and lateral branches in the aboveground parts, resulting in differences in growth allocation. However, differences in biomass allocation can be explained by the typical pipe model theory of the existence of a linear relationship between the part of the tree stem cross-section with conductive capacity and the corresponding number of supporting leaves[53]. The part of the tree stem cross-section with conduction capacity is the sapwood, which implies that the relationship between the sapwood area and the number of responsive leaves, as well as the difference between the sapwood area of the stem and the lateral branches, may be the key factors contributing to the differences in the growth of different parts of the tree.

[53] Lehnbach, R.; Beyer, R.; Letort, V.; Heuret, P. The pipe model theory half a century on: a review. *Annals of Botany*. 2018, 121: 773-795.

[13] Concerning the difference in growth of different tree compartments, it makes sense to mention pipe model theory (the recent review of it is, e.g., in Lehnbach et al., 2018, <https://academic.oup.com/aob/article/121/5/773/4820933>). New sapwood growth is compensating the conversion of inner sapwood into non-conductive heartwood, and the apparent diameter growth is a result of these two processes. This can be discussed when analyzing the resulting TRW dynamics.

[Response] Thank you for suggestion. We have added your suggestion to the 4.1 TRW dynamic change related section.

Factors such as a tree condition, natural environment, and physiological conditions can affect the stem, resulting in differences in radial growth at different stem heights [24]. In the present study, the TRW at different stem heights increased and then decreased with time. The TRW of the primary and secondary lateral branches of *P. euphratica* varied consistently at different heights (Figure 6a). We argue that diameter growth during tree growth is a result of the processes of new sapwood replenishment and conversion of old sapwood into corewood, and therefore trees as a complete system have consistent growth trends at different heights of the stem and lateral branches of TRW.

[14] Other comments are in the attachment.

[Response] The attachment is modified according to the attachment.