

Interactive comment on “Differences in spatial and temporal root lifespan of temperate steppes across Inner Mongolia grasslands” by W.-M. Bai et al.

Anonymous Referee #1

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The work by Bai et al presents novel data regarding differences in fine root lifespan across distinct types of grasslands within the inner-Mongolian steppe. The major finding was that there were significant differences in fine root lifespan across these sites. This is important to recognize as most models would generally treat these sites as equivalent. The authors also observed consistent differences in lifespan among roots born in different seasons. Overall, the manuscript was easy to follow and understand, despite some persistent, small grammar mistakes throughout (I have pointed some, but not all of these out in my detailed comments below). While the data collection, presentation, and interpretation were largely sound, I did have a few significant criticisms that may be addressed.

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First, the authors placed particular significance on the relationship between root lifespan and soluble sugar content. While this measure can be important, it is also known to be highly variable due to both methodological issues with carbohydrate analysis as well as high variability in root concentrations through time and in response to environment. To ensure that comparisons were accurate, it would also be important to know that sampled roots were all of approximately the same age. At the same time, there was no mention of more commonly observed/measured metrics of root traits related to root lifespan (i.e. root diameter, SRL, N content, et.). Were these measure at these sites, or for the dominant species? Additionally, the emphasis on root soluble sugars seemed odd given the fact that the usefulness of the variable may be limited to root focused studies. Yet, other variables measured at the sites, ANPP perhaps most important among them, were also strongly related to the differences in root lifespan, but these results were not emphasized and discussed to the same degree. In summary, the emphasis on soluble sugars may be acceptable, but it will require more justification. Otherwise, I would suggest emphasizing other variables as well and not focusing quite so much on the sugars.

P 20000, line 10: awkward phrasing “using the rhizotron” , either “using rhizotrons” or “using the rhizotron technique” would be better

P 20000, line 16-17: it would be useful to know in what way soluble sugars was related. For example, was higher soluble sugars positively related to lifespan?

P 20000, line 22: Roots are

P 20001, line 19: In particular,

P 01, line 25-26: “determined in a limited types of community” the grammar here is incorrect, but more importantly, I am not sure what the intended meaning is.

P 01, line 27: the way this is written, the “and reliable” part could be misinterpreted. Probably easiest to just delete that part, or you could partially rephrase the sentence.

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P 02, line 2-4: this sentence seems to just repeat the previous sentence.

P 02, line 9: here and throughout, would hm² be more normally expressed as ha?

P 03, line 25-26: you give the average January and July temps for the other grasslands, why not for this grassland?

P 03-04, section 2.1: Because so much emphasis is placed on the individual species *S. breiflora*, *S. grandis*, and *S. krylovii*, it would be very useful to know approximately what proportion (either biomass or total area) of each grassland type is dominated by the relevant species.

P 07, line 10-12: I may be confused, but why were all roots not considered if they were observed. It seems like only roots that fit into arbitrarily defined seasons were used. Was a significant proportion of roots born outside of those seasons? Were there any specific criteria used to define seasons (Spring and Summer are ~30 days, but Autumn was only ~20).

P 08, line 4: delete "were"

P 08, line 5: delete "s" in soil organic matter"s" here and throughout.

P 08, line 23: currently reads, "*S. grandis*, *S. grandis* and *S. breviflora*", should "*S. krylovii*" be first? Also, this references Table 1, but there is no lifespan information presented in Table 1. Should the reference be for Figure 2 instead?

P 09, line 5-6: the value/meaning of this sentence is somewhat unclear. What do you mean by comparable? They were similar?

P 09, section 3.3: It might be useful and interesting to give a sense of what proportion of roots were born in each season and how that contributed to overall differences in the root lifespan for a particular grassland. For example, how much of overall longer lifespan observed in the *S. breviflora* grassland was due to the roots in each season living longer than the other grasslands vs. there simply being a higher proportion of

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roots produced in the autumn season, which for all grassland types was the season with the longest root lifespan? Unfortunately, this comparison does have the problem of the seasons being arbitrarily defined.

P 10, line 9-11: It is OK to use the plot replicates (i.e. 3 grassland types x 6 replicate plots) as independent points in the regression? Please justify. Maybe OK, assuming that there were independent estimates of soluble sugar content from each plot, but still suspect.

P 10, section 3.5: based on the individual regressions presented in Figure 5, ANPP actually had a higher r-squared than soluble sugar. Why not emphasize that finding more, especially given the fact that the ANPP relationship would be much more useful for modelers as the models will incorporate or predict estimates of ANPP, but will not likely have estimates/parameters for soluble sugar content in roots.

Results section: were any of the more general site variables listed in Table 1 considered as covariates? What about temperature and precipitation across the sites? Even if none of these factors are significant, the findings should still be mentioned in the Results

P 10, line 18: "no consistent pattern" this is not a particularly useful statement. Moreover, your results that there might actually be consistent patterns across these grasslands (e.g. there were consistent patterns with soluble sugars, SOM, inorganic N content, and ANPP).

P 10, line 20-23: How did you estimate turnover from your lifespan estimates (no description or equations were given)? For species whose root lifespans are consistently less than 1 year, turnover should not be calculated as a direct inverse of lifespan. Root lifespan and turnover are not the same and species with different lifespans could have the same/similar turnovers. Conversely species with similar root lifespans could also have different turnovers. Without information of how the 48.6% estimate was reached, it is very unclear whether it is valid or meaningful.

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P 11, line 15: I believe you mean “interweaving” instead of “interleaving”

P 12: This is a good paragraph, but is a bit long which makes it difficult for the reader to maintain focus. I would suggest splitting, perhaps at line 12, where the focus of the paragraph shifts somewhat from intrinsic factors to more environmental factors.

P 12, line 22: the McCormack and Guo study is a review article. In the context of this sentence, you would be better served citing the primary literature mentioned in that review.

P 12-13, line 26-2: it is unclear why this is the overall summary of the paragraph (i.e. focusing only on soluble sugars) when there were many other factors that seemed equally if not more important (e.g. ANPP).

P 13, line 17: “in contrast” is maybe not the right phrase since the results were qualitatively the same among seasons, i.e. not in contrast.

P 14, line 6: should be “phenological” not phonological.

Figure 2: It might be good to indicate the different species by different shapes for each point in case readers print the figure in black and white, or in case readers are color blind. Something like squares, circles, and triangles for *S. krylovii*, *S. grandis*, and *S. breviflora*, respectively, would work.

Figure 5: it would be very useful to indicate the different grassland types on each figure, maybe using different shapes for the data points (e.g. square, circle, triangle for *S. krylovii*, *S. grandis*, *S. breviflora*, or possible match shapes to any updates from Figure 2).

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