We thank the reviewer for their critical assessment and will provide a revised manuscript addressing the reviewer's comments. Throughout the following document, the reviewer's comment is stated first, followed by our response in *italic* font.

Comment on bg-2021-217
Anonymous Referee #1

Referee comment on "Water uptake patterns of pea and barley responded to drought but not to cropping systems" by Qing Sun et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-217-RC1, 2021

The manuscript by Qing Sun and colleagues does certainly address a topic within the scope of the journal. The authors used water stable isotopes to determine the effect of limited water availability on water uptake of a mixture of pea and barley. The data are certainly interesting and contribute to shedding some light on the still poorly understood role of soil management in coping with the consequences of climate change. Overall, I find it a good study, well structured, and clearly written.

- *We thank the reviewer for these kind words and positive feedbacks.*

I have a few comments, mostly minor.
Among the keywords there is "FAST": I do not understand what it means and how it should be a keyword for this paper.

- *FAST is the name of the long-term field trail we conducted the experiment in, given in the MatMet. We fully understand it is not an internationally well recognized name, therefore we will remove it from the keywords.*

The introduction is not particularly fluent. For example:
Row 38 – more frequent and more severe than what?

- *The original text is "Due to climate change, drought events may occur more frequently and become more severe." We will add "**than at present**" in the end. In addition, we will check the rest of the text carefully.*

Row 40 – Aggravating respect to what?

- *The original text is "Thus, agriculture is facing increasing pressure to ensure food security under aggravating conditions." We will change it into "aggravating **drought** conditions".*

Row 42 – the word "adapted" is superfluous and misleading (not clearly explained adapted to what)

- *Thank you for the comment. We will change it into "**Potentially adaptive** crop management to the changing climate…"*

Row 60 – "illustrating the current gap of knowledge for cropping systems" not sure what does this mean.

- *We agree that the wording was not explicit enough. We will change this to "gap of knowledge **on plant water relations in** cropping systems".*

Regarding the methods:
Row 85: reporting also the altitude of the experiment would be useful.

- *Thank you for the suggestion. We will add "**489 m a.s.l.**" in the text.*

Row 106: what was the proportion of pea and barley in the mixture?

- *The mixture was composed of 20% and 80% of the recommended sowing densities of pea (90 seeds/m^2) and barley (350 grains/m^2), respectively. The seeds were sowed in a mixture with a standard drill-sowing machine. We will add this information in the text.*

Row 142: a short explanation of how cryogenic vacuum distillation was performed would be advisable.

- *Thank you for the suggestion. We will add "**During the extraction, the samples were kept in an 80 °C water bath, extracted under 10^{-2} MPa for 2 h, and collected in liquid nitrogen**."*

Row 145: which peripheral was used?

- *TC/EA was used. We will revise the sentence accordingly as the following: "The oxygen and hydrogen stable isotope ratios ($\delta^{18}O$ and $\delta^{2}H$) of water samples were analysed by coupling a high-temperature elemental analyser (TC/EA, Finnigan MAT, Bremen, Germany) with an isotope ratio mass spectrometer (IRMS, Delta^{plus}XP, Finnigan MAT, Bremen, Germany) via a ConFlo III interface (Finnigan MAT, see Werner et al., 1999), using the high-temperature carbon reduction method described by Gehre et al., (2004)."*

Row 146: I do not understand the citation of Werner et al 1999 since this paper describes the analysis of nitrogen and carbon stable isotopes. Please clarify or change with a more appropriate citation.

- *Thanks for the suggestion, our referral was not clear. We will replace Werner et al 1999 with "**Gehre M, Geilmann H, Richter J, Werner RA, Brand WA. 2004.** Continuous flow $^{2}H/^{1}H$ and $^{18}O/^{16}O$ analysis of water samples with dual inlet precision. Rapid Communications in Mass Spectrometry **18**(22): 2650-2660."*

Row 180: I'd suggest modifying the naming of the treatments. The term "after treatment" is (to me) a little confusing because the treatment had already been finished for a couple of weeks at the moment of sampling. In the M&M section, it is explained that the terms refer to the phases, but, still, it is confusing. For example, in table 1 it is reported a period "before drought", which makes sense, and "after drought", which also makes sense, but also a period "end of drought", which does not make sense since this is the period during which the drought actually took place! Maybe it would be better to call the last sampling something like "after rain" or "end of experiment" or simply "last sampling".

- *Thank you for the suggestion. We wanted to emphasise the timepoint for the sampling campaigns relative to the presence of the shelters, which simulated an experimental drought. The term "end of drought" fits better to the treatment duration and indicates that the sampling actually did not take place "after" the drought treatment, but shortly before the treatment was ended, i.e., before the shelters were removed. Since our drought study was an experiment, replacing "drought" with "experiment" would not be correct, since our study (i.e., our experiment) continued even after the drought simulation had finished (i.e., shelters removed). With the term "end of drought" we want to clarify that the plots were subjected by the drought for some time before our sampling took*

place. Therefore, after discussing this issue among the co-authors, we would prefer to keep the terms as they are defined in the Materials and Methods section.

Results

Row 210-211: also the fact that soil water content in the low tillage plots at 40 cm was higher in the drought plots than in the "control" plots should be highlighted and discussed

- *Since we had only two replicates of soil water content measurements, we did not conduct statistical analysis on the data, but used the data rather qualitatively, as differences between cropping systems could not be tested. Although the soil water content in systems with conservation tillage was slightly higher in drought than in control subplots since before the drought treatment (28 vs 27% in C-NT and 29 vs 27% in O-RT), it continuously decreased during the treatment in the drought subplot, while it responded to rain and natural conditions in the control subplots. Therefore, we did not emphasise the absolute differences among cropping systems or between treatments, but rather showed the changes of soil water content over time and how they were affected by the drought treatment. The slight differences in soil water content among cropping systems were covered in discussion (row 399-409). We will make sure this aspect is better explained in the final version of this manuscript.*

Row 213-218: I do not understand the relevance of reporting the soil and xylem water results with respect to the LMWL since this aspect is not further discussed. It might be of certain general interest to see if there is any difference due to the drought, but it is my understanding that the data in figure S1 are reported for the whole vegetative season.

- *Thank you for the comment. It is mainly to show the data points fall in a reasonable range. But that is a good point. We will separate this figure and show the three sampling campaigns in a revised version.*

Discussion

The main point that, in my opinion, is missing from the discussion is considering the type of soil. I understand that different species may act differently because of their genotype, but soil type (texture, bulk density, and soil organic matter content in particular) has a huge influence on soil water fluxes and root distribution (of any species). In addition, the soil type may influence the effect of soil management on plants' behavior, water uptake in this case.

- *Thank you for the suggestion. In general, soil type indeed would be an important aspect to discuss to explain water uptake depths as mentioned in the introduction (row 42-48 and 63-65) and the discussion (row 392-409). However, at our site, the soil type did not change across the field site, and the experimental set-up with a block design accounted for spatial variations. Although Wittwer et al. (2021) showed differences in soil properties in top 20 cm (e.g., soil carbon to clay ratio, aggregate mean weight diameter), our data showed no significant cropping system effects nor interactions between drought and cropping system effects on root water uptake patterns. Thus, soil physical properties among cropping systems cannot provide additional information on the similar drought responses observed on both pea and barley plants in water uptake patterns. We will make this clearer in a revised version of the final manuscript.*
  Wittwer RA, Bender SF, Hartman K, Hydbom S, Lima RAA, Loaiza V, Nemecek T, Oehl F, Olsson PA, Petchey O, et al. 2021. Organic and conservation agriculture promote ecosystem multifunctionality. Science Advances 7(34).

Other comments

Row 340 – but in the low tillage plots soil moisture at 40 cm is higher in the drought treatment than in the control. How do you justify this behavior?

- *Please refer to our answer above. With two sensors per cropping system, we cannot test for significant differences and therefore hesitated to put a lot of emphasis on the absolute soil moisture values, rather using their temporal development into the growing season/drought treatment. In addition, the absolute differences were rather small, particularly compared to the natural variability observed.*

Row 355 – do you think that plants had enough time during the drought period to adapt their root distribution?

- *Yes, we think so. The 5-week drought treatment started at an early stage of the vegetative phase when both crops, pea and barley plants, were around 20 to 30 cm tall. At the end of drought treatment, the plants reached around 60 cm. In parallel to above-ground growth, also belowground biomass is grown to keep the root:shoot ratio in balance. Thus, although we do not have root growth data, we still see changes in water uptake depths for the species. But in general, annual crops with a short vegetation period, have a rather short window of opportunity to acclimate their root distributions. The period of 5 weeks of no/less rain is a fairly strong treatment, comparable to what we expect in the future. In addition, from what we observed in grassland species, grasses increased carbon allocation to roots and more so in shallow soil layer under drought conditions (see Prechsl et al., 2015, Burri et al., 2014). We will follow up this line of argument in a revised version.*

  Prechsl UE, Burri S, Gilgen AK, Kahmen A, Buchmann N. 2015. No shift to a deeper water uptake depth in response to summer drought of two lowland and sub-alpine C_3-grasslands in Switzerland. Oecologia 177(1): 97-111.

  Burri S, Sturm P, Prechsl UE, Knohl A, Buchmann N. 2014. The impact of extreme summer drought on the short-term carbon coupling of photosynthesis to soil CO_2 efflux in a temperate grassland. Biogeosciences 11(4): 961-975.

Commented [SQ1]: By Anna and Nina: We could add that we know from grassland that the response in root growth is really fast. Prechsl, also Burri

Row 367 – table 5 does not show the water uptake during the “natural dry” (I suggest changing to "naturally dry") period.

- *Thank you for the suggestion. We will revise it accordingly.*

row 389 – what does “_ENREF_5” mean?

- *We apologize. That is a broken link which was previously removed. It will be fixed.*

Row 403-404 – in stating that there is no difference in MPC due to the cropping system, have you considered the difference between before and end of treatment? By doing a very very rough calculation, it seems to me that there might be some influence of the treatment at least in peas.

- *Thanks for the suggestion. Yes, we have calculated the difference between before and end of the treatment for different cropping systems and found no significant effects of cropping systems. Thus, we did not include this info in the original version. However, we will include these results in supporting documents as Table. S6 and refer to them in the text from row 316.*

Tables and figures

Table 5 – the legend is not clear: the effect on what? [I guess it is on the MPC, but it is not clear from the legend]

- *We will revise the caption accordingly*.

Table 5 is very dense and difficult to follow. It would be easier to read if the letters were closer to the respective number. Or consider splitting in two.

- *We will re-format the table to make it clearer*.

Fig. 6 – are these data pooled for all soil managements? Please specify in the legend.

- *Thanks for the suggestion. We will add "**in all cropping systems**" in the caption*.