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Interactive comment on “Nitrogen control of ^{13}C enrichment in heterotrophic organs relative to leaves in a landscape-building desert plant species” by J. Zhang et al.

Anonymous Referee #2

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This manuscript reports patterns in isotopic discrimination between leaf and heterotrophic bulk tissue after one growing season in two desert sites in China. The authors found interesting relationships between the discrimination and nitrogen concentration (N) of the heterotrophic tissues, thus hypothesizing that resource allocation is partly driving discrimination for this species. The sampling design is sufficient and the methods and analysis are relatively straightforward. The article is clear and well written and the topic is relevant to readers of Biogeosciences.

Main comments: What I am primarily concerned about is the presentation and interpretation of the results. In its present form, I find the article is short enough so that a further

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discussion of site differences could be explored more and the review and justification of N as a driver of isotope enrichment/fractionation could be better explained.

One of the main findings not discussed in depth is the difference in shrub biomass between the two sites. Plants within the Dengkou site were significantly larger than the Minqin site and thus the growth rate could also be greater. This is important because of the relationship between growth rate and N:P ratio, albeit the generality of this phenomena is still an active area of research (Niklas et al., 2005 Ecology Letters; Elser et al., 2010 New Phytologist). This highlights a further weakness in the analysis. The relationship depicted between N and N:P in Figure 5 (middle row) is an important basis for the paper, I would argue. One can see that the patterns are largely driven by nitrogen, as mentioned by the authors, but I think it is clear that spread in the data are more or less differences in site, rather than differences in organ N concentration. This is also reflected in the root length differences, the smaller plants from the Minqin site also have longer roots, perhaps because they are mining for nutrients and/or water. To their credit, the authors mention the correlative nature of their findings; however, I find the relationship between N and ^{13}C enrichment rather speculative and needs further bolstering. Perhaps there are data available on site nutrient availabilities? These data might add more to the discussion

If the authors can reconcile the issues mentioned above, then I think the development of N as a driver of ^{13}C enrichment of heterotrophic tissues needs to be further developed. The review of the literature on post-photosynthetic discrimination was fine, but I think a hypothesis based on plant physiology or allocation is needed to move this issue and research forward – for example, explain why an increase in N will lead to an increase in respiratory CO_2 refixation. A small paragraph in the introduction on the role of N in ^{13}C enrichment of heterotrophic tissues or even in leaf isotopic discrimination (e.g., Cernusack et al., 2007) might be helpful in preparing readers for the discussion later.

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