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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 #1

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The paper describes a careful study where the authors related the differences in the carbon isotope composition between leaves and heterotrophic tissues to nitrogen, phosphorus and carbon concentrations (and ratios between these elements). The aim of the work was to explore if the generally well-known 13C enrichment of heterotrophic vs. autotrophic tissues is driven by nutrients. The authors found a clear relationship between the 13C enrichment on the one hand and C/N and N/P ratios as well as N contents of heterotrophic tissues on the other. When the tissue N content was normalized against leaf N the relationship did not improve (but was more or less comparable). From these findings the author conclude that the relationship between tissue N content and 13C enrichment is due to processes in heterotrophic tissues rather than in the leaves

or related to leaf export. As a main candidate for such a process the authors propose PEPC activity, which has been shown to be related to N content. The manuscript is very well written and the structure and the story line are very clear and the finding is novel and interesting for the isotope community. The methodologies applied are adequate and the paper fits well into the scope of Biogeosciences. There are a few minors things I feel the authors should address before the manuscript can be published in BG: 1) The PEPC hypothesis: The authors follow a clear line of argumentation and they give a reference (Berveiller et al. 2010) to support their assumption that PEPC activity increases with N. However, it is still speculation - which I like - and it is not based on measurements of PEPC activity. This speculative nature of the conclusions gets fully clear in the discussion but I feel the authors should be more carefully in their wording in the abstract - "probably" sounds to strong without having the background from the discussion. 2) Fractionation during phloem loading: It is generally assumed that phloem loading itself is not causing fractionation but that rather the unreacted sugars loaded into the phloem are 13C enriched compared to the primary assimilates (because the non-exported (structural) compounds in the leaves are 13C depleted) (cf. Hobbie and Werner 2004). The same might happen associated with phloem transport - Continuous unloading of sucrose from the phloem, metabolic conversion of part of the sucrose and reloading of the rest. Lignin and other substances produced become 13C depleted (kinetic and equilibrium isotope effects) and the retrieved sugars thus 13C enriched (e.g. Gessler et al. 2014); this point might need clarification in the text.

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