

Responses to Reviewers' Comments

We highly appreciate the valuable comments and suggestions by the anonymous reviewer on our manuscript. We have attempted to address each point raised by the reviewer. The following is our detail responses we have made, with reference to the order of the comments by the reviewer.

1. Abstract:

P1 L13 removes the sentence “However, the Ca²⁺ dynamics of plants and soil are not well understood” into the P4 L10

P1 L14 deletes the s from the “samples”

P1 L16 “slop” should be slope

Reword all words “underground” into belowground in the entire manuscript

Re.1 Thanks for the positive suggestion. And sorry for the mistakes to write "slope" as "slop" and "belowground" is more suitable for our purposes. We have corrected all of them in the entire manuscript.

2. Introduction

P2 L2: use provides to replace “can provide”

P2 L8: delete “Of course”

Change the sentence “the severity of rocky desertification in Hunan Province was ranked fourth (Li et al., 2016) into; The severity of rocky desertification was ranked in fourth in Hunan Province of China (Li et al., 2016)

P2 L9: Insert the “Rocky desertification is an extreme form of land degradation in karst areas, and 10 has become a major social problem in terms of China's economic and social development (Sheng et al., 2015)” should be before ”The severity of rocky desertification was ranked in fourth in Hunan Province of China (Li et al., 2016)”

Re.2 Thanks, we agree to these advices and the manuscript was revised, accordingly.

P2 L110-12: Change the “The restoration and reconstruction of rocky desertification ecosystems has become the immediate focus of agro-forestry production environment improvements, regional economic development and helping to support people out of poverty (Jing et al., 2016)” into “The restoration and reconstruction of rocky desertification ecosystems have become the urgent environment improvements, regional economic development by using agroforestry system and helping to support people out of poverty (Jing et al., 2016).

P2L13 “soil with high Ca”

Re.3 Thanks, it is a good suggestion.

P2L14-15: rewrite “From the origin of rocky desertification, 15 the restoration of vegetation is key to the process of remediation (Wang et al., 2004). Consequently, the screening of plants which can grow

successfully in high- calcium environments is an extremely critical step.”

Re.4 Thanks, We have rewrote the two puzzling sentences to be:

“From the origin of rocky desertification, its remediation should focus on vegetation restoration, (Wang et al., 2004). Consequently, the screening of plant species which can grow successfully in high-Ca environments in rocky desertification areas is an extremely critical step.”

P3L2: Change “Ca²⁺ and pectin in the cell walls of plants combine” into: “Ca²⁺ combine with pectin in the cell walls of plants”

P3L11: change” than cannot” into “not”

P4L3-L4 “Ji et al. (2009) revealed that the mean soil ECa was 3.61 g·kg⁻¹ in the Puding, Huajing, Libo and Luodian Counties of Guizhou Province, which is several times that of non-limestone areas in China.” should be: “The mean soil ECa was 3.61 g·kg⁻¹ in the Puding, Huajing, Libo and Luodian Counties of Guizhou Province, which is several times that of non-limestone areas in China (Ji et al. 2009).

P4L7-L19 “These results indicate that there are differences in soil Ca content between different areas and that there are differences between calcareous and non-calcareous plants in terms of Ca absorption, transport and storage and other physiological processes. Collectively, these differences lead to different degrees of adaptability of plants to high Ca environments.” Should be “There are variations in soil Ca content among different areas and differences between calcareous and non-calcareous plants in terms of Ca absorption, transport and storage and other physiological processes. These differences need to identify the variety of the plants to adapt with high Ca environments.”

P4L10-L11 delete “there is a scarcity of extensive research into” should be” the mechanisms by which plants adapt to high Ca conditions, particularly in karst areas and the Ca²⁺ dynamics of plants and soil are not well understood.

P4L14: delete “In order to”, capitalize the “To”

P4L15 “we did the following:” should be “the following investigations were explored”

Re.5 Thanks for the constructive suggestions! And we have corrected all of them.

3. Materials and methods

P5: site description is too simple, should add more information regarding to the study, e.g. slope, soil pH, soil properties, and vegetation cover

Re.6 Thanks, We have corrected it. In order to make site description more detailed, we added a table.

Table 1 Basic description for different grades of rocky desertification sites

Sample areas	Score of rocky desertification	Aspect	soil pH	Gradient	Altitude	Bedrock expose rate	Vegetation coverage	Disturbance regimes
LRD	34(≤45)	South	5.56	20°	500	35%	80%	Slight human disturbance, rarely grazing
MRD	48(46~60)	Northeast	5.57	18°	500	57%	75%	Abandoned farmland, no disturbance after abandoning cultivation
IRD	67(61~75)	Southwest	5.59	17°	480	73%	40%	Slight human disturbance, rarely grazing

P5L4 title “Data collection” should be “Experimental design and data collection”

P5L6 delete “period. These four main indices”

P5L11: “We conducted a detailed survey of the three sample areas and collected samples in October 2016.”
Should be “The sample collection in these three sample areas were conducted in October 2016. “

Re.7 Thanks, Very good suggestions! Done.

P5L13: use “Within” to replace the “For” Elizabeth Kearsley et al. (2014). Conventional tree height–diameter relationships significantly overestimate aboveground carbon stocks in the Central Congo Basin. Nature Communications 4:226.

P5L14: add were set up after “(upper, middle, and lower slope)”

P5L14-L15: add (3x4x3) were set up before the “for analysis”, delete “We chose to study” and “the common plant species of the region, 15 and gathered plants using the whole plant harvest method. In each small quadrat, every kind of shrubs and herbs are collected.” Should be “The common plant species of the region were gathered using the whole plant harvest method in each small quadrat as well as all shrubs and herbs are collected.”

P5L17: “heated” should be “oven tried”

Re.8 Thanks for your suggestions. We have corrected all of them.

P5L18: add “and after” after the de-enzyme”

P5L18: not clear, “constant weight at 80oC, L 17 you mentioned 105oC, why?”

Rewrite it

P5L18: delete “and bagged” and add “chemical” before the “analysis”

Re.9 We add “and then” after the de-enzyme.

The 105°C is in order to de-enzyme, and the time does not need too long (only 15minutes). The 80°C is designed to make samples complete dehydration and it take a long time, but excessive temperature will carbonize the sample. And this sentence should be:

Plant samples were taken back to the laboratory, rinsed with distilled water before being oven tried at 105°C for 15 min to de-enzyme, and then dried to a constant weight at 80°C for about 480 minutes, crushed and passed through a 0.149 mm sieve, for later chemical analysis.

P5L30: delete “Finally” add “were sampled”

Re.12 Thanks, “Finally” was deleted, but “were sampled” cannot be added here.

This sentence should be: “Soil TCa, ECa content and plant Ca content were measured using an Atomic Absorption Spectrophotometer (3510, Shanghai, China).”

P6L5: “biennial herbs, while ‘deciduous shrubs’ included deciduous trees with a height less than 2 m or a ground diameter less than 3 cm.” not clear, rewrite

Re.13 In the small quadrats, there were very few biennial herbs, as a result, we gathered them to the 'Annual herbs'. We rewrite this sentence as:

The biennial herbs were gathered to the 'Annual herbs'. The deciduous trees with a height less than 2 m or a ground diameter less than 3 cm were gathered to the 'deciduous shrubs'.

P6L8-L9: "One-way analysis of variance (ANOVA), Two-way ANOVA and Pearson correlation analysis ($\alpha = 0.05$) were used to analyze the Ca content of soil and plants within and between different grades of rocky desertification." Not clear, rewrite it

Re.14 Sorry for the confusing, We have rewrote it as:

"We carried out two-way ANOVA for both species and soil for these 17 plants to determine differences in plant Ca content. One-way analysis of variance (ANOVA) were used to analyze the Ca content of soil and plants between different grades of rocky desertification. Pearson correlation analysis ($\alpha = 0.05$) were used to analyze the correlation between plant Ca and soil ECa content."

4. Results

P6L13: add in soil after "The mean TCa content"

P6L14: Use "location" to replace "points"

P6L15: delete "Furthermore", and add "The", and to use "that" replacing "to be"

P6L17: Add "Ca content" after: "average", and use "the" to replace "with"

P6L21: Use "Total" to replace "The"

P7L1: use "." To replace ",", and then use "Compare to" to replace "while"

P7L3: delete "when compared across", to use "throughout"

P7L4: "aboveground" add "and belowground", and delete "or that of underground parts, there"

P7L5: Delete the whole sentence "Furthermore, the grades of rocky desertification had no obvious effect on the Ca content of the aboveground and underground parts of the plants generally (Fig. 2)."

P7L8: "The 41 plant species were identified in the 36 small quadrats; these plants were divided into different functional groups" should be "The 41 plant species were identified and were divided into different functional groups in the 36 small quadrats."

P7L8-L9: delete "For each functional group," add "The" before Ca

P7L9-L10: "Ca content between the aboveground and underground parts were significantly different ($p < 0.05$), and 10 the Ca content of the aboveground parts was higher than that of the underground parts ($p < 0.05$)" should be "The Ca content of the aboveground parts significantly was higher than that of the belowground parts in each group ($p < 0.05$)"

P7L15-L16: "In terms of life form functional groups, shrubs showed a significantly higher Ca content, both aboveground and underground than herbs ($p < 0.05$)" should be "In life form functional groups, shrubs showed a significantly higher in Ca content than herbs in both aboveground and underground ($p < 0.05$)"

P7L18: "The aboveground and underground Ca content of dicotyledons" should be"

The Ca content of dicotyledons in aboveground and belowground parts"

Re.15 Thank you for these suggestions. We have corrected all of them.

P7L21-23: “In terms of monocotyledons and dicotyledons, further analysis revealed no significant differences in the Ca content of the aboveground parts when compared between the different grades of rocky desertification; this was also true for the Ca content of the underground parts.” Its not clear, rewrite it

Re.16 Sorry for the confusing, We have rewrote it as:

To monocotyledons and dicotyledons, there were no significant differences in the plant Ca content of the aboveground parts among the different grades of rocky desertification; this was also true for the plant Ca content of the belowground parts.

P7L23: Delete “The Ca content of both the aboveground and underground parts of monocotyledons was always low while those of dicotyledons were always high”

Re.17 Thanks. Agree and Done !.

P8L1-2 “The Ca content of dicotyledons was significantly higher than those of monocotyledons across” should be “The Ca content of dicotyledons in both of was significantly higher than those of monocotyledons in both aboveground and belowground parts throughout”

Re.18 Yes. But we think this sentence should be: The Ca content of dicotyledons was significantly higher than those of monocotyledons in both aboveground and belowground parts throughout.

P8L3: “For the 41 common plants collected, 17 plant species (which exist in each sample area) were widespread throughout the southwestern rocky desertification areas of Hunan.” Should be “Within total 41 common plants species, 17 plant species were found in each sample plot and were widespread throughout the southwestern rocky desertification areas of Hunan.”

P8L5: Delete “For each of t”, capitalize “T”

P8L3: use were calculated replace “we calculated”

P8L5: Delete “. These plants were common species in the local area”

Re.19 Thanks for the constructive suggestions! We have corrected them.

P8L5-“We carried out two-way ANOVA for both species and soil for these 17 plants to determine differences in plant Ca content” should be moved to the data analysis part, not in the results part

Re.20 Yes. We have moved it to the data analysis part. (See Re. 14).

P8L6: Delete “. The soil was graded into three categories: LRD, MRD and IRD.”

P8L7: Delete “df=16, F=11.277”

P8L8: Use “related among” to replace “significant among the different

P9L9: (df=2, F=2.299, p=0.117)

P8L9: “The” Ca not For “Ca”, delete “differences”

P8L10: Use “among the species”, delete “(df=16, F=8.543, p<0.01)”, and delete “but also among the different” and it throughout all the” , and delete “df=2, F=4.104,”

Re.21 Thanks. We have corrected them.

P8L12-13: “The correlation between plant Ca content and soil ECa content reflects what extent soil Ca content influences plant Ca content, and may also reflect how different plants respond to differences in soil ECa content” this sentence should not in results part, may be in discussion section.

Re.22 Yes. We have put it in the discussion section (4.2).

P8L13: Too many “For this” and “In terms of”, delete them.

Re.23 Agree. And we have deleted them.

P8L15: “which indicated that Sanguisorba officinalis was affected greatly by soil ECa conten” should be not in the results section.

P8L17: “indicating that the underground parts of these species were also greatly affected by soil ECa content.” should be not in the results section.

P8L19” which indicated that the aboveground parts of Themeda japonica was also greatly affected by soil ECa 20 content” should be not in the results section

Re.24 Thanks. We have put them in the discussion section (4.2).

P9L2: Delete “kinds of”

P9L3: “and were also the representative species that are able to adapt to a high Ca soil environment.” How do you know it? Suggest to delete it

Re.25 Agree. And done!.

P9L6-9: “The capacity of these plants which are able to adapt to high Ca soil environments can be reflected by two indicators: (i) the correlation between Ca content in the aboveground parts of the plants and soil ECa content; (ii) the species differences in terms of the Ca content of the aboveground parts of plants. Thus, based on the above two indicators, we classified these plants into the following groups: Ca-indifferent plants, high-Ca plants and low-Ca plants (Ji et al., 2009).” This should be moved to the discussion section. Results just present your results, no explanation and citation.

Re.26 Thanks. we have put it in the discussion section (4.3).

P9L10: The definition “Ca-indifferent plants” is it correct?

Re.27 Yes. It is correct.

P9L12:” The Ca content of these plants increased or decreased correspondingly with increases or reductions in soil ECa content, but plant growth was not affected by such changes.” Not clear, rewrite it

Re.28 Yes. This sentence was rewrote and was moved to 4.3. This sentence was:

In both high-Ca and low-Ca soil environments, the Ca-indifferent plants can survival normally. And the Ca content of them changes correspondingly with the change of soil ECa content.

P9L17: “High-Ca plants”, refer it “high Ca demand plants

Re.29 Yes. But High-Ca plants, Low-Ca plants and Ca-indifferent plants were used as terminology.

See Ji, F. T., 2009.

P9L20: “Moreover, the physiological activities of these plants had a higher demand for Ca and may have a strong ability to enrich soil Ca.” should be in the discussion part

Re.30 Yes. We have put it in the discussion section (4.3)

P9L21: “Low-Ca plants” should be Low Ca demand plants

Re.31 Yes. The same as Re. 29.

P9L23: Why do you use “19g/kg” as the boundary to determine the low or high Ca demand plants?

Re.32 Mainly according to the data of calcium content of plant (from 0.42 to 41.79 g • kg⁻¹) and refer to the relevant references(See Ji, F. T., 2009).

P10L2-5: the whole paragraph should belong to the discussion, not in the results. Again, the results should just present your results, do not need any explanation in this part, any explanation and citation should be in the discussion section.

Re.33 Thanks. We have put it in the discussion section (4.3)

5. Discussion

P10L9: delete “The aboveground parts of plants had a higher Ca content than the underground 10 parts, although”

P10L10: Capitalize T (The), delete when compared

P10L17: period after the (2014), and then separate the paragraph

Re.34 Thanks . Done!

P10L18: What is the ABC soil?

Re.35 Thanks. the ABC is a shorthand (full name: acid buffering capacity).

P10L18: “Tanikawa et al. (2017) revealed that concentrations of TCa and ECa were also low at the deeper horizons in the low-acid buffering capacity (ABC) soils, and pointed to differences in both organic layer thickness and soil chemistry as a reason for affecting Ca accumulation of low- and 20 high-ABC stands” is unclear, rewrite it

Re.36 We have rewrote it. This sentence should be: “Tanikawa et al. (2017) revealed that concentrations of TCa and ECa were also low at the deeper horizons in the low-acid buffering capacity (ABC) soils, and differences in both organic layer thickness and soil chemistry could be a reason affecting Ca accumulation of low- and high-ABC stands”.

P11L1: Add “compared to the aboveground and belowground Ca content in our study,” before the “The”, and then use lowercase of “t”

P11L3: “,” should be “.”

Re.37 Thanks . We have corrected them.

P11L1-4: “The maximum and minimum calcium content of plant aboveground parts were 41.79 g·kg⁻¹ and 2.15 g·kg⁻¹ respectively, and the maximum and minimum calcium content of plant underground parts were 40.14 g·kg⁻¹ and 0.42 g·kg⁻¹ respectively, Which is lower than the calcium content of calcareous plants leaves (maximum 85.13 g·kg⁻¹ ,minimum 6.26 g·kg⁻¹) by Luo et al. (2014).” Aboveground includes leaves and branches, how do you compared with leaves only? Ca presents the Calcium, should keep the constant in the manuscript.

Re.37 Sorry for the confusing. This sentence should be:

The maximum and minimum Ca content of plant aboveground parts were 41.79 g • kg⁻¹ and 2.15 g • kg⁻¹ respectively, and the maximum and minimum Ca content of plant belowground parts were 40.14 g •kg⁻¹ and 0.42 g •kg⁻¹ respectively. The maximum Ca content of plant (41.79 g •kg⁻¹) was found in the leaves which is lower than the Ca content of calcareous plants leaves with the maximum value of 85.13 g • kg⁻¹ by Luo et al. (2014).

P11L9: The beginning of the paragraph should present your research results pattern first, and then discuss and explain it.

P11L11: Use “had a” to replace “was extremely”. Use “.” and delete “and” to separate the sentence. The sentence “our results showed several plants (*Sanguisorba officinalis*, *Dendranthema indicum*, *Castanea henryi* and *Themeda japonica*) and soil Eca content was a positive correlation, but most plant calcium content and soil ECa content was not relevant.” Should be “Our results showed that most plants had no correlation relationship between soil ECa and plant Ca excepting several plant (*Sanguisorba officinalis*, *Dendranthema indicum*, *Castanea henryi* and *Themeda japonica*) had a positive correlation between soil Eca and plant Ca content.”

Re.38 Thanks . We have corrected it.

P11L14: what are “species-related factors,”? Do you mean plant species physiological factors?

Re.39 No. ‘species-related factors’ refers to ‘species factors’.

P11L15-16: “was in accordance with data reported previously by Ji et al. (2009).” should be “was supported with data reported by Ji et al. (2009).”

Re.40 Yes and thanks. Done !

P11L17: “Since the transport of Ca was mainly one-way (upward), this result indicated that nitrogen-fixing plants were the most efficient in terms of the upward transport of Ca, and that Ca was mainly concentrated

in the aboveground parts of the plant; these findings were not consistent with those of Ji et al. (2009).” Is not clear, rewrite it.

Re.41 Sorry. We have rewrote it as:

The Ca content in the aboveground parts of nitrogen-fixing plants was significantly higher than that of the belowground parts. And this result indicated that nitrogen-fixing plants were the most efficient in the Ca upward transport, since the transport of Ca was mainly upward; which was not the same with those of Ji et al. (2009). Ji et al. (2009) revealed that

P11L19: delete “In the paper”

P11L20: “.” after Ca, The sentence” and studied only three types of plants (pteridophytes, dicotyledons, monocotyledons) that did not include nitrogen-fixing plants, which may be the reason for the inconsistency of this previous data with our current findings.” Should be” They used three types of plants (pteridophytes, dicotyledons, monocotyledons) exclude nitrogen-fixing plants in their study, which may have a conflicting result compared with our current findings.”

P11L22-P12L1: delete “in terms of”, the sentence “In terms of the Ca content of monocotyledons, we found significant differences ($p < 0.01$) between the aboveground and underground parts, but the study by Ji et al. (2009) revealed that these differences were not significant. This may be because most of the monocotyledons collected were low-Ca plants.” should be” We found significant differences ($p < 0.01$) between the aboveground and belowground parts in Ca content of monocotyledons in our study. However, Ji et al. (2009) revealed that no significant differences between the aboveground and belowground parts in Ca content of monocotyledons. This phenomenon may contribute the most of the monocotyledons sample plants were low-Ca demand plants.”

Re.42 Thanks. We have corrected them.

P12L2-3: “Owing to the fact that the aboveground parts of low-Ca plants maintain a lower Ca content for different grades of rocky desertification, a significant difference was found between the aboveground and underground parts in monocotyledons. In addition, the Ca content of monocotyledons was lower than that reported for monocotyledons (Ji et al., 2009),” is not clear, rewrite it

Re.43 Thanks. We have rewrote it as: “A significant difference was found between the aboveground and belowground parts in monocotyledons, which may be because low-Ca plants maintain a lower Ca content in different grades of rocky desertification. In addition, the Ca content of monocotyledons was lower than that reported for monocotyledons (Ji et al., 2009)”.

P12L7-8: “Over the past decade, progress has been made in identifying the cellular compartments (e.g., endoplasmic reticulum, chloroplasts and mitochondria) that regulate Ca balance and signal transduction in plants (Müller et al., 2015). “ may move to the introduction section.

Re.44 Yes, We have put it in the introduction section.

P12L8-P13L14: again, authors should present the results pattern at the beginning of the discussion to

explain your results. This paragraph should be rewritten. Lots of “in terms of” showed in the manuscript, delete them. In this paragraph, I did not see any results at the beginning of the discussion. The discussion is used to explain the results

Re.45 Thanks. We have deleted it, and added some content.

P13L15-22: suggest deleting the paragraph because it does not make sense in your discussion, as well as so many times to cite the literature Ji et al (2009)

Re.46 Thanks . We have deleted it.

6. Conclusions

P13L5 “Conclusions”

P1323-P14L1: delete “followed by” add “and” before “LRD”

P14L1-2: delete the sentence” Significant differences were detected for both soil ECa and TCa content when compared between the rocky side and non-rocky side of each grade of rocky desertification areas. “

P14L3: add “sites” after “studied”, delete “Furthermore”

P14L5: Delete “(p<0.05)

L14L6; Delete “the” Ca

Re.47 Thanks. We have deleted them.

P14L6: Ca-indifferent” is correct?

Re.48 Yes. Thanks.

P14L7: “,” after “Themeda japonica”, delete “For these plants,” and put had

P14L8: “High-Ca plants included *Pyracantha fortuneana*,” should be” High-Ca plants in our study were *Pyracantha fortuneana*,

P14L10: delete “In this case”, the sentence “the aboveground parts of these plant were able to maintain a higher Ca content under conditions of variable soil ECa content. ”should be” the aboveground parts of these plant were able to absorb a high Ca content from various of ECa content soils.

Re.49 Thanks. We have corrected them.