Egusphere-2022-905

Author's response for reviewer #1

Dear reviewer,

Thank you for your valuable comments that will help us to improve the manuscript. Please find our answers below on how we plan to revise the manuscript.

Reviewer's remarks highlighted in yellow:

General response:

The authors present a manuscript that provides interesting data supporting some hypotheses raised during the last years: first, that the contribution of crop in soil Si bioavailability and Si uptake of crop; second, that authors point at some interesting findings regarding their Si flux via driving various Si distribution in plant. The experimental work has been well performed. It consisted of experimental analysis that yielded some interesting data. It is in general nicely documented by the authors, but some parts are not well introduced and discussed. It is a bit strange on missing the data from soils, while it may be improved by introducing recent findings from soils. Overall, I support publication of this work. Yet I have some comments to be considered before further publication.

Thank you for your overall positive feedback supporting the publication of our work. We also thank you for pointing out that soil data is missing. We respond to this point in your comment below.

Detailed response:

Abstract

In Abstract. at line 15, to revise 'raised' to 'raise'; to revise 'if' to 'as'; in fact, high Si concentrations Oil-palm has been by Munevar and Romero (2015), suggesting a high Si accumulator.

We will edit the sentences accordingly.

At line 20, Revise 'by NaCO3 extraction' to 'using NaCO3 extraction'; to revise 'are needed' to 'were'

We will rephrase the sentences accordingly.

At line 35, [more Si can be returned to soils through pruned palm fronds than is lost 35 through fruit-bunch harvest….] is not right as it is hard to understand. Should be rephased.

Indeed, we will rephrase this sentence accordingly.

In addition, Abstract should be shortened and precise a bit to highlight the key significance and findings.

Indeed, we will considerably shorten and rephrase the abstract for better understanding.

Introduction

In introduction. In introduction session, I encourage that authors carefully consider the previous studies on straw return regarding its silicon recycling and silicon uptake; what have it done? what should be considered on the Si status under the management of their return in cropland; next step to point at What is its existing gap in oil cultivation? Indeed, it is true that it is not well-investigated on the Si flux of oil palm. This is a key challenge, especially that their respective return on Si biological cycle is largely active in the highly weathered soil where oil palm grows. This needs to a better estimate on Si distribution in oil palm, bettering predicating their management in future. Indeed, crop straw return has gained increasing attention in recent years due to its importance as an approach to supply soil biogenic and plant available silicon (Si) for mitigating agricultural desilication due to its importance as nutrient for many plants. Recent research, for instance, has demonstrated that biological processes, such as plant-Si-uptake, phytolith production and recycling of phytoliths in soil, are important regulators of the Si cycle in the soil-plant ecosystems (Li et al., 2020, Geoderma 368, 114308; Puppe, et al., Geoderma 403 (2021): 115187, and so on). Returning their phytoliths into soil thus boosts the biological recycling of Si in agroecosystem, sustaining its health development, especially in highly weathered soils (Li and Delvaux 2019, GCB Bioenergy 11 (11), 1264-1282). But

this effect is less studied in oil-palm plantations, as it is limited on a better understanding of Si distribution in oil palm.

Thank you for this helpful comment. We agree that the introduction would be improved if studies on Si cycling in other crop systems (e.g., straw management) were included. In a revised version of the manuscript, we will include the suggested studies. Indeed, this would highlight more clearly that this kind of knowledge is largely missing for oil-palm plantations.

At line 145, 'The procedure was conducted on two replicate samples', did each sample have two replicates? Why not three replicates?

Thank you for pointing out the need for clarification. In a revised manuscript, we would introduce the table shown below:

Table 1 Sampling scheme and number of replicates providing the statistical basis of Figures 2 and 3

Oil-palm part	Water regime[b]	Palm trees (replicates per plot)	Plots (replicates per water regime)	Replicates of palm trees/plots used for Fig. 2	Replicates of palm trees/plots used for Fig. 3
Frond no. 9	WD	3	4	3/4	2 *(excl. tree 3)*/4
Frond no. 17	WD	3	4	3/4	2 *(excl. tree 3)*/4
Senescing frond	WD	3	4	3/4	2 *(excl. tree 3)*/4
Rachis	WD	3	4	3/4	***
Frond base	WD	3	4	3/4	***
Fruit-bunch stalk	WD	3	4	3/4	***
Fruit pulp	WD	3	4	3/4	***
Kernel	WD	3	4	3/4	***
Frond no. 22	WD	*2 (excl. tree 3)*	4	***	2 *(excl. tree 3)*/4
Frond no. 25	WD	*2 (excl. tree 3)*	4	***	2 *(excl. tree 3)*/4
Frond no. 9	RI	3	4	3/4	***
Frond no. 17	RI	3	4	3/4	***
Senescing frond[a]	RI	3	*3 (excl. HOr2)*	3/3	***
Rachis	RI	3	4	3/4	***
Frond base	RI	3	4	3/4	***
Fruit-bunch stalk	RI	3	4	3/4	***
Fruit pulp	RI	3	4	3/4	***
Kernel	RI	3	4	3/4	***

[a] only 3 replicate plots as no senescing fronds were left hanging on palm trees at site HOr2 (differing management practice)
[b] WD = well-drained, RI = riparian / [c] Italics = differing from general sampling scheme / *** = not relevant for statistics

Each oil-palm part (e.g., frond no. 9, frond no. 17, etc.) shown in the new table was extracted twice. Thus, the final number of measurements for each oil-palm part was 24 because we calculated as follows:

- 4 plots per water regime * 3 palm trees per plot * 2 replicate extractions = 24 values to calculate the mean Si concentration of each oil-palm part.

Three replicate extractions would have led to 36 measurements for each oil-palm part. Due to the high number of oil-palm parts, the analytical effort would have been substantially greater. We believe that 24 values per oil-palm part provide a solid basis and that the additional analytical effort would not have further increased the robustness of the data.

DeMaster technique using 1% Na2CO3 can underestimate amorphous silica (i.e., phytogenic silicon, phytolith; Meunier et al., 2014; Li et al., 2019; Puppe, et al.,2019). Author should refer this issue, as this directly impact the Si content in the analyzed plant tissue and then its budget.

Thank you for your comment. We agree that we need to mention that extracting Si using Na_2CO_3 is less efficient than using NaOH in the revised manuscript.

Indeed, we did a test to compare the efficiency of 1 M NaOH and 1% Na_2CO_3 to extract Si from various types of plant parts included in this study. Compared to NaOH, Na_2CO_3 extracted (relatively) 5-15% less Si from leaflets of mature palm fronds, 8% less Si from fruit-bunch stalk, and 27% less Si

from frond bases. For leaflets and the rachis from a senescing frond, Si concentrations of NaOH and Na_2CO_3 extracts were very similar (within the error). Interestingly, Na_2CO_3 was much more efficient than NaOH in extracting Si from the kernel and from the fruit pulp: NaOH extracted (relatively) 20% less Si from the kernel and 52-64% less Si from the fruit pulp compared to Na_2CO_3. Thus, NaOH was more efficient in extracting Si from those oil-palm parts that remained in the system, whereas Na_2CO_3 was more efficient for those oil-palm parts that are removed from the system through harvest. Using Na_2CO_3 to extract Si from oil-palm parts seemed more appropriate to us because our key question was whether Si exported through harvest may cause a problem over time. Fruit pulp was largely underestimated using the NaOH method.

In the revised version of the manuscript, we will give the above reason to explain our preference of using Na_2CO_3 instead of NaOH. We will briefly explain that our test extractions showed that NaOH could generally extract Si more efficiently from those plant parts staying in the system, whereas Na_2CO_3 could extract Si more efficiently from those plant parts leaving the system through harvest (fruit-bunch stalk excluded). As the latter are more important for calculating the final Si budget of the system, we decided to use Na_2CO_3.

In addition, we will repeat the calculation of Si export through harvest considering 8% Si underestimation for the fruit-bunch stalk. These results (alternative calculation) will be included as additional information in the revised manuscript.

Also a bit strange is that soil data is missing in this section

Indeed, thank you for pointing this out. The reason is that we conducted several separate studies on Si in the soil-plant system under oil-palm plantations. Some results have already been published:

- https://egusphere.copernicus.org/preprints/2022/egusphere-2022-281/
- https://link.springer.com/article/10.1007/s12633-020-00680-2

We agree that soil Si needs to be mentioned in this manuscript, as well, as it is part of Si cycling. We will do so in the revised manuscript. We will add the aforementioned publications where soil Si data has been reported in detail.

At line 260-265, these sentences look much more discussion than results.

Thank you for pointing out that this paragraph may be misleading. The purpose of this paragraph is not to discuss our own results against the outcomes of other studies, but to provide biomass data from literature we used to calculate Si storage in the total above-ground oil-palm biomass. We were not permitted to fell oil palms to analyse the biomass of the stem and frond bases. We regret that this was not clear in the current version of the manuscript.

In the revised version of the manuscript, we will start this paragraph as follows: “Calculating Si storage in the above-ground biomass of oil palms required biomass data for all plant parts. As we were not permitted to fell oil palms to determine the stem and frond-base biomass per palm tree, we used mean biomass estimates from mature oil palms in SE Asia reported in literature (Table 2a)”. By rephrasing the sentence in this way, we hope to avoid the impression that we are mixing results and discussion.

In conclusion, To add ‘that’ before ‘mean Si concentration increases with leaf age’; what do you mean ‘In fact, Si availability could suffice for a second generation of oil-palm plantations’? is it soil Si availability? If yes, could authors offer these data referring soil analysis?

Thank you for this comment. Indeed, we will edit the sentence accordingly and will also be generally more precise in the conclusions.

The focus in this study was to discuss the disturbance of Si cycling in oil-palm plantations through fruit-bunch harvest, e.g., by the whole oil-palm fruit-bunch which includes the fruit pulp, kernel and fruit bunch stalk. Therefore, the study had two key questions: i) how much Si is stored in oil palms (e.g., Si staying and being recycled in the system) and ii) how much Si is exported through fruit bunch harvest?

Soil Si on the other hand is less in the focus of this study because strong Si leaching from soils is generally characteristic for the humid tropics. It is not specific for oil-palm plantations but also occurs under rainforest. We therefore view soil Si leaching to occur naturally under these climate conditions. Under humid-tropical conditions, we intend to discuss those Si fluxes that are specific for oil-palm plantations. Thereby, we aim to identify any potential Si losses from the system that are only related to the cropping system.

In the revised version of the manuscript, we will rewrite the conclusions to make the focus of our work clearer.

I am not native English speaker but still found some grammatic errors in this manuscript, but I feel that it will be better to improve its English a bit. Personally, it also needs to enhance its readily for reader, to concentrate its key finding and significance to be highlighted.

We agree and will have the manuscript edited (spelling, grammar). We will reformulate those sentences that are too long and cumbersome. We will shorten and rephrase sentences to improve the readability. Furthermore, we will highlight our key findings more clearly.

Please also note the supplement to this comment:

We are going to consider all suggested literature (e.g., impacts of the soil weathering degree on Si losses) and language comments.

In the revised manuscript, we will highlight all changes suggested by reviewer #1 in yellow, all changes suggested by reviewer #2 in green, and all general changes to improve the readability of this manuscript in grey.