

Investigating the synergistic potential Si and biochar to immobilize soil Ni in a contaminated calcareous soil after *Zea mays* L. cultivation

Summary

Interesting study that could provide useful information in regard to the immobilisation of Ni in agricultural soils. However the manuscript needs a significant re-write before it is in any way acceptable for publication.

General comments

- The standard of English is generally good but improvements should be made throughout to ensure smooth reading, especially related to the use of the abbreviation PTEs.
- There is a distinct lack of detail in all sections, all of which would benefit from considerable expansion. The reader should be able to replicate this experiment exactly in the same way the authors carried it out - impossible currently with the paucity of information.
- More thought should be given to presentation and interpretation of results and results should be better compared to available literature. Please don't split tables over 2 pages, very difficult to review.

Specific comments

- More background information is needed throughout the manuscript to enhance understanding of the need for the experiment and also on contamination and soil processes and how these relate to the importance and findings of this study.
- The Introduction needs to be greatly expanded to include more information on why this study is so important, especially for a country like Iran. For example what area of the country is available for agriculture, how much is needed/is it enough? How much land is contaminated and with what...? Why is Ni particularly relevant?
- Also in the introduction much more detail on the various soil processes/mechanisms/chemistry related to the bioavailability of PTEs, their distribution between various soil fractions and how mechanistically additions/amendments increase or decrease both the bioavailability of PTEs like Ni in soil and the enhancement or otherwise of crop growth.
- Lots of things are stated without giving any examples. E.g. L73 "The quantity and rate of release of soil PTEs from soil particles over time can influence their bioavailability". In what way? Is it the same for all PTEs? How does Ni compare to other PTEs? Are the processes generally the same? How do they differ? Also add details on climate, topography and the variety of soil types in Iran, are the soils studied representative? Coordinates of sampled soils contaminated and otherwise. etc. Maps would be useful - show location of sites in Iran at a minimum.

Technical corrections

L 18 Please delete “remains” as other studies have been carried out on this topic. Or be more specific.

L18 Please change to “affects the immobilization of PTEs...

Hereafter read “please” for all changes

L22 Sort out S1 closing bracket

L23 Change included to including

L34 Add “of” between potential and Si

L37 Add “through” between the and consumption

L45 Expand on contaminated sites and what the relevance is - perhaps percentage area of the country, why it is important to use this land. What are the expensive techniques used...

L51 Do you mean “soil stress caused by PTEs?

I will stop with comments on English here - manuscript needs the English to be improved throughout, specifically I would read out the abbreviation for PTEs when rewriting - see previous comment and rearrangement of word order, e.g. L67 should read “in stabilizing PTEs in soils...”. L68 reads “Soil potentially toxic elements...”, no, “potentially toxic elements in soils...”

L53 Give example of other materials that are not as good for remediation

L55 Silicon itself does not directly increase soil pH. However, silicon can indirectly influence soil pH through various mechanisms - please provide some background / further expansion on this

L71 delete “as”

L73 what characteristics?

L74 - expand on this process - give some examples on how bioavailability can be influenced

L88 - remains - see previous comment L18, or be more specific

L96 polluting? Pollution? What characteristics?

L97 Section 2.1 - add more details on general soil characteristics (how do these compare for example to other Iranian soils and to European agricultural soils) laboratory methods / equipment.

- Also more detail on the method of Boostani et al., readers don't want to have to go searching in other papers to find out what you have done - provide brief description at a minimum. Ni(Cl₂) solution, more details on concentration, purity, supplier....
- How were soils sampled? Where, with what? How was representativeness ensured?

L104 Section 2.2 - ditto above, much more detail required. Where did the feedstocks come from? What are they? What weights were used? What kind of mesh? Material? Supplier?

L113 and throughout manuscript - space between all temperatures and °C

L116 contaminated soil samples - this just appears from nowhere. What contaminated soil? From where? Contaminated with what and by how much? How was the contaminated soil

sampled? How many sampling points? Were all the samples combined and then sub-sampled?

Section 2.3 - much more detail required - what are the pots? How many pots? What weight of soil in the pots? Controls? Replicates?... What required reactions? Why was distilled water used to keep soil at field capacity? Is field capacity representative of Iranian soils? If not how are results extrapolated to reflect average water content in soils in this part of Iran?

Section 2.4 - ditto above sections - provide enough detail that other researchers can repeat exactly what you have done. Details on chemicals, suppliers...

Section 2.5 Ditto above and improve English

Section 2.6 Ditto above and improve English

L153 Discussion not discussions

L155 and on, Section 3, how was SOM quantified? Ditto CEC? This is not mentioned in section 2. Ditto all other determined values listed in Table 2.

L155 What uncontaminated soil?

L165 How exactly was the pH, EC and other parameters listed in Table 3 determined?

L171 Surface functional groups and CEC - add some information on this to the Introduction

L181 Expand on how the ratios indicate what you say here

L182 The results "displayed in" Table 3. Table 3 did not by itself produce results. Where are the uncertainties in Table 3? Are differences in this table significant or not?

L184 indicate not indicated

L185 Insignificant how? Compared to what? As it appears none was detected

L186 - limited yes but more than the RH biochar and is the difference between SM300 and SM500 significant?

L188, Section 3.3 FTIR and SEM come out of nowhere. Details in the methods section please. In this section replace evident with evidenced or rather "as indicated"

L205 Figure 2

L252 Figure 3

Figure 3 - why sum Si and biochar? Why not show them separately?

L 213 Change to "Soil Ni chemical fractions after addition of silicon and biochar"

L215 - significant how? What happened to the fractions? Confusing, please re-write. Actually many paragraphs in this section need to be revised as there are a lot of random observations: Table 4 results are discussed, then Table 3, then Figure 1 without a logical coherent story/interpretation. Again, a better review of the literature in the introduction would help here, i.e. what previous studies have shown when it comes to amendments to soils, and their affect on PTEs and crop production.

L239 Was microbial activity measured? Can you really say with certainty from lower H/C mole ratios that there were lower rates of microbial oxidation?

Figure 4 - Ni not Cd on y axis

Table 4 What are the values in bold in the right hand column?

L252 State from what concentration to what concentration that Ni decreased by (11.7%). Is it Ni-Car or Car-Ni? Figure 4 Cd-Car

L275 rates?

L276 Define BCR

L278 Application rate? A rate implies speed of application

L282 Why the difference between SM biochar and the others? Provide some more detail, mechanisms

L291 ---

L292 rates? The addition of S_0 is not an addition - nothing was added - please rephrase

L294 C+S₀ is not a treatment -it is a control with no addition - please rephrase

Table 7 - mg Cd kg⁻¹ h⁻¹??

Without going further this manuscript needs a significant re-write before it is in any way acceptable for publication. If the authors revise the manuscript taking into account the above comments and apply the same thoroughness to the remainder of the manuscript I will happily review this again from the beginning.