

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

ATC1

Summary

I acknowledge the efforts the authors have made to revise and improve the manuscript, for example section 2 is much better. However, significant work is still needed before the manuscript is acceptable for publication. For example in the introduction more information is required in order to provide better context and the relevance/importance of the study. I would appreciate if after making all the corrections that the authors read through the manuscript again carefully, at least twice, as it seems to me, that in a rush to get it re-submitted a plethora of careless mistakes have been made/missed.

Corrections

Abstract: there might be no previous study like this one, but why then is it important/relevant? Please say why reducing the bioavailability of Ni is important. How much agricultural soil is contaminated with Ni? The first sentence should start with “*In Iran, X% or a significant percentage of agricultural soils are contaminated with a range of PTEs including Ni, with levels ranging from X to X....*” Then Si is a

L19 interactive effects, delete levels,

L20 biochar singular, replace alleviate with “reduce”

L38 replace using with “use of”

L44 replace “it” with Ni

L46-54

- The information on the Shabhazi study should come first to provide the context. *In a study conducted by Shabazi et al....*
- Collected soils from different climates? What does this mean? Climates don't have soils. Climate is typically defined as the long-term patterns of temperature, humidity, wind, precipitation, and other atmospheric conditions in a particular region. Climatic regions? As mentioned in the last review, more background is required. For example something like the following but with references and put more succinctly:

Land type

“Iran is a country known for its diverse geography, ranging from deserts to mountainous regions, which affects the availability of land suitable for agriculture. Arable Land: Arable land refers to land suitable for cultivation of crops. In Iran, arable land accounts for approximately 10% to 12% of the total land area. Cultivable Land: This category includes not only arable land but also land suitable for other forms of agriculture such as orchards, vineyards, and pastures. The percentage of cultivable land in Iran is slightly higher than arable land, estimated to be around 16% to 18% of the total land area. Irrigated Land: Iran has a significant reliance on irrigation for agriculture, particularly in arid and semi-arid regions. Irrigated land accounts for approximately 10% to 12% of the total land area. Marginal Land: Some portions of Iran's land are considered marginal for agriculture due to factors such as soil quality, topography, and water availability. The extent of

marginal land varies across regions but can be significant, particularly in arid and mountainous areas. Overall, while Iran has considerable agricultural potential, it also faces challenges such as water scarcity, soil degradation, and limited access to modern farming technologies, which can affect the actual percentage of land available for agriculture and agricultural productivity.”

Climate - use the Köppen classification

BWh: Hot Desert Climate (Arid):

BSk: Cold Semi-Arid Climate:

Csa: Hot-Summer Mediterranean Climate:

Csb: Warm-Summer Mediterranean Climate:

Dsa: Cold Semi-Arid Climate:

ET: Tundra Climate:

- Characterise the climate, average annual precipitation etc. of your study area
- Please add a summary of the background above before introducing the Shabazi study

All the above information should provide good background to the study being carried out and underscore the importance/relevance of the study.

L47 2 significant figures is enough - 350

L61 mitigate “the toxicity of PTEs....

L63 reduce “the bioavailability of PTEs...

L64 and “the formation of...

L68 Biochar can be used for many things including water filtration. Change to “Biochar *can be used for a number of applications including...*

L81 Increased

L86 organic matter

L89 PTEs don’t have chemical fractions. Rephrase, PTEs in other....

L100 the bonding of...

L105 Rewrite the latter half of this sentence after oxides

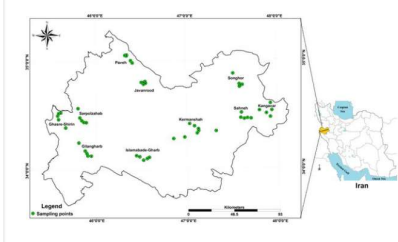
L107 Explain what light texture means

L111 “..reduce plant PTE (potentially toxic element) uptake... change to plant uptake of PTEs. Again, this PTE word order issues was mentioned previously. Read out loud all the abbreviation in the text in full to ensure correct word order.

L116 change alleviate to reduce

Section 2 is much better!

But for section 2.1 I still strongly suggest adding a map of Iran or Southern Iran to show arable regions, where your study area is and how close it is to industrial areas - see below paper as an example



Figure

Caption
Study area and sampling points in Kermanshah province

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L121 with an auger and placed into what? How was the sample then transported to the lab. How were they stored in the lab before preparation?

L124 Sieve material?

L152 determined

L173 “from” the pots. In what and where was the soil stored before analysis?

L183 millilitre should be singular here. In addition please standardise, millilitre, ml or mL (L 131)?

L195 space between brackets

L197 “between” the individual...

Section 3

L214 Low relative to what? Remind the reader that the average for Iran is 350 mg kg⁻¹. Why did you use a soil with such a low Ni content for this experiment?

L236 indicate

L242 3.3 Change to “Biochar analysis using FTIR and SEM”

L255 FTIR “spectra”... delete “of”

L264 SEM “images”

L269-271 You say effect of treatments were significant except for Ni-Car fraction, and then you say “where only the main effects were significant”. Confusing - please re-write this sentence.

L271-272 for which biochar is this? State the concentrations in addition to the % reduction.

L274 As above, state the concentrations - from xx mkg⁻¹ to xx mg kg⁻¹

L281 For clarity state what is being reduced in the WsEx fraction

L295 delete probably

L296 replace “indicated” with “reflected”, replace “by” with “in”, replace “higher” with “greater”

L297 replace “reflected” by “indicated”. Add “the” between by and lower

L304 Sentence beginning “Due to the...” How does this information from the Ma et al., study relate to this study?

L314 Change to “Si application rates from...”

L315 2 at most 3 sig figures is enough. The same goes for Table 4 and Table 3

L318 “mine contaminated soil”? ...a soil contaminated by mining activities...

L322 PTEs and word order again. ...bioavailability of PTEs in soil...

L321 State what this experiment used as an amendment

L324 “The decrease in the concentration of Ni in the carbonate form with an increase in the Si levels...”, to what is this referring? As found in this study? What treatment/s?

L337 “The greatest OM-Ni reduction (18.6%) was due to SM500”. Rephrase - see line 314 “... *the greatest reduction in soil Ni content in the OM fraction was found to be in that which underwent the SM500 treatment...*”

L341 Relace “they” with the study

L342 delete “as affected”

L344 “...in the organic matter cadmium fraction...” sounds strange, change to “... increase in Cd in the OM fraction...”

L348, L349 - see L344

L349 - no fighting going on as far as I am aware. Please replace “conflict” with “contrast”

L350 Change “According to the above-mentioned points, it seems that..” to “These observations point to the fact that... or “These observations indicate...”

L354 - see L344

L353-354 For which treatment? Or is this a mean? Please add this info.

Table 4 - where is the Ni mobility factor (%) referred to in the table caption and notes? Is this whole table not concentrations of Ni in mg kg⁻¹?

L354-355 Where has it been shown? References.

L356 Start with “In this study, the interaction....”

L357 - see L344

L359 C+50 is not a treatment it is a control - please rephrase

L360 - see L344

L361 “the” control. Delete “was”. Replace “attributed to” with “caused by”. “.. the SM300 *treatment*”. Replace “by” with “at”

L363 - see L344

L364 .. at “a” lower...

L366 .. at “a” higher...

L367 Delete “the” after increasing

L368 Replace “low” with lower, temperature with temperatures

L367-L369 Where does this information come from? Provide reference or start the sentence with “It is well known....”

L371 Change “...the exchangeable and water-soluble Mn concentration...” to “.. the Mn concentration in...”

L373 - see L344

L373-375 The control is not a treatment. Start sentence with “Compared to the control which had the highest concentration of Ni in the MnOx fraction, the greatest interactive effect was....”

L376 concentration not concentrations “..the” AFeOx and CFeOx “fractions was...”

L382 - see L344

L384, delete “the” after however. Only the “mean value” of the control and the 2 different applications of Si for the RH500 treatment...

L385 Delete B from SMB

L386-387 - what do you mean by this? By form do you mean “fractions”. It seems to me that the addition of Si did affect the Ni concentration in this fraction. E.g. for SM 200, S1 and S2 significantly decreased the concentration of Ni compared to the control. There are other examples for this fraction.

L388 In this study was contaminated or amended soil used?

L390 Ni in the Res fraction and reduced Ni in the other fractions

L392-393 Did the amount of the fractions increase or did the Ni increase in the fractions? Rephrase entire sentence.

L394-396 Ditto

L397 PTE again, rephrase

L401 Ni did not transform, it moved or transferred more into other fractions

L404 replace “use” with “application”

L405 replace was with “is”

L403-405 The RH500 with Si was also effective for this fraction

L407 “application” rates, replace “interactions” with interactive effects

Table 4 and Table 5 captions and text - standardise the addition of Si. You have Si application levels (Tab 5), silicon levels (Tab 4) and “application rates” or just “Si rates” (L407) in the text

L407-408 Change to “With the exception of SM500 (S0) use of biochar, Si application and their interactive effects were all had a statistically significant effect on shoot Ni concentration.”

Table 5 (and actually also Table 4): I am not sure of the value of calculating the mean of different treatments. Surely the point is to compare the effects and interactions of the individual treatments? What does taking the mean of the control with no silicon, the control with 250 mg kg Si and the control with 500 mg kg Si bring? Likewise what is the point of taking the mean value of the control with no silicon and 4 different biochars with

no silicon bring? The data of real value in the table are which silicon application level and which biochar reduce the amount of shoot Ni - i.e. SM500 and SM300 S2.

L408-409 32%? For which treatment? Seems to me that SM500 S2 has more than 50% less Ni relative to the control with no silicon and about 50% of the shoot Ni relative to the same biochar with no Silicon.

L409-411 - SM500 (S0) does not have a significantly different shoot Ni concentration compared to the control.

L411 Replace interaction with interactive

L412 C+S0 is not a treatment, it is the control by which all treatments are compared.
Rephrase

L413-416 - there is no data shown to confirm this statement and this sentence is a bit random. Perhaps start with something along the lines of that you compared shoot Ni concentrations with Ni concentrations in the soil fractions. From this analysis it was found.... Similarly soil pH.

L419 Change “reduction of shoot Ni concentration of spinach...” to “a reduction in the concentration of Ni in spinach shoots...”

L420 Add “of” between application and rice. Delete 2nd application. Was the reduction significant? Say so either way.

L423 PTE - rephrase

L424 What do you mean by “surface adsorption” is a significant factor? Rephrase. Surface adsorption by what?

L425 What do you mean by “altered redox conditions of PTEs”, be more specific

L433 Maize not maze, Pb concentration in shoots not Pb-shoot concentration. What are lead-shoots?

L434 Ni concentration in shoots

L438 see L434

L447 Fig. or Figure - standardise throughout according to journal format

Fig. 5 y-axis caption - capital C, y-axis - no need for .00, 2 sig. figures enough. The colour coding for the different treatments could be improved as there is not much difference between the colours of some of the treatments. At least make the control red or some stronger colour to stand out, maybe start the axis at 5 to spread the different points out a bit more.

L453 Add “the” between higher and pyrolysis, delete “the” between reducing and soil

L454 “the” lower...

L455 C+S0 - again, not a treatment - this is the control with nothing added

L464 kinetic

L490 did you contaminate the soil or amend it?

L492 kinetic

L493 metal

L494 “the” treatments. Replace “of all the biochar treatments” with “all 4 biochars”

L497 delete “has”

L498 see L490

L499 interactive, indicate

L510 It looks more like 50% to me - please check

Table 7 caption “the” power... “Ni-polluted”? See L490

L522 see L490

L541 enhances

L543 distribution of Ni between the various soil chemical forms

Conclusions: Please say something about how you think your results arising from a soil amended with Ni compares to an aged Ni-contaminated soil. In other words how representative is your experiment to the real life situation?