

Author Response to Reviewer Comments

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We thank the reviewer for the careful and constructive feedback during this second round of review. All points have been addressed as detailed below. Reviewer comments appear in *blue italics*; author responses in *green text*. Line numbers in our responses refer to the revised manuscript.

Additionally, during this revision we identified and corrected two issues in the MAOC saturation analysis (Section) that are disclosed transparently below.

Reviewer #2 — Round 2 Comments

General Comment

Thank you to the authors for the nice job responding to and integrating the feedback provided during review. This is an important dataset and the research is clearly communicated and well organized. I am providing my remaining suggestions and clarifications which I believe are critical to the interpretability of the paper.

We thank the reviewer for the positive assessment and the continued engagement with our work. We have addressed each point below.

Boxplot Captions

Throughout, boxplots are referred to as reflecting standard error and means, which is incorrect. The authors assert that bar plots obscure distributional information, but bar plots are not what was recommended by this reviewer—if means and standard error are desired, those may be produced by simply representing the means as points and the standard error as error bars (which would then correspond to the differences assessed by statistical tests). The language justifying the use of boxplots in the methods is fine, but it is important to remove any language referring to boxplots as representing means and standard errors.

[Changed] We have corrected all boxplot figure captions throughout the manuscript. The phrase “Error bars represent standard error of the mean” has been removed from the captions of Figs. 1, 3, 4, 5, 7, 8, 9, and A2. Each now reads: “Boxes span the interquartile range with the median marked; whiskers extend to the most extreme observations; individual data points are overlaid.” We apologize for this inaccuracy and appreciate the reviewer’s persistence in flagging it.

MAOC Uncertainty Propagation and Statistical Tests

Although the authors assert that they propagated uncertainty, the numbers are improbable. As stated, $\sim 10\%$ uncertainty was propagated (86 ± 9), but that is very unlikely, as the confidence intervals reported reflect 10% or less uncertainty (11.5 ± 1.2 and 7.4 ± 0.5). More detail is needed to understand what was performed (maybe there was averaging and pooling?). It is not present in the code on the Google Drive, but the code also doesn't include the paired t-test, so perhaps it has been updated and was not re-uploaded. Please upload the revised code so that it is possible to understand how this process was conducted.

1. The Round 1 code computed SEs from sampling variability alone ($SE = SD/\sqrt{n}$), treating the Georgiou et al. (2022) coefficient $\beta = 86 \text{ mg C g}^{-1} \text{ mineral}$ as exact.
2. The paired t-test by block (committed to in Round 1) was not actually implemented; the code retained an unpaired two-sample t-test.

Both issues have now been corrected:

Delta-method propagation. Because $Sat_i = C_{measured,i} / (\text{mineral}_i \times \beta) \times 100$, the partial derivative $\partial Sat / \partial \beta = -Sat / \beta$ gives a systematic uncertainty component:

$$SE_{\beta} = \overline{Sat} \times \frac{\sigma_{\beta}}{\beta}$$

This systematic term does not shrink with n (it is shared across all samples). The combined SE is:

$$SE_{combined} = \sqrt{SE_{sampling}^2 + SE_{\beta}^2}$$

The SE decomposition for each treatment is:

Treatment	$SE_{sampling}$	SE_{β}	$SE_{combined}$	95% CI
CTCC	1.063	1.199	1.602	[7.3, 15.6]
STNC	0.334	0.773	0.842	[5.2, 9.6]

Paired t-test. The comparison now uses a paired t-test by block ($block = \lceil row/4 \rceil$; $n = 6$ blocks), yielding $p = 0.007$ (previously 0.004 from the unpaired test). The Shapiro–Wilk test on the paired differences gives $p = 0.288$, confirming the normality assumption is met.

[Changed] Manuscript updated: SEs changed from $\pm 1.2/\pm 0.5$ to $\pm 1.6/\pm 0.8$; CIs changed from [9.2, 13.8]/[6.5, 8.3] to [7.3, 15.6]/[5.2, 9.6]; p -value updated from 0.004 to 0.007. Mean values (11.5% and 7.4%) and the conclusion (significant treatment difference at $p < 0.01$) are unchanged.

[Changed] Code uploaded. A complete, documented analysis package is now available on Dryad at <https://doi.org/10.5061/dryad.pg4f4qs3c> (reviewer access: http://datadryad.org/share/LINK_NOT_FOR_PUBLICATION/OKn6yFW3M1MUg00YzzETz9bkSGo6zgEN8YnktR1RNIc). The MAOC saturation analysis is in `scripts/07_maoc_saturation.R`.

Specific Line Comments

Line 123: Italicize species name. *Italicize binomial species name (*Rhizobium leguminosarum* biovar *viciae*)*

[Changed] Done. *Rhizobium leguminosarum* biovar *viciae* is now properly italicized.

Line 131: Missing opening quotation mark. *Correct missing single quotation mark from ‘8892’*

[Changed] Done. Opening backtick quotes added to both cultivar names.

Line 132: Planting density precision. *Does this reflect the true precision? Consider amending.*

[Changed] Amended. The value 21,581 plants ha⁻¹ was a unit conversion that overstated the precision of the planting protocol. Tomatoes were planted at 1-ft (30-cm) in-row spacing in single rows on 60-in (152-cm) beds, giving a design density of ~21,500 plants ha⁻¹. The manuscript now reports “approximately 21,500 plants ha⁻¹ (1-ft [30-cm] in-row spacing on 60-in [152-cm] beds).”

Line 133: Missing opening quotation mark. *Correct missing single quotation mark from ‘Riata’*

[Changed] Done.

Line 174: Clarify bulk soil sampling locations. *I should have raised this in the first round, but upon rereading I noticed that it is unclear where the bulk soil samples were collected. Please clarify. Also, if cores were sampled between beds that should be explicitly stated (not sure what is meant by inter-row positions).*

[Changed] Clarified. The phrase “inter-row positions away from tillage operations and irrigation lines” has been replaced with an explicit description of sampling locations. All soil samples (both undisturbed cores and bulk samples) were collected from the bed tops, offset from the bed centerline to avoid the buried subsurface drip irrigation line and crop row. Core and bulk sampling locations were independently and randomly selected within each plot.

Line 189: Size-fraction notation. *List the smaller number first, e.g. 4–8 and 2–4 mm.*

[Changed] Done. All occurrences corrected to 2–4 mm and 4–8 mm throughout the manuscript and in the R code for figure facet labels.

Line 201: Extra space. *Correct extra space after parenthesis.*

[Changed] Corrected. The extra space after the parenthesis in “(~12 days)” was replaced with proper formatting: (≈12 days).

Figure 1: Boxplot description and labeling. *Adjust figure titles to match caption (2–4 and 4–8 rather than 4–2 and 8–4). Also, the “whiskers” of the box plot are not error bars; they represent the minimum and maximum (importantly, the mean is not represented in boxplots as suggested: the horizontal middle line is the median, and the “box” is the interquartile range). Please correct this in all figures it pertains to, i.e. all boxplot figures in the manuscript.*

[Changed] Both issues corrected. (1) The R code facet labels have been changed from “4–2 mm”/“8–4 mm” to “2–4 mm”/“4–8 mm” (in WAS_calc.R), and the figure has been regenerated. (2) All boxplot captions have been corrected as described above.

Line 420 / Figure 9: MAOC uncertainty and boxplot language. *As mentioned earlier, the confidence intervals obtained by the delta method are too small to reflect the propagated uncertainty, please make the calculations clear in the methods. Additionally, Figure 9 refers again to “error bars” which is untrue based on the provided code, which forms boxplots. Therefore, there is no relation to the boxplots and propagated uncertainty. Please clarify.*

[**Changed**] Both issues resolved. (1) The MAOC uncertainty is now correctly propagated via the delta method as described above, and the corrected SEs and CIs are reported in the text (Section 3.6). (2) The Fig. 9 caption no longer refers to “error bars” or “propagated standard errors.” It now uses the standard boxplot description and cross-references Section 3.6 for the propagated-uncertainty methodology.

Lines 604–608: Out-of-place monitoring recommendation. *The sentence “Monitoring protocols...” reads as out-of-place because the previous sentences do not speak to depth-based differences. Either remove the link (“should therefore”), contextualize it, or remove the sentence.*

[**Changed**] Removed. The sentence beginning “Monitoring protocols for long-term conservation agriculture should therefore prioritize surface-stratified sampling...” has been deleted from the Conclusions, as the methodological recommendation does not follow from the preceding conclusion statements and the point is already made in the Discussion.

Lines 604–611: Duplicate text. *This is restating almost verbatim the language in 485–493. All language and concepts should be original for clarity and brevity. Please remove / revise.*

[**Changed**] Removed. The duplicate paragraph (surface-stratified vs. bulk-sampling discussion) has been deleted from Section 4.6, retaining the original occurrence in Section 4.5.

Line 625: Capitalization error. *De-capitalize the N in Inc.*

[**Changed**] Done. “INc.” corrected to “Inc.”

Additional Author-Initiated Corrections (MAOC Analysis)

In the course of addressing the reviewer’s comments about MAOC uncertainty, we identified and corrected two issues in the MAOC saturation code that were not explicitly flagged by the reviewer:

1. **Unpaired → paired t-test.** As noted in our Round 1 response, we committed to using a paired t-test by block to account for the RCBD design. However, this was not implemented in the code uploaded for Round 1 (the code retained `t.test(..., var.equal = TRUE)` without pairing). The corrected code uses `t.test(CTCC, STNC, paired = TRUE)` with `block = [row/4]`.
2. **Sampling-only SE → delta-method combined SE.** As the reviewer correctly identified, the Round 1 SEs reflected only sampling variability. The β -uncertainty ($\sigma_\beta = 9$) was not propagated despite the manuscript claiming otherwise. This has been corrected using the delta method as described above.

Neither correction changes the qualitative conclusions: CTCC plots remain significantly more saturated than STNC plots ($p = 0.007$, paired), and the mean saturation values (11.5% vs. 7.4%) are unchanged. The wider confidence intervals under proper propagation ([7.3, 15.6] vs. [5.2, 9.6]) more honestly reflect the total uncertainty, including the systematic component from the Georgiou coefficient.