

Interactive comment on “The combined effects of nitrification inhibitor and biochar incorporation on yield-scaled N₂O emissions from an intensively managed vegetable field in southeastern China” by B. Li et al.

Anonymous Referee #1

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General comments

This paper presents data of a two-year experiment on the effect of the nitrification inhibitor (NI) nitrapyrin and of wheat-straw-derived biochar on yield and yield-specific N₂O emission in vegetable production in southeast China. For this purpose, experimental plots of 7.5 m², with three replicates, were established in 2012. Six different treatments, i.e., three different biochar levels (0, 20, 40 t ha⁻¹) combined with two different application forms of nitrogen fertilizer (“compound fertilizer”; and urea with nitrapyrin) were established. The amount of N fertilizer applied was the same for all

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treatments and amounted to approx. 1200 kg ha⁻¹ yr⁻¹. Yield and N₂O emissions were determined over seven consecutive vegetable periods within the following two years. N₂O emissions were quantified with the static chamber technique, with three replicate chambers for each treatment, and with measurements every other day for one week directly after fertilizer application, and weekly thereafter. Cumulative N₂O emissions were calculated for each cropping season, and related to the respective yield. The authors found that application of the nitrification inhibitor led to an increase in yield and to a decrease in both cumulative N₂O emissions and yield-scaled N₂O emissions, whereas the biochar also effected an increase in yield, but only a decrease in yield-scaled N₂O emissions, but not in cumulative N₂O emissions. In contrast, the combination of both factors slightly increased yield-scaled N₂O emissions. A significant difference between the two different soil amendments was observed with respect to pH: while the application of the NI led to an increase in soil pH, amendment of the soil with biochar from wheat straw was associated with a strong decrease in soil pH below 4 in the treatments without NI.

The paper presents relevant data on a timely topic, i.e., increasing agricultural nitrogen use efficiency, which is especially relevant to vegetable production, as in this special sector of agriculture incredibly high amounts of nitrogen fertilizer are being used. The experimental design appears appropriate, the work has been conducted properly, and the paper is reasonably well written, although the language and the punctuation need some final check by a professional. The weaknesses of the paper are that (i) two different kinds of nitrogen fertilizer have been used for the two treatments with and without NI, i.e. a “compound fertilizer” for the no-NI treatment (N form was not specified), and urea + nitrapyrin for the NI treatment; (ii) beside total N, no information about the different N species in the soil were available, such as ammonium and nitrate concentrations. This would have been especially useful to interpret the effect of NI and biochar on plant-available N; and (iii) significant pH effects, induced by the introduction of the soil amendments, superimposed the pure NI and/or biochar effects and were impossible to disentangle from them. Besides, the potential effects of these pH effects

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were not sufficiently discussed and taken into account for the interpretation of the experimental results. However, despite the weaknesses of the study, the paper could be taken into account for publication in Biogeosciences, if the following specific comments are sufficiently addressed.

Specific comments:

p. 15187, l. 22-23: Here, the literature is not fully up-to-date. There are more recent papers, e.g., Zhou et al., *Ecosystems* (2014) 17: 286–301.

p. 15188, l. 18: Here and throughout the paper, you should use the common name, i.e. nitrapyrin, to facilitate literature search and comparison. The correct IUPAC name of nitrapyrin is 2-chloro-6-(trichloromethyl)pyridine.

p. 15188, l. 29–p. 15189, l. 1: Give reason why lower pH will cause a negative effect of biochar amendment.

p. 15189, l. 7: “we estimated”: estimated or quantified?

p. 15189, l. 16-17: Give source of climate information.

p. 15190, l. 10: “1217.3 kg”: Here and in the following: I suggest omitting the decimals, as one decimal (i.e., 100 g N ha⁻¹) would correspond to 75 mg applied to the 7.5-m² plots. I cannot imagine that this accuracy was achieved during the experiments.

p. 15190, l. 14: Specify nitrogen form.

p. 15190, l. 21-22: How stable was the biochar over the course of the experiment (two years)?

p. 15190, l. 25: Do not start a sentence with a number, i.e.: Seven...

p. 15191, l. 7-9: All management procedures should be summarized in a table.

p. 15191, l. 15: frame(s), not channel(s)

p. 15191, l. 27-28: Give detection limit of your N₂O flux measurements, i.e., minimum
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detectable N₂O flux.

p. 15192, l. 1-2: In which way were the fluxes weighted? Was only the period preceding the measurement used for weighting, or half of the preceding and half of the succeeding period?

p. 15192, l. 6: Stored for how long? At which temperature? Well-aerated or in closed bags?

p. 15193, l. 3: kg N₂O t⁻¹ yield is the unit of the fraction, not of the denominator (and it should be kg N₂O-N t⁻¹ yield).

p. 15193, l. 16-18: The first two sentences are dispensable.

p. 15193, l. 22: "Similar to..."

p. 15194, l. 3-5: Give increase/decrease of pH in absolute terms. To specify a relative change for a logarithmic number is problematic.

p. 15194, l. 14: One digit is sufficient.

p. 15194, l. 22: Probably the decimals are dispensable, depending on your detection limit.

p. 15195, l. 9: Replace “In addition” with “In contrast”.

p. 15196, l. 1: Split (too long) sentence between “period, and”.

p. 15196, l. 19: “related to mitigating”

p. 15198, l. 9: “primarily due to”

p. 15198, l. 15: “result in adversely affecting”

p. 15198, l. 20-23: Change sentence slightly to: “. . . biochar increased cumulative N₂O emissions in the soil when ammonia oxidation and nitrifier-denitrification (ND) were the major processes generating N₂O emissions, whereas it decreased N₂O emissions in

the soil when denitrification was the main pathway. . .”

p. 15199, l. 9: Replace “in a rice paddy” with “in paddy rice”.

p. 15200, l. 6-9: Here, you mix up yield-scaled with grain N yield-scaled N₂O emissions. Venterea et al. (2011) found grain yield-scaled N₂O emissions in the range of 0.046-0.073 kg N₂O-N t⁻¹ yield in conventional tillage, and 0.067-0.1 kg N₂O-N t⁻¹ yield in no-till systems, i.e. comparable with your findings.

p. 15201, l. 11: “interactions”: Need to be specified between which factors.

Table 1: Unclear, where P and *** refer to (last line of table).

Figure 2: Font size in Fig. 2 should be increased.

Figure caption 2: Replace “dashed line apart the vegetable growing and fallow periods” with “dashed line separates the vegetable growing and fallow periods.”

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