

Interactive comment on Biogeosciences Discuss., 11, 15185, 2014.

Interactive comment on “The combined effects of nitrification inhibitor and biochar incorporation on yield-scaled N_2O 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 N_2O emission in vegetable production in southeast China. For this purpose, experimental plots of 7.5 m^2 , 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 treatments and amounted to approx. $1200 \text{ kg ha}^{-1} \text{ yr}^{-1}$. Yield and N_2O emissions were determined over seven consecutive vegetable periods within the following two years. N_2O 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 N_2O 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 N_2O emissions and yield-scaled N_2O emissions, whereas the biochar also effected an increase in yield, but only a decrease in yield-scaled N_2O emissions, but not in cumulative N_2O emissions. In contrast, the combination of both factors slightly increased yield-scaled N_2O 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;

A: Thank you very much for your great support and nice comments! We are now incorporating all your comments into the revised version to improve the manuscript. Please see the following point-to-point answers.

In the revised version, we specified N form for the compound fertilizer on Page 4 line 27-28. We choose the compound fertilizer according to the local farmer's practice. Since a commercial product of CP for the NI treatment was in the form of urea + nitrapyrin, we can only roughly compare the effects of nitrapyrin. Besides, the corresponding P and K fertilizers were broadcast in the form of calcium phosphate and potassium chloride, respectively, in addition to the CP urea. Sorry for the inconvenience!

- (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;

A: Thank you for your nice comments! A parallel experiment demonstrated the effects of nitrapyrin and biochar on soil ammonium ($\text{NH}_4^+\text{-N}$) and nitrate ($\text{NO}_3\text{-N}$) content was supplemented in the revised manuscript and was presented in Figure 3. Page 6 lines 14-20; Page 7 line 13-19.

- (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 were not sufficiently discussed and taken into account for the interpretation of the experimental results.

A: Yes, you are right! We discussed more on the pH effects on N_2O emissions Page 10 line 21-22 and Page 11 line 9-11 in our manuscript. However, it is very difficult for us to disentangle the pure NI and/or biochar effect according to the current treatments. Thank you!

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.

A: Thank you so much for your understanding and your great support!

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.

A: We have revised it on Page 2 line 20. Thank you!

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.

A: We have revised CP as nitrapyrin throughout the paper. Thank you!

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

A: We have revised on Page 3 line 22-23. Thank you!

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

A: We have revised it on Page 3 line 28. Thank you!

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

A: We have revised it on Page 4 line 6. Thank you!

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 achievable during the experiments.

A: We have revised it on Page 4 line 23. Thank you!

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

A: We have revised it on Page 4 line 27-28. Thank you!

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

A: Biochar is relatively stable in agriculture soil for it due to its inert recalcitrant C component, so it can contribute long-term C sequestration in soil (Kuzyakov et al., 2014). Thank you!

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

A: Thank you for your comments! We have revised it on Page 4 line 18 and Page 5 line 7.

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

A: We have summarized them in Table 1 on Page 24. Thank you!

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

A: We have revised it on Page 5 line 21. Thank you!

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

A: Thank you for your comments! The concentration of the standard gas for measuring N₂O flux is 320 ppb. With the characteristic of high N fertilization and frequent irrigation, the N₂O fluxes in vegetable field are relatively higher than other upland ecosystems, so the N₂O fluxes measured in our experiment were all detectable.

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?

A: We just use the period preceding the measurement used for weighting. Thank you!

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

A: We have revised it on Page 6 line 7. Thank you!

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).

A: Thank you for your comments! We have revised the unit of yield-scaled N₂O emissions throughout our manuscript.

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

A: We have deleted the first two sentences on Page 7 line 13. Thank you!

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

A: We have revised it on Page 7 line 16. Thank you!

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

A: We have revised it on Page 7 line 20-21. Thank you!

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

A: We have revised it on Page 8 line 1. Thank you!

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

A: We have revised it on Page 8 line 7. Thank you!

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

A: We have revised it on Page 8 line 28. Thank you!

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

A: We have revised it on Page 9 line 16. Thank you!

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

A: We have revised it on Page 10 line 3. Thank you!

p. 15198, l. 9: “primarily due to”

A: We have revised it on Page 11 line 17. Thank you!

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

A: We have revised it on Page 11 line 21. Thank you!

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. . .”

A: We have revised it on Page 11 line 26-28. Thank you!

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

A: We have revised it on Page 12 line 12. Thank you!

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.

A: Thank you for your comments! We have deleted the incomparable result on Page 13 line 3.

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

A: We have revised it on Page 13 line 29. Thank you!

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

A: We have some supplement in Table 2 on Page 25. Thank you!

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

A: We have changed the font size in Figure 2. Thank you!

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

A: We have revised it in Figure caption 2 on Page 29 line 9. Thank you!

We also modified the language use with a marked-up manuscript version, thank you!

Thank you very much once again for your helpful comments!

Best Regards!

Zhengqin

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