Reply to anonymous referee no. 1

Dear Sir or Madam

We thank you again for your careful reading and your new suggestions. After all, they improved the coherency and significance of the manuscript considerably. Please find in the following our minor revision.

L. 19: … formation *and emission* of nitrogeneous gases

→ edited accordingly

L. 21: inhibitory effect of the high NH4+ content in BD on what? Nitrification?

→ On nitrification, right.

L. 22. " … like after injection"? Do you mean "right" after injection? How about writing: Our results suggest a larger potential for N2O formation right after BD injection in the fine-textured clayey silt than the coarse loamy sand. ? & L. 23: … which could be followed by: "By contrast, the loamy sand showed a larger potential for N2 production under anaerobic conditions".

→ Thank you for your suggestions!

l. 24: rephrase this last sentence in the abstract: the need for longer-term studies is not a direct result of your observations; thus, saying "… our results show the need for further investigations on the dynamics and the duration …" is misguiding. Rather try to summarize the significance or relevance of your observations. For instance, you could say something about how much of the added N was lost during the denitrification event simulated in your experiment, since you in the beginning of the abstract present BD injection as a counter-measure for NH3 volatilization. If you get N2O-N losses up to 11.7 mg N2O-N m-2 h-1 at 30%WFPS in the clayey soil or 35 mg N2-(N?) in the sandy loam, how would this compare to typical rates of NH3-N loss during the first days after surface application? I know, reported NH3 volatilization rates are all over the place, but still it would be interesting to learn how this compares to potential N gas losses from injected BG.

→ This is a good suggestion. “Supposed that 15 % of NH4+-N is volatilised as NH3 within the first ten hours after surface application of BD (Quakernack et al., 2012), the losses in our experiment would have averaged to 80 mg NH3-N m-2 (LOBD) and 160 mg NH3-N m-2 (HIBD), respectively. The actual losses of up to 11.7 mg N2O-N m-2 h-1 at 30 % WFPS in the clayey soil (Table A2) or of up to 35.1 mg N2 m-2 h-1 at 55 % WFPS in the sandy loam (Table A3) from our HIBD treatments add up to 117 mg N2O-N and 351 mg N2, respectively, for the same period. Hence, increased N2O and N2 emissions after injection of BD might effectively cause higher N losses compared to a surface application and have to be studied closer in future.” (L. 282 – 288 in the section ‘Discussion’)

We summarised this phrase in the abstract (“Our results suggest that short-term N losses of N2O and N2 after injection may be higher than probable losses of NH3 following surface application of BD.”; 23 – 25) and in the ‘Relevance and implications’ section (“Since coupled nitrification-denitrification N losses from injected BD seem to be massive in your study, the short-term emissions of N2O and N2 after injection appear to offset the reduced NH3-N losses that would have arose hypothetically from surface application.”; 360 – 362).

L. 44: *may* promote … if it does not get inhibitory

→ “may” removed (45)

L. 66: “but with the restriction that inorganic sources could not be differentiated”; skip this here. Since you later get a good correlation with total N gas loss, carbonates do not seem to be a major issue.

→ skipped (64)

L. 68: what do you mean by “hypothetical concentration”? Concentration of what?

→ “of C and N” (62)

L. 97. “…repacked to reach nutrient concentrations comparable to that in injection bands”. Good! That’s the right way to express it.

→ Thank you!

L. 203: why do you express N2O loss as mg N2O-N m-2 h-1, but N2 loss as mg N2 m-2 h-1?

→ Because it is indifferent. 1 mg N_2 equals 1 mg N_2-N.

L. 230: "However, the latter studies assumed a distribution of BD into soil by a cultivator, which implies a smaller concentration of BD compared to its occurrence in injection slits". Here you still argue that you applied slurry in "slits", which is not true. You mixed it into the soil, right?

→ Yes, we mixed it into the soil. It reads now: "[…] which implies a smaller concentration of BD than we actually applied" (226 – 227).

L. 249: "generally adverse conditions for the formation of N2O and N2." What kind of conditions would this be? Explain

→ We supplemented this phrase with a reference to section 4.2 ("diffusion"): "generally adverse conditions for the formation of N2O and N2, i.e., a sufficient supply of O2 (see section 4.2)" (238 – 239).

L. 347: "…also true for our incubation as well". Language!

→ "as well" omitted now (346)

The R1 version still needs language checking!

→ Language is now checked by a co-author.

L. 351: Why "however"?

→ Good question. Substituted by “in summary” (350)

L. 354. Why “nevertheless”? Putting conjunctive adverbs in front of every sentence does not automatically make a “story”. Conjunctions have to make “sense” and I do not grasp how expected change in N2/(N2+N2O) ratios relates (or opposes) to ammonium inhibition in the sentence before. Revise.

→ Thank you for this clue, substituted by “at the same time” (353).

l. 342. Conclusions: based on your study, how do you judge BD injection environmentally? What is the smaller evil? NH3 losses after surface application or N2O + N2 losses after injection. I am aware that a lab experiment cannot easily be extrapolated to field conditions, but somehow it would be nice if you could come back to the starting point/motivation of the study and give a rough assessment. Coupled nitrification/denitrification N losses from injected slurry seem to massive in your study ….

→ This is a very good suggestion and we realized it as described above.

Kind regards,

Sebastian Fiedler and co-authors

References

Quakernack, R., Pacholski, A., Techow, A., Herrmann, A., Taube, F., and Kage, H.: Ammonia volatilization and yield response of energy crops after fertilization with biogas residues in a coastal marsh of Northern Germany, Agriculture, Ecosystems & Environment, 160, 66–74, doi:10.1016/j.agee.2011.05.030, 2012.