

## ***Interactive comment on “N<sub>2</sub>O emission from organic barley cultivation as affected by green manure management” by S. Nadeem et al.***

**S. Nadeem et al.**

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Anonymous Referee #1

We thank the reviewer for his/her positive appraisal of the main objectives of our study and respond to the specific comments point by point:

R1-1: Page 2318 line 14 The reader does not see the “short-lived peaks” after ploughing since there were no measurements right after ploughing. It would be better to say “During the growing season, N<sub>2</sub>O emission showed ...”.

A.R. We agree with the reviewer and changed the text accordingly

R1-2: See also p2323 line24. I think the spring peak is the result of fertilizing, not

C1441

ploughing

A.R. Fertilisation and ploughing are synonymous in the case of the GM treatments (GM was incorporated by ploughing) but not in the case of biogas residue and mineral fertilizers which were applied 20 days after ploughing in spring. We agree with the reviewer that we cannot delineate the mechanisms (mechanical perturbation, input of fresh organic matter) leading to high emissions in spring, particularly since we are missing data directly after ploughing. We have rewritten the entire section discussing ploughing effects and also point at the caveats arising from missing data after spring ploughing. . Concerning autumn ploughing, it is striking that N<sub>2</sub>O emissions also peaked even though there was no input of fertiliser (mineral or organic) and fertilisers applied in spring were expected to be exhausted by the end of the growth period. We now point at this fact and speculate that green manure with different degrees of mulching seems to have a potential to induce high N<sub>2</sub>O emissions several months after its application.

R1-3: P2322 line 7 The difference of 370 g is shown in Table 4, not Table 3 and it seems to be statistically significant, not non-significant as you state? I would say it is small but significant.

A.R. We thank the reviewer for pointing us to the right table which by mistake was written as table 3. The increase of N<sub>2</sub>O emission attributed to mulching (370 g N) was small but indeed significant as indicated in table 4. We corrected the manuscript accordingly.

R1-4: Figures. It would be nice to have the standard deviations in the figures but they would indeed reduce the readability. In the case of N<sub>2</sub>O, there are the deviations and results of statistical tests in the tables which is adequate. In the case of mineral N, you could probably add a statement of the (lack of) statistical differences in the text.

A.R. We appreciate that the reviewer accepts the omission of standard deviation in the N<sub>2</sub>O emission figures for reasons of readability. In response to similar concerns from

C1442

reviewers 2 and 3 we have now included asterisks for dates with significant difference in flux ( $p < 0.05$ ) across the treatments and discuss these dates in more detail in the revised manuscript. For mineral N, we pooled soil samples per treatment because we considered it as more important to follow the temporal dynamics than exploring statistical differences between treatments. We are aware that there is a trade off between temporal and spatial resolution in our study, but logistic reasons (i.e. lack of funding) prevented us from studying both. We now comment on this trade off and describe the details (8 soil cores per treatment from two plots (4 cores per plot) were pooled to one composite sample per treatment).

R1-5: Discussion on the amount of applied N in the GM/fertilizer is lacking. The reader would appreciate data on the amount of N in the mulch (maybe presented in Table 2) and a comparison on the different forms of fertilizer.

A.R. We agree with the reviewer and now give the aggregate amounts of N applied to barley in 2010 in table 6. However, these amounts are based on various assumptions, such as that N from mulched aboveground biomass in 2009 is carried over quantitatively to 2010. Moreover, we do not have data on the amount of N in GM root biomass, so that the values given in the table are necessarily incomplete.

R1-6: You state that the biogas residue did not yield as much DM and N as mineral fertilizer but you might also say that there was less available N in the residue at the time of application. The availability of N in the mulch is poor as well and the estimate of the amount of N in it would be interesting background data

A.R. We agree with the reviewer that the availability of N in biogas residue and mulch as compared to mineral N is an issue, particularly when relating it seasonal emission factors. For the biogas residue we now mentioned in the discussion that there was less readily available N ( $60 \text{ kg NH}_4^+-\text{N ha}^{-1}$  as compared to  $80 \text{ kg N ha}^{-1}$  supplied as  $\text{NH}_4\text{NO}_3$  in the C-(M) treatment). For mulch, we only have data on total N in the above ground biomass of all tree cuts, which we chose to aggregate (table 6) to give

C1443

an approximation of the total organic N input in the various mulching treatments during 2009.

R1-7: The small (or lacking) differences between the treatments in the mineral N content of the soil are also worth of discussing. One would expect greater differences? Since there were no clear differences in mineral N content could the higher  $\text{N}_2\text{O}$  flux from mulch treatments reflect the higher soil moisture content under the mulch (P2322 lines 7-9)? Correlation analysis could reveal something more of the results?

A.R. As suggested by the reviewer we performed correlation analysis and found that WFPS and soil temperature were the only controlling factors for  $\text{N}_2\text{O}$  emissions in 2009. Thus, higher WFPS in the mulched than in the non-mulched treatment during summer is likely responsible for higher emission rates in G-3M. We have revised the text accordingly.

R1-8: Technical correction p2308 line7 "return" is a better verb than "replace" in this connection. See also p2320 line 11.

A.R. Corrected at both places in the revised manuscript

R1-9: line 23 "greenhouse" not "green house"

A.R. Corrected

R1-10: p2315 line20 please give the manufacturer of the porous cups line 24 "augered" line 25 "angle"

A.R. Done and corrected

R1-11: page 2317 line 6 "excursion" is probably not the best word here? line 12 " $\text{NH}_4^+$ " line 18 What do you mean by "erratic"?

A.R. We replaced "excursion" with "increases"; fluctuations in  $\text{NH}_4^+$  content were "erratic" in the sense that they were not in phase among the different treatments unlike it was the case for  $\text{NO}_3^-$ . We replaced "erratic" by "less uniform".

C1444

R1-12: p2319 line 2 On the contrary, not “to”

A.R. Corrected.

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C1445