

Interactive comment on “Organic wastes from bioenergy and ecological sanitation as soil fertility improver: a field experiment in a tropical Andosol”

by A. Krause et al.

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We are thankful for providing us thoughtful feedback and valuable comments to support the improvement of our manuscript. We discussed the provided comments, the raised issues, criticism and suggestions thoroughly among the authors team. Please find our responses below and also see the final author's comment.

Best regards,

Ariane Krause, on behalf of the author's team

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Comment #1: The paper (...) deals with an interesting aspect that completely fits the scope of the journal, such as the effects of different soil amendments, mainly organic amendments, on a type of soil with requirements of P.

Response: We appreciate the Referee's acknowledgement that our results are interesting and that our work fits the scope of SOIL journal.

Comment #2: However, I consider that this study does not represent an innovative contribution to the knowledge concerning soil management and constitutes a work mainly descriptive.

Response: We agree that parts of the current manuscript are too descriptive. We will work on this thoroughly when revising the manuscript. However, we don't agree with the lack of innovation in our work. We argue, that the innovative elements in our work are:

1. A field experiment using practice oriented intercropping system and field size.
2. The design of our experiment was highly adapted to local practices so that results can be easier transferred to the real world, e.g. using local crop species and comparing locally available materials such as compost, biogas slurry, biochar and sanitized human excreta.
3. We chose a complex approach (to study a complex problem), which combines soil chemistry, soil physics and plant nutrition in one study.
4. We conducted an experiment on a special and interesting soil, a tropical Andosol with high P requirements.

However, we interpret this comment in the way, that we haven't justified sufficiently why our work is an innovative contribution to soil science. Hence, we want to react on this by (1) improving the Abstract (in the Authors' comments) and (2) adding a section to the introduction where we deduce the chosen research design from scientific results in the field of organic materials and biochar application of the past years.

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Comment #3: The work is correctly outlined, but in some aspects (description of the soil amendments, discussion of the results, etc.) is a little confusing. For this, the following comments are some suggestions to improve the work.

Response: We are thankful for the provided comments, which we will consider when revising our manuscript.

To improve comprehensiveness of the description of the soil amendments, we suggest adding an additional table to the manuscript providing general information about the amendment's chemical characteristics such as pH, moisture, C and nutrient contents etc. Furthermore, we assume that we provided too many details and combined too many aspects in the chapter "Results & Discussion". To significantly improve this part of the manuscript, we suggest the following changes for the revised submission:

1. Elimination of section 3.5 where we provide an outlook on how the tested soil amendments can contribute to close nutrient cycles on small-scale farms in Karagwe. By withdrawing this section we will enhance the focus on the results of the field experiment. We consider shortening this section to only one sentence to be part of the conclusion.
2. Elimination also of section 3.6 to reduce the amount of information provided in this chapter and to support the readers' focus on the most important results of the experiment. (Also see our response to comment #10.)
3. We will completely rewrite the chapter to improve readability.

Comment #4: In the Abstract is not clear the soil parameters determined and only after reading the Materials and Methods section I found that the authors have studied more parameters than physico-chemical parameters (pH and EC); please, specify the parameters studied in the abstract.

Response: We rewrote the Abstract and included a selection of the examined parameters. Please see the improved Abstract in the Authors' comment.

Comment #5: The introduction perfectly reflects the topic and the main objectives of the

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study; however, the authors should explain in more detail some aspects of the previous studies that are slightly mentioned, to justify the use of these specific soil amendments.

Response: We highly appreciate the general evaluation of the introduction we provided. We will work on the suggested improvements and we will change section 1.3 accordingly.

Comment #6: In the Materials and Methods section, the experimental design is adequately explained, except for the characteristics and origin of the soil amendments used (only described for urine). The characteristics of the soil amendments used constitute an essential aspect to evaluate the effects of their use in the soil-plant system.

Response: We agree. We will rephrase chapter 2 on "Material and Methods" and hope that it will be more clear and better justified, especially for the origin of the soil amendments. Therefore, we will shift details about the amendments from section 1.3 (p. 1224, line 22-28) to the section 2.2. By this, we can also react on Comment #2 and #3 of Referee #1. Furthermore, we will also rewrite this part to improve the readability and we will add an table; please see our explanations and suggestions in our response to your comment #3

Comment #7: In addition, the methods for the determination of several parameters are described in the table and figure legends; the authors should include this in the part of Materials and Methods, because it is a little confusing.

Response: We agree and will change the manuscript accordingly.

Comment #8: In the Statistical analysis section, the authors comment the number of replications of each treatment. I consider that this aspect should be moved to the section of the plot preparation.

Response: In our opinion, it is appropriate to have an extra section on statistical analysis at the end of chapter 2 on "Material and Methods", which includes also the number of replications. In section 2.2 ("soil amendments") the number of replications accord-

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ing to the design of the experiment is explained. In section 2.7 ("statistical analysis") we elucidate variances in the number of replications according to different parameters, which were assessed. Please also see our response to your comment #9.

Comment #9: Why is different the number of replications in the treatments?

Response: We apologize that this fact was not explained sufficiently and we will improve this when revising the manuscript. According to the design of the experiment as Latin rectangle, the number of replication of the five treatments did not differ and was n=5 for all treatments. However, we had to eliminate one outlier in the control and urine treatment so that for statistical analysis n was 4. Hence, n=5 (for biogas slurry, compost and CaSa-compost treatment) was combined with n=4 (for the control treatment) for all parameters we collected during harvesting, e.g. on biomass growth and crop yields. However, we had to use n=3 for all parameters, which were assessed through laboratory analysis (soil chemical and physical parameters as well as examinations of nutrient content in the maize plant) because of financial restrictions.

Comment #10: In general, the Results and Discussion section should be revised and clarified, because apart from being mainly descriptive, some aspects in the discussion of the parameters are difficult to understand. As an example, it is not clear the effect of the properties of the soil amendments on the soil characteristics (see previous comment related to the characteristics of the soil amendments).

Response: We agree with the Referee's comment and we will improve comprehensibility of chapter "Results and Discussion" when revising our manuscript. However, in our opinion we already discussed the observed effects in relation to the soil amendments by discussing effects on plant growth, plant nutrition and changes in soil properties. For example we discussed different P contents in the tested soil amendments and related them to the observed differences in CAL-extractable concentrations of soil P. Furthermore, we applied the vector nutrient analysis to identify the primary response of maize plants to improved P availability. In addition, we discussed the different CaO-

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equivalents of the soil amendments in the context of the observed changes in soil pH. We also discussed, that under the given tropical conditions, an increase in soil pH will positively affect the availability of nutrients in the soil, hence stimulate biomass growth. As typical for the local Andosol, nutrient deficiencies and acidity in the soil were most present on the unamend control plots, which depressed plant growth. However, we will work on improving comprehensibility of chapter "Results and Discussion".

Comment #11: Why were the crops African egg and pepper not harvested?

Response: We planted African eggplant and pepper as part of the chosen intercropping system. The local agricultural expert recommended this because our aim was to be in line with local agricultural practices. However, these two plant species are perennial and harvesting started only in June 2014 when our experiment was finished. So we decided to integrate them in the intercropping but exclude them from analysis. However, we will make this point clearer when revising our manuscript.

Comment #12: Section 3.6 should be included in the discussion of the results, since it is not clear if it is part of the conclusions or of the discussion of the results.

Response: We agree. In combination with comments #6 and #10 of Referee #1, we suggest withdrawing this section and erase especially the subjective impressions. However, we will keep two relevant aspects: (1) the effect of biogas slurry on beans plant will be moved to section 3.2 (Results and discussion of biomass production, p. 1234 f.) and (2) the discussion of the practical application and the addition of urine to CaSa-compost, which are based on recent scientific results. The latter issue will be shortened and moved to section 2.2 (p. 1226 f.), hence integrated into the revised and improved description of the used soil amendments.

Comment #13: In addition, it would be interesting to include a figure with the climatic data at the experimental site during the period of study, which can help in the discussion of the effects of the treatments on the soil, instead of mentioning only average values.

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Response: We agree with this comment and offer to include a figure (either to the manuscript or to the supplements) providing data on humidity, temperature and daily precipitation throughout the experiment.

Comment #14: The Conclusions section should be summarized, only including the main aspects found in the study, avoiding speculations and general ideas

Response: We will improve our conclusions especially by focussing on the main aspects found in our study. We already suggested erasing section 3.5 and 3.6. from the chapter of results and discussion. Hence, we will also adjust the conclusions accordingly when revising the manuscript.

Interactive comment on SOIL Discuss., 2, 1221, 2015.

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