Thanks to the Reviewer for his comments and valuable advice, which will contribute to improving the quality of the article and bring more clarity. Responses to comments:

I suggest including in the tittle the kind of crop/rotations where the study has been done or the study environmental conditions (template climate or whatever…).

Answer:

Analysis of changes in soil physical properties and CO2 emissions under the influence of biopreparations of different composition in Central Europe (Lithuania).

Section 2.1. you should mention here the previous work where the experimental design and overall the biopreparations are firstly and properly explained: Naujokienė et al.2018

Answer:

2.1. According to Reviewer comment in the section we inserted referent: Naujokienė et al., 2018.

Section 1.3. Please, revise the reference Juknevičius et al., 2018. The percent of increase in SOC with biopreparations does not match. In addition, this line should be refunded with line 73 where the same idea is mentioned.

Answer:

After using the biological preparation, the amount of organic carbon in the soil increased from 1.8 to 2%, the difference in increase is 0.2%. We will move this sentence to line 73.

Line 97. After "sufficiently studied" you should mentioned your previous work Naujokienė et al., 2018 where those aspects have been already studied.

Answer:

Based on your comments, reference Naujokienė et al., 2018 will be added to Line 97.

Objectives: Please, add in which kind of crops or under what climatic conditions the work is done and also the temporal scale. You should remove "by stablishing correlations" because correlation analysis does not automatically prove the existence of cause and effect connection among phenomena!

Answer:

We have added the purpose of research. The aim of this study was to investigate the effects of different biopreparation formulations on soil porosity, temperature, and CO2 emission from the soil in Central Europe (Lithuania). According to Reviewer comment we removed the statement wgich was incomprehensible and we have rephrased everything more clearly.

Section 2.2. Soil porosity and aeration porosity methods are not clearly described. Authors mention a couple of equations but the way to obtain the components of the proposed equations are not explained. For example, soil density? Or soil solid phase density??? You should also explain the adding value of analyse aeration porosity besides total porosity (for example, you do not conclude anything about this soil property).

Answer:

Thank you for the correct and more precisely explaining the processes comments. We clarified everything in the article. Soil density was determined by weighing, taking samples with a Nekrasov drill and calculated according to the formula ϑ=m/v i.e. mass to volume ratio. The density of the solid phase was determined with a vacuum air pycnometer, after which the obtained results were inserted into the formulas presented in the article.

Aeration porosity is a very important quantity for the soil, as it determines the amount of air spaces in the soil, and air is needed for plant roots to grow and develop normally.

Line 130: Please, explain why the soil sample depth is carried out at 0-10 cm but the soil temperature and moisture are measured at 0- 5cm?? Also, specify how many temperature and moisture measurements were carried out in each scenario.

Answer:

The tests were carried out in 5 repetitions, and the depth of temperature measurement is indicated as 0-5 cm, as the rounding error is on the smaller side.

Line 144. Measurement of CO2 emissions from soil should be better explained: i.e. There are some missed information related to: the number of rings measured in each treatment, the ring depth into the soil, the time where those measurements has been carried out…..Also, you should specify if soil temperature and moisture are measured at the same time and places than CO2 emissions measurements given the dependence among them.

Answer:

CO2 gas emissions were measured in each repetition 5 times, the ring was placed in the soil at a depth of 20 mm, and all measurements were made in the first half of the day (from 10 a.m. to 2 p.m.). The soil temperature was measured in parallel with the measurement of CO2 gas emissions.

Section 2.4. Please, specify where the meteorological data are coming from. Is there a meteorological station at the experimental location?? Where the long-term average precipitation data are coming from? How many years are included in the long-term average?

Answer:

Acording to Reviewer comment we explained that meteorological data received from the Kaunas Meteorological Station (KMS). The distance between the KMS and the area where the experiments were conducted is approximately 500 m. Meteorologinė stotis teikia daugiamečius duomenų vidurkius, kurie yra apskaičiuoti nuo 1974 m. iki 2017m. KMS provides multi-year data averages that are calculated since 1974 until 2017.

Section 2.5. Statistical analysis should be better described. i.e., authors did not specify if data are normally distributed in order to use ANOVA parametric test. By the way, change ANOVA program by ANOVA test!. The objectives of those ANOVA are also not very clear through the manuscript (results and discussion) because sometimes you compare changes with time but others you compare among treatments within each date. Please, introduce a table foot in each figure explaining this.

Answer:

According to Reviewer comment Statistical Analysis was corrected and fulfilled for more clear understanding and explaining. To assess the reliability of the results obtained, the data were evaluated by analysis of variance. Arithmetic averages, standard deviations, and confidence intervals at 0.95 and 0.99 probability levels were determined. ANOVA expression was corrected by Reviewer notice. It was used Student's t-test to calculate Significant differences between the averages of the variant data were determined by calculating the minimum threshold for the significant difference at LSD.05 and LSD.01 (Raudonius, 2017; Olsson et al., 2007). Statistical analysis of data was performed by using STAT and SIGMA PLOT software. The probability level was indicated as follows: * – differences are significant at the 95% probability level; ** – differences are significant at the 99% probability level.

In addition, they do not specify if parametric or not parametric correlations were used. Authors mention regressions but they do not use them.

Answer:

Thank you for the correct and more precisely explaining the processes comments. We have clarified the inaccuracies related to the translation in the article. According to Reviewer comment this part was corrected. It was used Parametric correlation.

Line 205 “a strong negative correlation between temperature and total porosity…. is obtained while in line 237 (year 2017) the same relationship was strongly positive”: First of all: Are those correlations done across treatments? And, secondly you should explain and discuss these opposed results.

Answer:

Yes, in this way, correlations are made between all soil properties and variants. Since the meteorological conditions were not the same in each of the research years, it is assumed that their influence was the greatest.

Line 260: why the highest increase in aeration porosity is given at CS1 if it is supposed that the increase in aeration porosity is due to both, biopreparations and meteorological conditions?? Please, be more specific on it.

Answer:

After re-vegetation of plants, the SC1 option had the lowest aeration porosity, and after a month it increased 2.6 times, but in other options, where biological agents were used, the soil aeration porosity was found to be higher. It is likely due to meteorological conditions (soil moisture) and plant root system.

Line 275: soil temperature depends on environmental variables but also on land use and management (existence or not of cover crops, for example…). In fact, you explain it later on. Neither Moyano et al. 2013 nor Sierra et al 2015 references support soil temperature dependence.

Answer:

Thank you for the comment. Yes, this was explained at the end when we summarized, in order not to repeatedly overload information and not to duplicate. The data of other authors do not confirm our research, because all the research of ours and other authors were in other spheres of soil composition and climate, so this was added as additional information, as it was obtained in other countries, but perfectly parallel studies were not found, only similar ones, due to the soil and the diversity of the area.

Line 284. Which is exactly the meaning of difference in temperature due to a denser crop????. That is mean that CS1 contains more vegetation covering the soil? This information is not given.

Answer:

In response to the comment, we did not study the vegetation, we only assume and predict that there could have been denser plants, a higher amount of weeds.

Figure 4c: you should remove the LSD results from the figure because of the bars!

Answer:

According to the Reviewer's comment, the picture was properly arranged.

Conclusions should be improved including only information extracted from this work: for example, “soil temperature is affected by crop density and plant height” (besides environmental conditions). However, these

crop characteristics are not given. In relation to reduction of soil CO2 emissions when biopreparations are used, authors do not explain why it happens in three of seven treatments but not in the rest.

Answer:

According to the Reviewer comments the conclusions were supplemented and adjusted based on the Reviewers' recommendations.

Conclusions

In the first and second years of the study, the total porosity of the soil varied between 41% and 62%, while in the third year, the total porosity of the soil increased in all scenarios and over the whole study period ranging from 51% to 74%. This increase was due to the interaction between the long-term use of biopreparations and meteorological conditions.

In the first year, soil temperature in August showed a significant increase compared to the control ($P<0.05$) in scenarios SC6, SC7, SC2, and SC8. Similar trends were confirmed in the second and third years.

The use of biopreparations had an impact on CO2 emissions from soil. In the first year, it was found that, just scenario SC2 reduced CO2 emissions from soil. The cumulative effect of biopreparation application was most pronounced in the third year.

Tillage intensifies CO2 emissions from the soil, these studies confirmed that biopreparations (SC3, SC7, SC8) can significantly reduce the CO2 emission intensity from the soil after tillage, predictable due to the overlap of bio composite components such as Marine algae extracts and bacteria.

Future research on the use of bacteria-based and environmentally friendly bioproducts should focus on increasing CO2 storage in soil, simplifying agricultural operations, reducing inputs, and increasing the efficiency of crop production.