REVIEWER REPORTS

Reviewer Comments:

Reviewer 2

This manuscript addresses an important and timely topic concerning the management of Bactericera cockerelli, the vector of Candidatus Liberibacter solanacearum, a serious pest associated with zebra chip disease in potatoes. Given the growing threat of this pest in Andean and other potato-producing regions, the study is of significant regional and global relevance. The field-based evaluation of both biological and chemical control agents provides valuable data that may inform integrated pest management (IPM) strategies.

The manuscript is generally well-written, logically structured, and the findings are clearly presented. However, there are some methodological issues that need to be addressed to strengthen the manuscript before acceptance.

Dear Reviewer, thank you very much for your comments and feedback on improving the manuscript. Each suggestion will be addressed below. All changes in the manuscript are highlighted in red.

Study Area and Meteorological Conditions (2.1)

Comments 1: Only a brief qualitative description ("heterogeneous, alluvial and colluvial") is given. Missing are pH, organic matter content, texture, and nutrient status — all of which can influence both fungal agent viability and potato yield.

Response 1: Thank you very much for the comments. We agree with the suggestion. The results of the soil analysis have been incorporated into Section 2.1, Study Area and Meteorological Conditions (lines 129–136).

Comments 2: Average humidity and temperature are given for the study period, but not by month or corresponding to application timing. Since entomopathogenic fungi are highly sensitive to temperature and humidity, detailed temporal data (weekly or per growth stage) are necessary.

Response 2: Thank you for your comment. The authors agree with your point of view. For this reason, the timing of the treatment applications has been added to Figure 2 (lines 148, 151).

Comments 3: It is unclear whether the field was irrigated or rainfed, and how weeds or other pests were managed. These factors can strongly affect biological control outcomes.

Response 3: Thank you for pointing this out. We agree with this comment. The crop was managed under irrigation, and weed control was carried out manually; this text was added to the manuscript (lines 119–121).

Comments 4: The landscape context (surrounding crops or vegetation) is not described, though it can influence psyllid migration and infection pressure.

Response 4: Thank you for pointing this out. The landscape context description was added to the manuscript text (lines 116–119).

Target Crop (2.3)

Comments 5: Missing description of field preparation, fertilization regime, or soil amendments, which influence plant vigor and pest tolerance.

Response 5: Thank you for the comment. The agronomic management information were added to item 2.3 “Target crop” in the manuscript (lines 183–187).

Application Methodology of Treatments (2.5)

Comments 6: No record of spray volume per hectare: Essential for reproducibility and comparison with standard agricultural practices.

Response 6: Thank you for pointing this out. For the reproducibility of the experiment, we used the recommended doses of the control agents according to the information provided in their technical data sheets, which are described in the Materials and Methods section (lines 207–248).

Comments 7: No verification of conidial viability: Although conidial viability was “preserved,” no laboratory germination test or viability count before application is reported.

Response 7: Thank you for this comment. In the present study, conidial viability was not evaluated. This information will be included as one of the limitations of the study (lines 634–635).

Entomological Variables and Visual Inspection (2.6)

Comments 8: It’s unclear how many leaves per plant were inspected or how the sampling positions were selected (random vs. fixed).

Response 8: Thank you for pointing this out. Ten plants were selected and evaluated at all evaluation times. The entomological variables were assessed on all the leaves across the four quadrants of the plant (lines 255–257). This information was included in the revised manuscript.

Comments 9: No mention of the total number of observation dates: The temporal dimension (how many weeks or sampling events) is not specified.

Response 9:

Thank you for pointing this out. We agree with this comment. We have added the requested information, the total number of observation dates (lines 254–255).

Comments 10: No description of how sticky trap data were analyzed: Frequency, density (adults per trap per day), or correction for environmental bias is missing.

Response 10: Thank you for pointing this out. The data were collected and directly used for the analysis of the adult population in the agroecosystem following the methodology described in the manuscript (lines 289–299). The results were discussed in lines 407–410.

Statistical Analysis (2.9)

Comments 11: Model structure incomplete: The random effects (block, replicate, sampling date) are not specified explicitly.

Response 11: We agree with this comment. Therefore, we have clarified in the revised manuscript that a linear mixed-effects model was used to analyze the data, explicitly specifying the random effects structure as follows:

lmer(nda ~ 0 + (1 | block) + (1 | repeticion) + Tipo.de.control * id_variable)

In this model, nda represents the response variable (number of psyllids), Tipo.de.control (Control type) and id_variable (sampling date) are fixed effects. At the same time, block and repeticion (replicate) are treated as random effects to account for the hierarchical structure and repeated measures of the experiment. The model can be expressed as:

$$Y_{ijkl} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + b_k + r_l + \varepsilon_{ijkl}$$

Where:

Y_{ijkl} : observed value of psyllid count

μ : overall mean

α_i : fixed effect of control type

β_j : fixed effect of sampling date

$(\alpha\beta)_{ij}$: = interaction between control type and sampling date

$b_k \sim N(0, \sigma_b^2)$: random effect of block

$r_l \sim N(0, \sigma_r^2)$: random effect of repetition

$\varepsilon_{ijkl} \sim N(0, \sigma^2)$: residual error

This specification has been incorporated into the revised manuscript in the statistical analysis section (lines 346–363).

Comments 12: No mention of residual diagnostics: Assumptions for GLM/LMM models (residual distribution, dispersion, homoscedasticity) are not reported.

Response 12:

Thank you for pointing this out. Therefore, we have replaced the previously used Generalized Linear Model (GLM) with a Linear Mixed-Effects Model (LMM). This change was made to better account for the hierarchical structure of the data and the presence of random factors (block and repetition), which influence the variability within the experiment.

A linear mixed-effects model was fitted to assess treatment effects, providing robustness against potential violations of normality and homoscedasticity assumptions (Schielzeth et al. 2020). This modification has been incorporated into the revised manuscript in the statistical analysis section (lines 338–344).

References:

Schielzeth H, Dingemanse NJ, Nakagawa S, Westneat DF, Allegue H, Teplitsky C, Réale D, Dochtermann NA, Garamszegi LZ, Araya-Ajoy YG, 2020. Robustness of linear mixed-effects models to violations of distributional assumptions. Methods in Ecology and Evolution 11, 1141–1152.

Comments 13: Unclear how repeated measures over time were handled: If weekly data were collected, time should be treated as a repeated factor or covariate.

Response 13: Thank you for the observation. In our study, weekly data represented successive observations within the same experimental framework rather than repeated measurements on individual biological units. Therefore, it was not necessary to specify an explicit repeated-measures structure.

The adopted linear mixed-effects model already accounts for data hierarchy through the inclusion of random effects for block and repetition, which represent the main structural sources of variation within the experiment. Additionally, time (id_variable) was treated as a fixed factor interacting with the control type, allowing a direct evaluation of how psyllid counts varied among treatments across the observation periods.

As discussed by Tanaka and Hui (2019), the model structure should reflect the actual experimental design and sources of variation while avoiding unnecessary overparameterization. In this context, the inclusion of random effects for block and repetition adequately captures the intra-experimental variability, and modeling time as a fixed factor provides a clear representation of treatment dynamics across evaluation periods.

This specification has been incorporated into the revised manuscript in the statistical analysis section (lines 364–369).

References:

Tanaka, E., & Hui, F. K. C. (2019). Symbolic formulae for linear mixed models. In Communications in computer and information science (pp. 3–21). https://doi.org/10.1007/978-981-15-1960-4_1

Yang, R.-. (2010). Towards understanding and use of mixed-model analysis of agricultural experiments. Canadian Journal of Plant Science, 90(5), 605–627. https://doi.org/10.4141/cjps10049