As of now, we modified the original data frame so to isolate the variables of interests:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Treatment | Treatment ID | Plant # (1-4) | Date | Aphids inoculated | Aphid live | Aphid parasitized | Syrphid fraction | Final biomass | Distance from buffer |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

Only a few studies measured the degree to which different enemy guilds affect pest populations across a gradient in landscape complexity. In this study, the field locations covered a gradient in landscape complexity from 6.3% to 43.3% semi-natural habitat in a 700 m radius around the fields. Our major objectives are to assess:

1. The effect of natural enemies on aphid population growth across a gradient of landscape complexity.
2. The individual and interacting effects of different natural enemy guilds on aphid population growth
3. The possible interaction effect between natural enemy guilds and landscape complexity.

3. **Define the main hypotheses**.

1. We will study whether the presence of natural enemies decrease aphid population growth, comparing plots with NE present to plots where NE is absent. In this case, the null hypothesis is that there is no significant difference in pop growth between plots when NE is present and NE is absent.
2. Even though intraguild predation has been reported in other studies, we will study whether the combination of natural enemies have a complementary effect and not an antagonistic effect on aphid population growth. This means that we will study whether the reduction of aphid growth is greater when several guilds of natural enemies are present, comparing plots when a few NE are present and plots where multiple NE are present.
3. We will study whether the effect of natural enemies is stronger in complex landscapes, comparing plots with complex landscapes to plots with simplified ones.
4. We will study whether there is an interaction effect between the type of NE and landscape complexity. According to the null hypothesis, the interaction may not be significant. If it is rejected, it would probably mean that we will see some guilds perform better in some landscape than others.
5. We will see whether the rate of parasitism and syrphid fraction increase with landscape complexity or not. Complex landscapes usually have more semi-natural, interconnected habitats that can be used by natural predators of aphids for overwinter and nesting. Also, food resources tend to be more abundant in complex landscapes.
6. We will study whether aphid growth population decreases cabbage biomass (null hypothesis: no significant differences)

4. Analyses needed or intended.

We know that:

1. **Dependent variables**: aphid population growth, final cabbage biomass, parasitism rate, syrphid fraction. The only real final dependent variable is final cabbage biomass.
2. **Independent variables**: landscape complexity, exclusion treatments (a combination of one or more natural enemies)

Interactions between variables

* Natural enemies 🡪 aphid population growth
* Aphid population growth 🡪 final cabbage biomass
* Natural enemies 🡪 parasitism rate
* Natural enemies 🡪 syrphid fraction
* Parasitism rate 🡪 aphid population growth
* Syrphid fraction 🡪 aphid population growth
* Relation between natural enemies and landscape complexity

(?) aphid pop growth? How to calculate it?

Steps:

1. Once checking for all the possible relationships between variables, the first step would be to look for the best statistical method to use to see if they are significant. Linear models + anova
2. Check for possible interactions between variables.

**Note** that since colonization of aphids from the surrounding area occurred, aphid density was not considered as relevant as aphid population growth which takes into account the variable number of aphids initially present in each plot.

We intend to carry out anova analyses to estimate the statistical significance of differences between treatments.

In this study, different distribution models were tested in order to best represent the interactions between the variables. We intend to follow the same strategy as most of these models were used on R. In fact:

1. Aphid population growth was modelled using a linear mixed model in the package nlme.
2. Parasitism rates and syrphid fractions were modelled using a binomial response with logit link in package lme4.
3. Crop biomass (n = 432 plants) was modelled using a Gamma error with log link in package lme4.

In this study, a second set of models was built to account for the density-dependent effects on pest control (e.g. how does the initial population of aphids affect aphid population growth and pest control). Thus, they included other variables like the sampling date and treatment. As of now, we are still unsure whether to do the same or not.

Chi-square tests were used to assess the relationship between aphid population growth and syrphid fraction/parasitism rate and the relationship between syrphid fraction and final cabbage biomass. Correlation tests could maybe be used instead. However, it is reasonable to believe that chi-square tests best represent their data.

**Remark**: Given that there are many other independent variables such as the crop type of surrounding fields (Brassicaceae vs. non-Brassicaceae), the maturity of the crop and the management intensity of surrounding fields (organic vs. conventional), we are still unsure whether to evaluate the effects of these variables or not. We will consider it after having conducted others analysis.

Steps :

1. Once checking for all the possible relationships between variables, the first step would be to look for the best statistical method to use to see if they are significant. Linear models + anova
2. Check for possible interactions between variables.