

IMPLEMENTATION OF INNER-ROWS FLOWER STRIPS IN APPLE ORCHARDS TO PROMOTE THE BIODIVERSITY OF BENEFICIAL ARTHROPODS AND ENHANCE APHID'S BIOLOGICAL CONTROL



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INTRODUCTION

The change in the agricultural policy over the last decades is a major factor in the biodiversity loss globally observed. Orchards are perennial and monospecific agroecosystem, resulting in a low diversity with few interactions. This creates favorable conditions for different pests, such as the green apple aphids (*Aphis pomi* De Geer and *A. spiraecola* Patch). In Québec, aphids are considered a secondary pest but due to the rapid increase of populations, a colony can cause important damage. As an alternative to chemical insecticides, and to increase biodiversity, inner-rows flower strips were implemented in 2020 in an experimental apple orchard. Our objective was to investigate the impact of these flower strips on aphid colony dynamics and their predators.

MATERIALS AND METHOD

The size of 10 colonies and the number of predators in each of the four experimental units were weekly observed throughout the apple growing season. Observations were done from the end of May to the end of August 2021, and from the beginning of June to the middle of August 2022. The size of the colonies was scored into 6 classes (0: 0, 1: 1 to 5, 2: 6 to 25, 3: 26 to 50, 4: 51 to 125, 5: more than 125 aphids) (Dib et al., 2010). The first colonies observed, as were the replacement of collapsed colonies, were middle-sized class 1 or 2. The colonies were compared between the two treatments, flower strips and control, using a generalized additive model (GAM). A Generalized mixed model (GLMM) was used to compare each predator's abundance between treatments.

RESULTS

1.1 Colony Dynamics

2021 The mean of the colony class was slightly higher in the flower strip treatment than in the control one ($p < 0.01$). Colonies of both treatments had similar dynamics.

2022 Different dynamics were observed in each treatment ($p < 0.01$). The growing phase of aphid colonies in the flower strip treatment was faster than in the control ones, reaching an earlier peak and an earlier and slow decreasing phase. The difference between the two treatments reversed in the middle and at the end of the season.

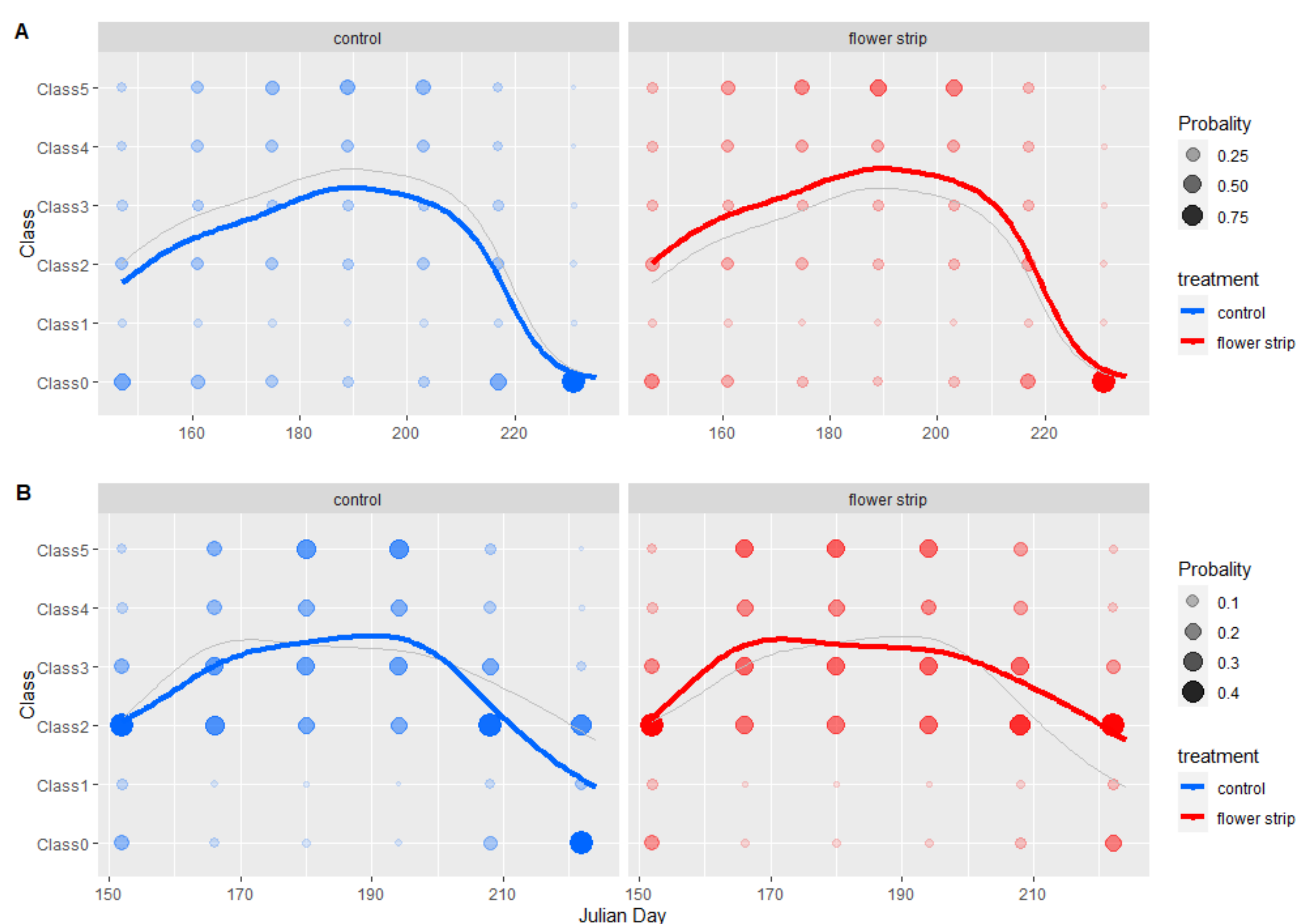


Figure 1: Class of aphids' colony through time in 2021 (A) and 2022 (B). Blue line represents the control treatment and red line represents the flower strips treatment. The circle represents the probability and size of each class colony. The dash line represents the compared treatment during the same year.

1.2 Predator

No significant difference in the number of predators was observed in 2021 (Figure 2).

In 2022 (Figure 3), the number of predators in the flower strips was higher than in the control treatment ($p < 0.05$). Moreover, a higher abundance of Cecidomyiidae was observed in the flower strip treatment ($p < 0.05$). In 2021, the community of predators was mainly composed of Coccinellidae and Cecidomyiidae, but Coccinellidae was rarely observed in 2022.

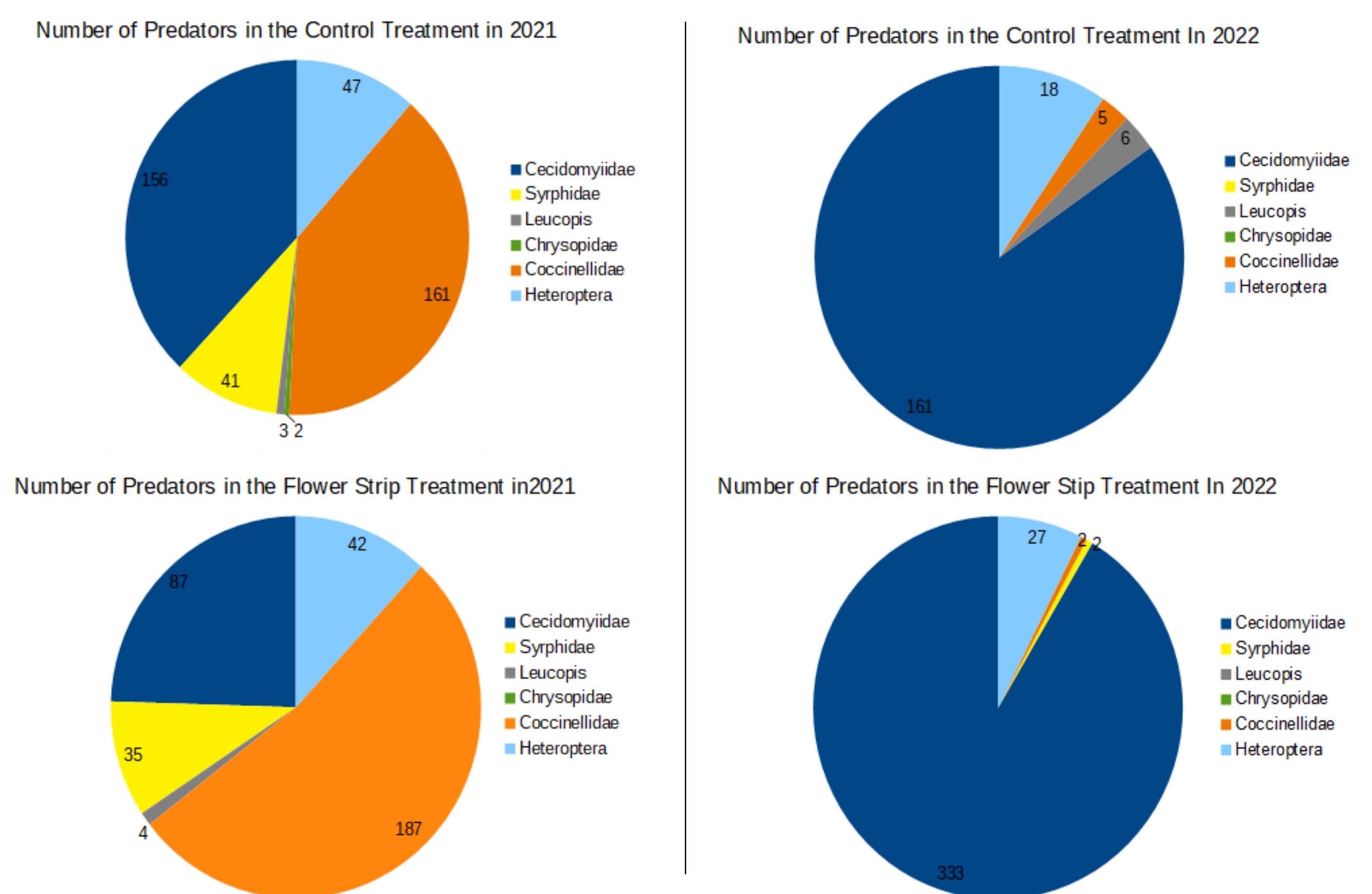


Figure 2: Representation of the number of predators in each treatment in 2021.

Figure 3: Representation of the number of predators in each treatment in 2022.

DISCUSSION

- The community of predators in our orchard was mainly composed of Cecidomyiidae and Coccinellidae, but in 2022 the Coccinellidae presence was rare. Fréchette et al. (2008) observed in the same orchard a similar predatory arthropods community. Coccinellidae doesn't seem to be influenced by flowering ground and their mobility allows them to attack colonies without being detected (Fréchette et al., 2008).
- In the flower strip treatment, the earlier decrease observed in aphid colonies could be related to the abundance of Cecidomyiidae, known to colonize well-established colonies (Boulanger et al., 2018).
- Most of the predators observed have a great flight capacity and may have moved between our treatments, which could explain the absence of difference between the treatments.
- Furthermore, it takes several years to have an effective biocontrol community (Bostanian et al., 2004, Cahenzli et al., 2019). However, the difference observed between colonies dynamics and in the predatory community, especially with the Cecidomyiidae, after only two years is promising for a long-term implementation.

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REFERENCES

- Bostanian, N.J., Goulet, H., O'Hara, J., Masner, L., Racette, G., 2004. Towards insecticide free apple orchards: flowering plants to attract beneficial arthropods. *Biocontrol Sci. Technol.* 14, 25–37.
- Boulanger, F.-X., Jandric, S., Bolckmans, K., Wäckers, F.L., Pekas, A., 2019. Optimizing aphid biocontrol with the predator *Aphidoletes aphidimyza*, based on biology and ecology. *Pest Mgt Sc.* 75, 1479–1493.
- Cahenzli, F., Sigsgaard, L., Daniel, C., Herz, A., Jamar, L., Kelderer, M., Jacobsen, S.K., Kruczyńska, D., Matray, S., Porcel, M., Sekrecka, M., Świergiel, W., Tasin, M., Telfer, J., Pliffner, L., 2019. Perennial flower strips for pest control in organic apple orchards - A pan-European study. *Agric., Ecosys. Environ.* 278, 43–53.
- Dib, H., 2010. Effect of codling moth exclusion nets on the rosy apple aphid, *Dysaphis plantaginea*, and its control by natural enemies. *Crop Protection* 12.
- Fréchette, B., Cormier, D., Chouinard, G., Vanoosthuysse, F., Lucas, E., 2008. Apple aphid, *Aphis* spp. (Hemiptera: Aphididae), and predator populations in an apple orchard at the non-bearing stage: The impact of ground cover and cultivar. *Eur. J. Entomol.* 105, 521–529.