



# Impact of plastic mulches on the biological control of thrips

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## Abstract

Integrated pest management techniques offer solutions to controlling damaging pests in agricultural systems. Using a pest's natural enemies to reduce their numbers, known as biological control, is one of these solutions. *Thysanoptera* are common pests of many fruit and vegetable crops that spread disease and decrease agricultural yields, while *Orius* are natural predators of *Thysanoptera*. Both insect groups have biological attractions to specific wavelengths of light, which can be used to attract them or repel them from crops. Plastic mulches can be highly reflective of light depending on the mulch color, suggesting they can be used to control these wavelengths in the canopy of raspberry crops. With black, white, and metallic mulch treatments compared to a control plot with no mulch, each treatment created different radiance levels in the raspberry canopy. *Thysanoptera* populations were decreased by the metallic and black mulches, while the white mulch had equivalent numbers to the control without a mulch. However, in contrast to initial expectations, this does not seem to be driven by changes in radiance in the canopy. *Orius* populations were not impacted by any of the plastic mulches. Further research on the factors that impact *Thysanoptera* and *Orius* populations is needed.

## Introduction

- ✦ The increase in concerns surrounding pesticide use on fruits pushes for further development of sustainable integrated pest management strategies.
- ✦ Thrips, Order *Thysanoptera*, are one of the leading pests in modern agriculture – and directly lead to extreme annual crop and economic losses.
- ✦ Minute pirate bugs, Genus *Orius*, are natural predators of thrips.
- ✦ Insects exhibit phototactic behaviors in response to different, specific colors of light and, especially, UV wavelengths.
- ✦ Plastic mulches are utilized to increase crop productivity but can also decrease pests such as spotted-wing drosophila (McIntosh et al., 2022).
- ✦ Raspberry systems are susceptible to pest infestation and typically rely on pesticides.

Metallic and white mulches are expected to have the highest radiance levels in the raspberry canopy, which is believed to increase the population count of both *Orius* and *Thysanoptera*. Although both insect groups might display attraction to the increased UV light, the presence of increased *Orius* will act as a natural biological control over and decrease *Thysanoptera* count.

## Methods

- As a part of a larger study on the impacts of plastic mulches on *Drosophila suzukii*, fall-bearing raspberry plants were planted in May of 2019 at the West Madison Agricultural Research Station (McIntosh et al., 2022).
- ✦ Four rows of raspberry plants were each divided into 5 blocks which were randomized to receive one of three plastic mulches or a control with no mulch.
  - ✦ Radiance in the raspberry canopy was measured using a spectrometer.
  - ✦ Insects were caught in each raspberry plots using sticky cards.
    - ✦ Insects caught were identified and counted by hand.
  - ✦ Analysis of Variance (ANOVA) was conducted and, when treatment was significant, was followed by a Tukey HSD test to make pairwise comparisons between treatments.

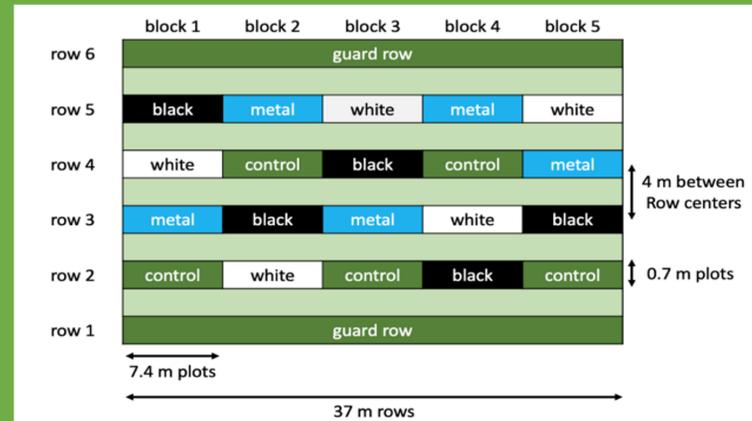


Figure 1. Randomized experimental design and dimensions of raspberry plots with one of three plastic mulches or a control (McIntosh et al., 2021).

## Results

### Radiance (Figure 3)

- ✦ Metallic mulch produced the highest mean radiance in the UV spectrum.
- ✦ Metallic and white mulches had the highest mean radiance in the visible light spectrum.

### Insect Counts (Figure 2)

- ✦ *Thysanoptera* counts were significantly different across the three treatment groups and one control group (ANOVA,  $F = 12.58$ ,  $p < 0.0001$ ).
- ✦ *Thysanoptera* mean count was lowest in the black and metallic mulch treatments, with averages of 61.44 and 37.75, respectively.
- ✦ *Orius* counts were not significantly different across the three treatment groups and one control group (ANOVA,  $F = 1.3$ ,  $p = 0.276$ ).

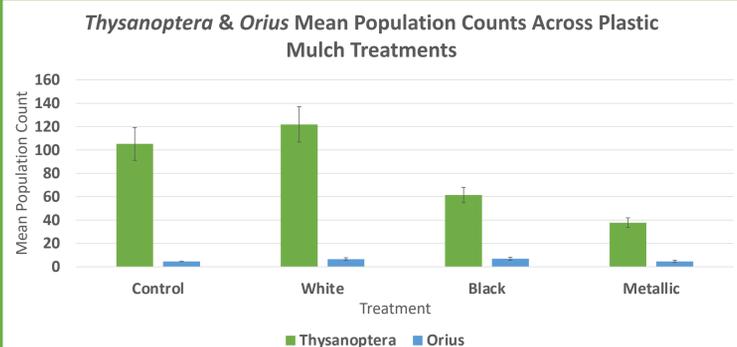


Figure 2. Average population counts of *Orius* and *Thysanoptera*, including error bars indicating standard error within each average. Averages are taken from all sticky cards during the growing season. SE *Thysanoptera*: control=14.03, white=15.09, black= 6.54, metallic=4.16. SE *Orius*: control=0.87, white=1.72, black=1.28, metallic=0.95.

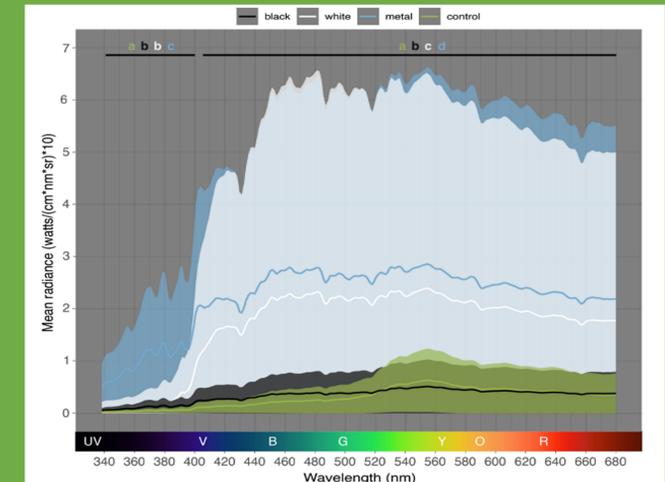


Figure 3. Mean radiance (+/- SD) in the raspberry plant canopy. Black lines correspond to black mulch, white lines to white mulch, blue lines to metallic mulch, and green lines to the control (McIntosh et al., 2021).

## Discussion

- ✦ The results of this experiment do not suggest that *Orius* populations show an increased biological control over *Thysanoptera* in high radiance mulch treatments.
- ✦ The decrease of *Thysanoptera* in the black and metallic mulches was an unexpected result, as the black mulch treatment had some of the lowest overall radiance, while the metallic had the highest overall radiance.
  - ✦ Plastic mulches influence other microclimate aspects like humidity or heat, which could have led to this decrease in counted *Thysanoptera*.
- ✦ The minimal differences of *Orius* counts between each treatment suggest there was no attraction or deterrence to specific radiance levels within the raspberry crops.
- ✦ The results of this study suggest that a factor other than radiance leads to a deterrence of *Thysanoptera*, as a decrease was noted in both high and low radiance environments.
  - ✦ Further research is required to determine which factors play a role in reducing *Thysanoptera* while increasing *Orius* populations - specifically in raspberry systems.

## Acknowledgements

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## References

McIntosh, H., Atucha, A., Townsend, P., Hills, W., & Guedot, C. (2022). Plastic mulches reduce adult and larval populations of *Drosophila suzukii* in fall-bearing raspberry. *Journal of Pest Science*, 95. <https://doi.org/10.1007/s10340-021-01456-2>