Survey for Entomopathogenic Predator Populations of Plum Curculio in Apple Orchards of Western Massachusetts

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Abstract

Entomopathogenic nematodes (EPN) are effective biological control agents for the soil-swelling stages of some pests. I monitored the presence of native EPN species in two apple orchards by sampling the soil underneath grafted trees which are known to congregate plum curculio (PC), an important apple pest, within those tree canopies. Soil from unmanaged trees were also surveyed. While there was no significant difference between the larval mortality associated with soil from grafted versus non-grafted trees, there was a significant difference in wax moth larvae mortality levels from 'managed' and 'unmanaged' soils. Our findings will inform growers on the presence of natural PC enemies relative to the management practices and cultural controls implemented in their orchards.

Introduction

Current Integrated Pest Management strategies that deal with key apple pests such as plum curculio (PC), *Conotrachelus nenuphar*, call for perimeter trees to be equipped with attractive lures and spray insecticides only to those trap trees [1]. Recently, six highly attractive apple varieties were grafted to existing trap trees, to concentrate PC populations on those tree canopies. This 'Attract-and-Kill' model can incorporate commercially available entomopathogenic nematodes (EPN) as biological controls of PC larvae in the soil [2].

Here, I sought out to determine if trap trees that were grafted with six apple cultivars in 2018 would also harbor EPNs in the soil. I hypothesized that underneath the canopy of designated grafted trap trees there would be higher populations of EPNs compared to other trees. Soil samples were also collected from unmanaged trees to determine if different management practices could impact these predators' population levels.

Materials and Methods

The assessment for native EPNs took place at two fruit farms in Western Massachusetts: (1) UMass Amherst Cold Spring Orchard (CSO) located in Belchertown, MA, and (2) Plum Brook farm located in Amherst, MA. The UMass CSO is a research orchard under standard management. Research was conducted in two different blocks (X block and Empire block) both of which have multi-cultivar grafted trees. Plum Brook is an organic farm that has some unmanaged trees. For each block, 5 sites were randomly selected, the top level of organic matter removed and mixed to create a soil sample. In the laboratory, the samples were evenly split into two sanitized containers and labeled accordingly. Then, 1.9 mL of distilled water with 100 infective juveniles of *S. riobrave*/cm^2 and a water control were applied to four soil samples having 20 wax moth larvae (80 in all per treatment. Mortality was documented at 24-, 48-, and 72-hours post-application.

Results

All samples from grafted and non-grafted sites treated with water showed significantly lower rates of larval mortality over the measured time when compared to the samples treated with *S. riobrave* (Fig. 1).

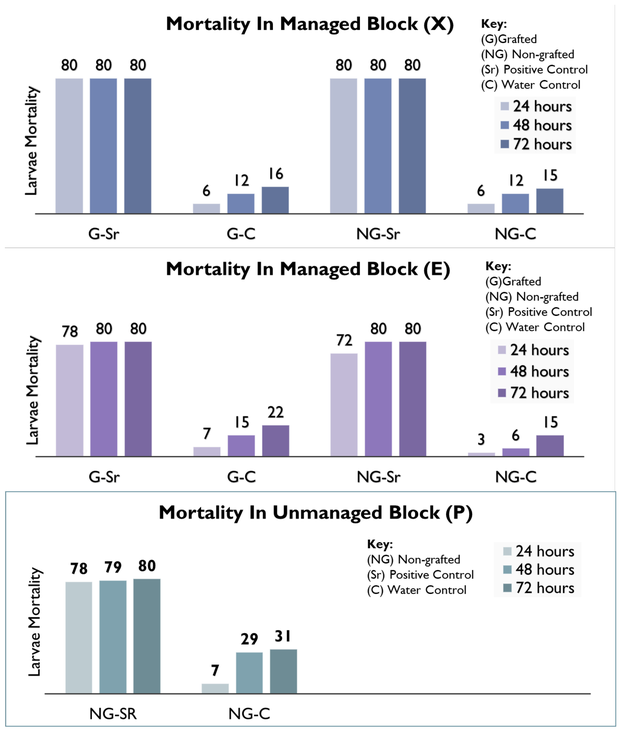

Figure 1. Total mortality in three apple blocks. Eighty larvae were exposed t S. riobrave or to water (control) and mortality was recorded at 24, 48, and 72 hour intervals.

The mortality rates of wax moth larvae associated with non-grafted samples from managed trees were significantly greater in the unmanaged orchard (Plum Brook, = P-block) at 48 hours (ANOVA; F_9=9.537, $p < 0.05$) as well as at 72 hours (ANOVA; F_9= 6.619, $p < 0.05$) after larval exposure to the soil when compared to larval mortality recorded in the two managed blocks (X and E).

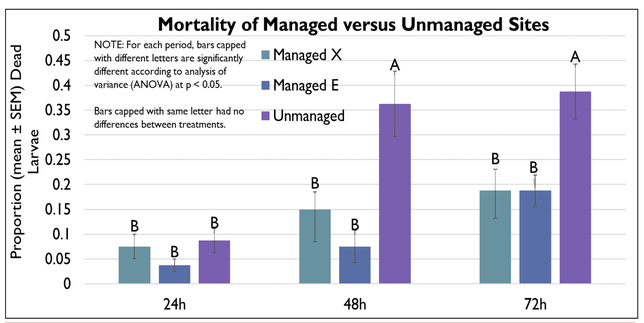

Figure 2. Comparison of larval mortality between managed blocks (X and E) and one unmanaged site in Massachusetts at 24, 48, and 72 hours post-treatment. Different letters represent grouped data with statistically significant differences between groups.

Conclusions

My results indicate that, two years after the initial fruiting year, grafted trap trees do not show heightened mortality of wax moth larvae, which was used a s surrogate for PC, when compared to non-grafted trees. Significantly greater levels of wax moth larval mortality were recorded in soil from unmanaged trees compared to managed orchards.

Further research is needed to better understand how farm practices may affect EPN populations as there was a significant difference between the samples from an organic orchard when compared to a conventional orchard.

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References

[1] Piñero, J.C., Shapiro-Ilan, D., et al. 2020. Toward the integration of an attract-and-kill approach with entomopathogenic nematodes to control multiple life stages of plum curculio (Coleoptera: Curculionidae) Insects 11(6), 375; https://doi.org/10.3390/insects11060375

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