Feeding Preferences of Rosy Apple Aphids for Six Apple Cultivars

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Rosy apple aphid (RAA), *Dysaphis plantaginea*, is one of the most widespread insect pests that cause fruit deformation, leaf curling, and significant crop yield losses when left uncontrolled. Prolonged leaf curling may lead to leaf abscission, fruit deformation, and stunting in young trees. Furthermore, RAA reaches adulthood in 7-8 days and each female can produce up to 80 offspring in one week. Thus, managing RAA populations during the early stages of fruit growth is important to prevent outbreaks. It is known that RAA prefers some apple cultivars over others. Examples of attractive cultivars include Cortland and Gala. Some studies published by researchers from other states (e.g., West Virginia) have reported that Ginger Gold is attractive to RAA.

In 2018, a long-term IPM project aimed at developing a permanent trap cropping system that is lure-free, inexpensive, grower-friendly, and works for the growers for the entire season was developed. The approach consisted of grafting six pest-attractive apple cultivars onto a handful of apple trees on the orchard perimeter and using them as perennial trap trees. The six cultivars that were chosen are Liberty, Ginger Gold, Red Astrachan, Wickson, Yellow Transparent, and Dabinett. By 2023, more than 150 trees have been grafted in 19 orchards in Massachusetts, New Hampshire, and Maine. Originally the two target insect pests targeted in that project were plum curculio and apple maggot fly, and research data have been collected for a 3-year period.

The main objective of the present study was to assess the feeding preferences of RAA for the six cultivars that are represented in the multi-cultivar grafted trees. We also determined the occurrence of natural enemies attacking RAA in the grafted branches.

Materials and Methods

Study Site. We quantified RAA populations at three different apple tree blocks located at the University of Massachusetts Amherst CSO in Belchertown throughout the month of June 2023. The experimental trees were grafted with six apple cultivars (Liberty, Red Astrachan, Ginger Gold, Dabinett, Wickson, and Yellow Transparent) (Figure 1) in 2018 and 2019.

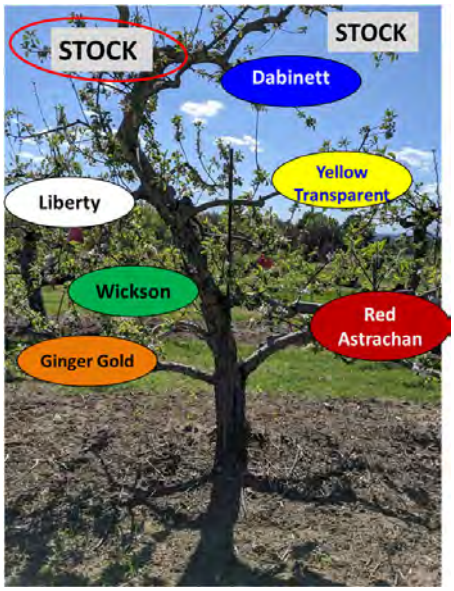

Figure 1. Representative example of an apple tree grafted with 6 cultivars. Rootstock represents the original branches.

Leaf cluster inspection. RAA sampling was conducted twice, on June 5-6 and June 21-23, 2023. Data from the second sampling coincided when most of the RAA had begun to migrate to their secondary hosts. Within each block, four grafted, four non-grafted, and four trees in a different block located about 100 meters away from the grafted block were sampled. Ten fruit clusters with foliage were inspected on each of the 6 grafted branches and 1 stock branch. For the non-grafted and control trees, 20 clusters were randomly sampled. All samples were chosen at random by walking around the entire

perimeter of the tree and selecting leaves and shoots generally at stomach and chest height.

Aphid counting. For each block, the number of fruit clusters with RAA incidence were recorded in a sample of 10 fruit clusters per tree. Leaf samples (one cluster from each cultivar and two clusters from each non-grafted and control tree) were collected and wrapped in a damp paper towel to retain moisture. Afterwards, the samples were taken back to the laboratory at UMass Amherst. Each of the infested clusters was inspected under a light microscope to quantify the severity of the infestation, evaluated as the number of mobile RAAs present per apple cultivar. Since each fruit cluster contained an upwards of five leaves, only the ones with the highest counts of aphids (maximum two per cultivar, per sample) were analyzed under the microscope. Samples that were not observed analyzed the day of were kept inside an ice pack-filled cooler to avoid decomposition until the samples could be analyzed (which occurred within four days of the initial collection date).

Natural enemy estimates. In addition to aphid counting, natural enemies (parasitic and predatory insects and spiders) were recorded and identified at the order level to determine differences in biological control potential across treatments. Whenever possible, we also took pictures of the encountered insects to identify later. Parasitized aphid mummies were counted per leaf under the light microscope on all the grafted cultivars, non-grafted, and control trees to estimate parasitism rates.

Results

Incidence of RAA injury. For week one, results from the Rock Mountain block (Figure 2A) show the highest RAA infestation in Ginger Gold. Across blocks, the least-infested cultivars were Liberty and Dabinett (Figure 2A-C). In the case of Yellow Transparent, there were either no grafted branches present on the trees or no RAA infestations in the branches sampled for two blocks. For the Empire block, data were highly variable and no differences in RAA infestation were noted (Figure 2B). Tree branches grafted with Wickson and Liberty had zero RAA infestation; thus, they are not represented on the graph. For X block (Figure 2C), RAA infestations were too low for any interpretation of results. Results for the second sampling (on June 23) followed similar patterns but RAA numbers were too low given that they were migrating to perennial weeds. Therefore, those results are not presented.

RAA abundance. Statistical analyses for abundance were only conducted for the Rock Mountain block during week one due to insufficient sample sizes in the Empire and X blocks. In Rock Mountain, Red Astrachan, ginger Gold, Dabinett, and Wickson had the highest number of RAA in a 2-leaf sample (Figure 3). Liberty had the lowest counts of RAA. By the second week of data collection, RAA had migrated from the apple trees onto their pe-

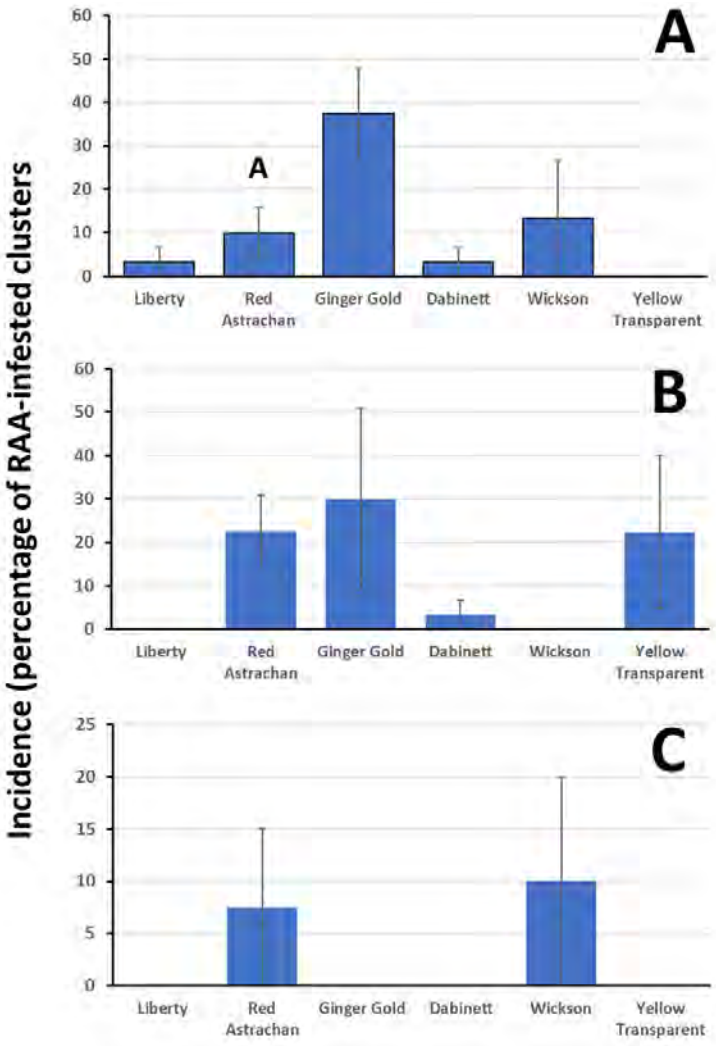

Figure 2. Rosy apple aphid incidence at the UMass Amherst Cold Spring Orchard on June 8th, 2023. (A) Rock Mountain, (B) Empire block, (C) X block

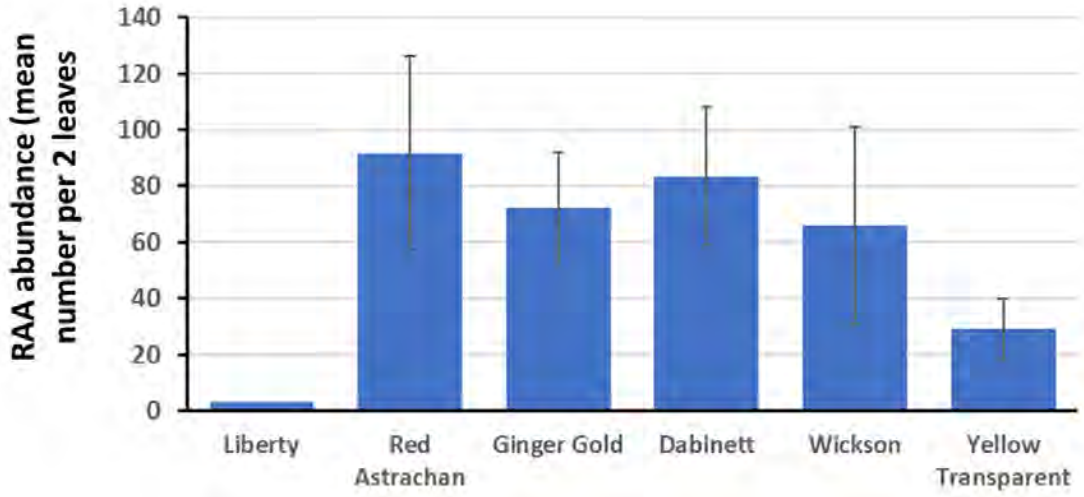

Figure 3. Rosy apple aphid abundance in the June 8th sampling at the UMass Cold Spring Orchard Rock Mountain block.

rennial hosts and numbers were too low to show any meaningful results.

Parasitism of RAA. Parasitism was averaged across all three blocks at CSO for week one only. Numerically higher rates of parasitism were recorded in Red Astrachan and Ginger Gold, with similar results found in Yellow Transparent (Figure 4). The lowest parasitism levels were recorded in Dabinett and Wickson. Liberty was excluded due to only one sample being recorded.

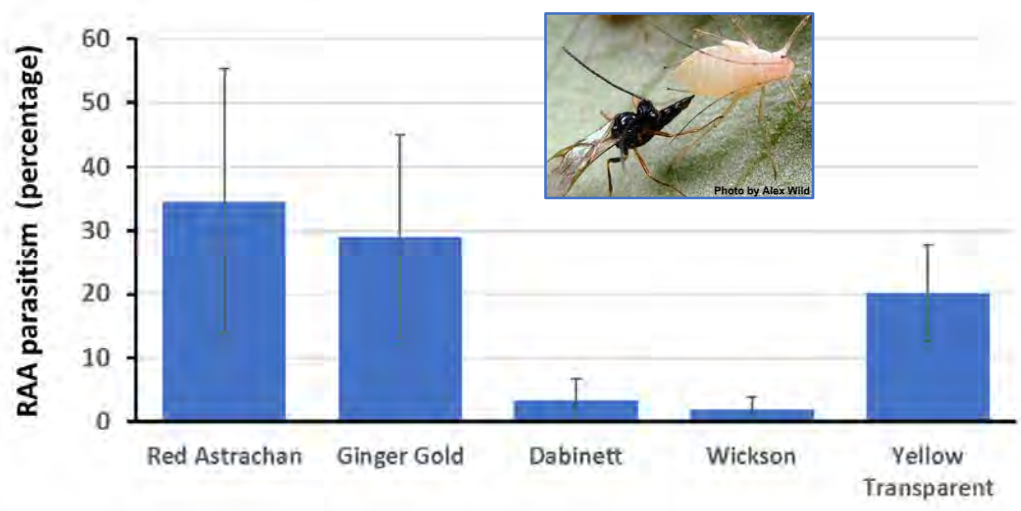

Figure 4. Parasitism of Rosy Apple Aphids recorded on June 8th, 2023, across the three experimental blocks at the UMass Amherst Cold Spring Orchard.

Presence of beneficial arthropods. As shown in Figure 5, the most abundant beneficial insects and arachnids found on the leaves on the June 8th collection date were aphid predatory midges (15 total), followed by spiders (8 total counts including egg masses). These counts were totaled from all sampled trees, across all three blocks (Rock Mountain, Empire, and X).

Conclusion

The combined results from this study suggest that Ginger Gold and Red Astrachan seem to be more attractive to RAA than other cultivars (e.g., Liberty, Dabinett). The highest levels of RAA parasitism were recorded in Ginger Gold and Red Astrachan, followed by Yellow Transparent. The most abundant predatory arthropods were midge larvae, spiders, and earwigs, highlighting the potential impact of biological control agents attacking RAA. Because this study was initiated relatively late in the apple growing season,

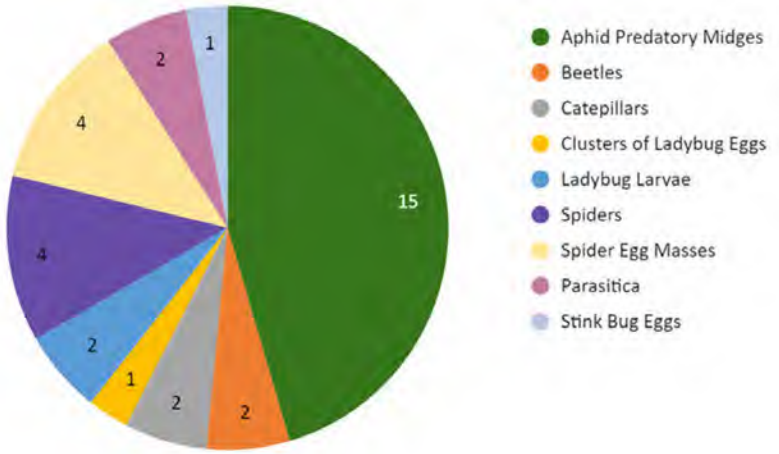

Figure 5. Beneficial arthropod counts across three apple tree blocks at the UMass Amherst Cold Spring Orchard in the June 8th sampling.

Predatory midge larvae were the most abundant beneficial insect present.

in 2024, the team plans to follow-up on this study including multiple orchards across Massachusetts.

Acknowledgements

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