Assessing the incidence and abundance of Rosy apple aphid infestation at the UMass Cold Spring Orchard in 2021

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Rosy apple aphid (*Dysaphis piantaginea*; RAA) is the most destructive aphid pest of apple in many regions of North America. This aphid feeds mainly on apple foliage, notably fruiting spurs, causing leaf chlorosis and severe leaf curling (Figure 1). RAA feeding indirectly stunts and deforms fruits in the cluster. RAA overwinters on apple trees as eggs laid on twigs, bud axils, or in bark crevices. The overwintering eggs give rise to only female aphids which give birth to live young. Shortly after silver tip the eggs hatch. The aphids continue to reproduce on apples until summer, then winged forms are produced which migrate to other hosts such as dock and narrow-leaved plantain to spend the summer. In the late fall, winged forms migrate back to apples and lay eggs in bark crevices and on twigs. Cortland, Idared, and Golden Delicious are the most susceptible cultivars to RAA injury. A cool, wet spring favors aphid development by providing conditions unfavorable for aphid parasites and predators.

RAA numbers can vary considerably from year to year, so this aphid species may not be a pest every

Figure 1. Shoot terminal infested with Rosy apple aphid (RAA) and RAA females with progeny.

Figure 2. Early-season infestation by RAA at the UMass CSO Orchard in 2021 (picture credit: Jon Clements).

year. In recent years, however, RAA populations seem to be gradually increasing in some orchards in Massachusetts. In 2021, outbreaks of RAA were reported in various apple orchards throughout Massachusetts and adjacent states. At the University of Massachusetts Cold Spring Orchard (CSO), infestations of RAA were first detected in April 2021 (Figure 2). No pre-bloom insecticides were sprayed at CSO. Insecticides applied with the delayed dormant oil application have historically been used for control of RAA, but control is best accomplished from the tight cluster to pink stages.

The main goal of this study was to quantify the level of RAA infestation in terms of both incidence (expressed as the percentage of shoot terminals infested with RAA) and aphid abundance, in 8 apple blocks at CSO. We also quantified the abundance of natural enemies and the level of RAA mortality attributable to insecticide sprays that targeted plum curculio (PC) at the time of petal fall, which took place ca. 10 days before the RAA assessments.

Materials & Methods

Study site. This study took place at the UMass CSO, in Belchertown, MA, on May 28, 2021. Eight apple blocks were used for the assessments.

Foliage sampling. A group of four people received training on identification of RAA injury to apple foliage. For each of the 8 sampled blocks, 100 shoot terminals (5 shoot terminals per tree, 20 trees per block) were visually inspected for symptoms of RAA infestation. To avoid visual bias, the observers positioned themselves in front of trees and without looking at the foliage they pointed to an area within the tree canopy. The terminal shoot closest to the blindly-chosen area was inspected. Data recorded were used to calculate the percentage of shoot terminals that were infested with RAA, a parameter known as incidence of infestation.

In addition, three terminal shoots infested with RAA were removed from 20 trees per block using scissors. Those three samples of foliage per tree were placed inside zip-lock bags labeled with information about block, row, and cultivar. For the analyses, explicit cultivar information is presented in some cases. In some blocks with highly mixed cultivars, this type of information was not collected for every single cultivar that was sampled and therefore we are referring to such blocks as 'Mixed1' (predominant cultivars: Ginger Gold, Gala, Zestar, Silken, Pink Lady, McIntosh), 'Mixed2' (predominant cultivars: Mutsu, Spigold, Northern spy, Idared, Golden Delicious, Jonagold, Golden Russet, Empire, Jonathan, Red Delicious), 'Mixed3' (predominant cultivars: Gala, Fuji, Red Delicious, Golden Delicious, Macoun, and McIntosh), and 'Mixed4' (predominant cultivars: Golden Delicious, Pazazz, Ambrosia, Gala, Fuji, and Honeycrisp).

Processing of foliage samples. All foliage samples were taken to the UMass campus laboratory. One randomly selected leaf from each infested terminal shoot was inspected under a stereomicroscope and the total number of RAA (dead and alive) was recorded. We also recorded natural enemies present in the samples that were examined. Sixty leaf samples per block were inspected.

Effect of insecticides applied against PC (not against RAA). On May 17, 10 days before conducting the RAA assessments, insecticides targeting PC were applied to all blocks at CSO (i.e., petal fall spray). Because different blocks received different insecticides, then this report also presents RAA mortality results that are attributable to the petal fall spray that targeted PC. More specifically, the insecticides sprayed against PC on May 17 were Imidan (active ingredient: Phosmet, IRAC group 1B), Avaunt (active ingredient: Indoxacarb, IRAC group 22), and Verdepryn (active ingredient: Cyclaniliprole, IRAC group 28). For details about the performance of Verdepryn to control PC when compared to Avaunt, see the Summer 2021 Issue of *Fruit Notes*.

Results

Incidence of RAA infestation. The cultivar with the highest incidence (expressed as the percent of infested terminal shoots) of RAA was Cortland (25% of the terminal shoots were infested, on average) (Figure 3), followed by a mixture of cultivars present in the block 'mixed4' (18% RAA infestation, on average) which included the cultivars Golden Delicious, Pazazz, Honeycrisp, Gala, and Ambrosia. These cultivars are known to be relatively attractive to RAA. Third in ranking was the 'Mixed3' block (14% RAA infestation), which contained relatively attractive cultivars such as Gala and Golden Delicious and less attractive cultivars like McIntosh and Macoun. The least susceptible cul-

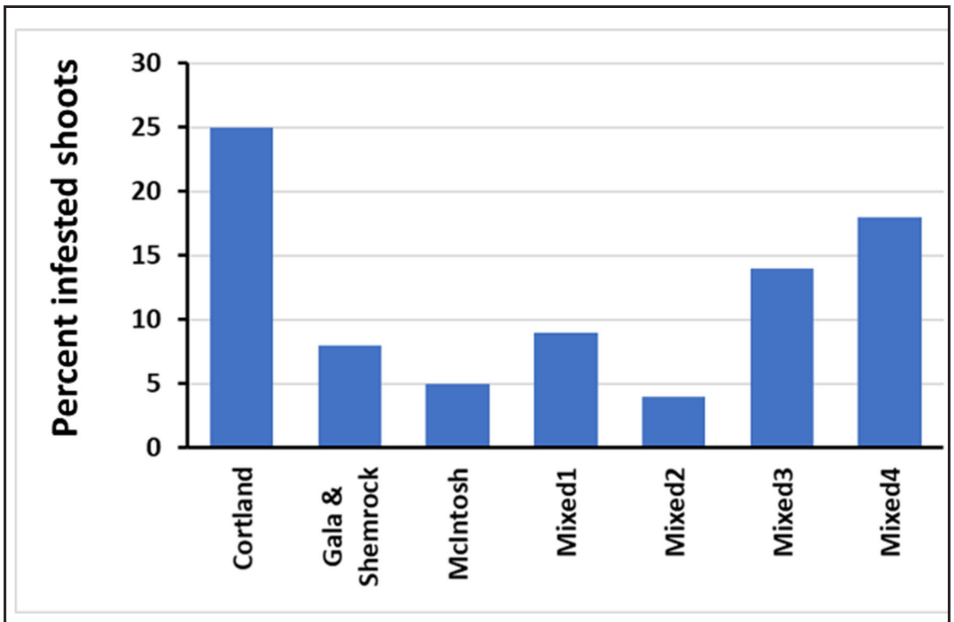

Figure 3. Percentage of shoot terminals that were infested with RAA. For each of the 8 blocks, 100 shoot terminals (5 shoot terminals per tree, 20 trees per block) were visually inspected for symptoms of RAA infestation. Results are presented according to cultivar, except for the highly mixed apple blocks.

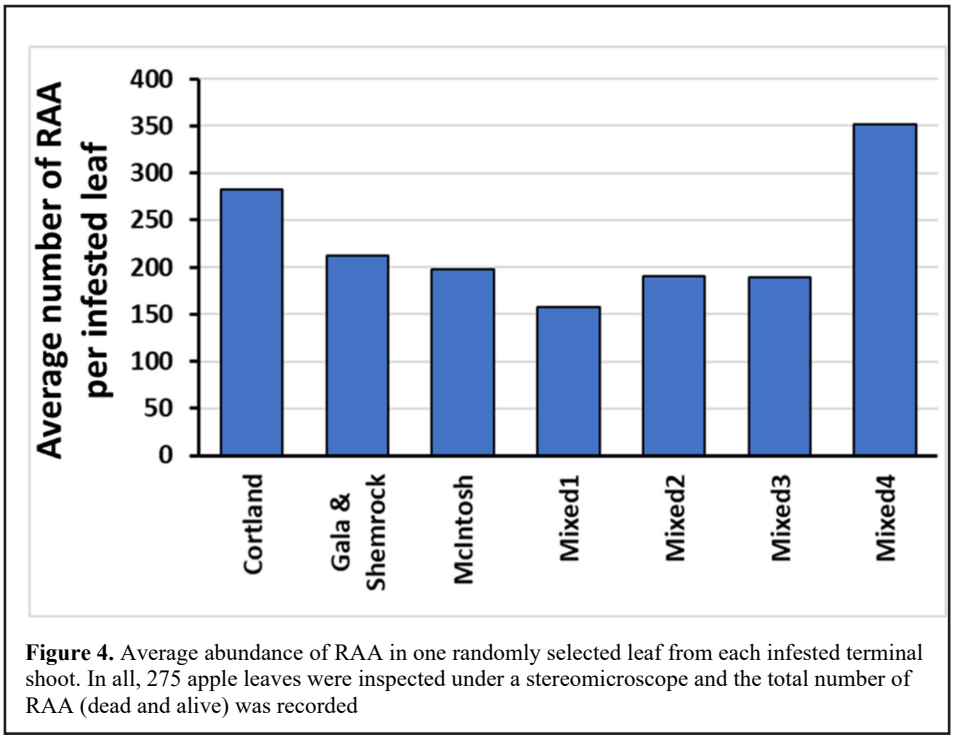

Figure 4. Average abundance of RAA in one randomly selected leaf from each infested terminal shoot. In all, 275 apple leaves were inspected under a stereomicroscope and the total number of RAA (dead and alive) was recorded

tivars to RAA were in the 'Mixed2' block (4% RAA infestation), and McIntosh (5% incidence of RAA). The former block had a high diversity of cultivars that included Mutsu, Spigold, Ida Red, Golden Delicious, Jonagold, Empire, and Red Delicious, among others.

RAA abundance. Across all sampled blocks, 56,413 RAA were counted on sampled leaves. The greatest abundance of RAA was recorded in the 'Mixed4' block, which included the cultivars Golden Delicious, Pazazz, Honeycrisp, Gala, and Ambrosia, among others. In this block, each sampled leaf that was infested with RAA had 350 aphids, on average, across all sampled leaves (Figure 4). Despite the comparatively high abundance of RAA, no sooty mold was observed neither on foliage nor fruit at the time of the observations. At CSO, RAA caused significant fruit deformity where present and resulted in economic loss in yield in susceptible varieties (Figure 5).

Presence of natural enemies. The number of natural enemies (Figure 6) found attacking RAA in four sampled blocks was very low. Percent parasitism by wasps (family Braconidae) ranged from 0.21% (2 wasps per 1,000 RAA) to 0.34% (3 wasps per 1,000 RAA). Hover fly larvae (family Syrphidae) ranked second, with densities ranging from 0.03% (equal to 3 lacewing larvae per 10,000 aphids) to 0.12% (1 lacewing larva per 1,000 RAA). Lady beetle larvae/adults (family Coccinellidae) were also present, but in even lower numbers.

Figure 5. RAA feeding injury to developing apple fruit (picture credit: Jon Clements).

Level of RAA control achieved with the petal-fall insecticide spray against plum curculio (PC). Because in addition to recording the number of live RAA on each sampled leaf we also recorded the number of dead aphids (not showing signs of predation), we are attributing the mortality observed to the effect of the insecticides that were sprayed against PC 10 days before the RAA assessments. As a reminder, the insecticides that were applied against PC (not RAA) were Imidan, Avaunt, and Verdepryn and the targe species was not RAA. For more information about the excellent performance of Verdepryn when applied at petal fall to control PC see the Summer 2021 Issue of *Fruit Notes.*

The overall level of RAA mortality that can attributed to insecticides sprayed at petal fall (on May 17) against PC was 8.3%. Imidan achieved 17.2% mortality of RAA, whereas Avaunt and Verdepryn led to 9.5% and 7% mortality of RAA, respectively.

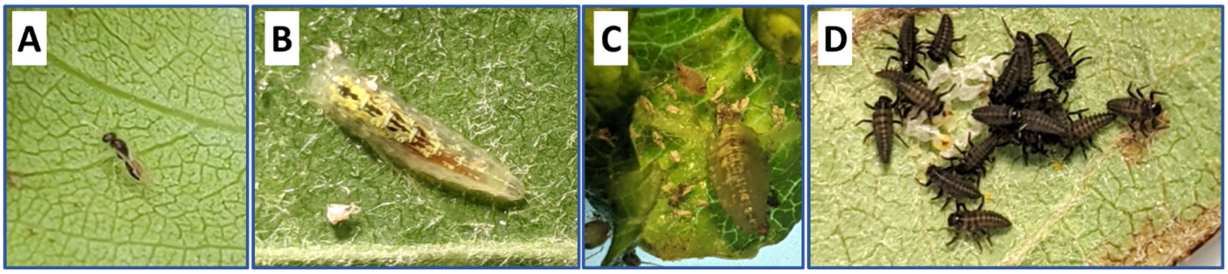

Figure 6. Natural enemies identified during apple foliage sampling: (A) parasitic wasp, (B) hover fly larva, (C) lacewing larva, and (D) lady beetle larvae.

Conclusions

Rosy apple aphid was most prevalent in Cortland and in blocks having mixed cultivars that contained attractive cultivars such as Gala, Honeycrisp, and Golden Delicious. The least susceptible cultivar was McIntosh. RAA highest densities were recorded in the 'Mixed4' block as a whole, which included the cultivars Golden Delicious, Pazazz, Honeycrisp, Gala, and Ambrosia all of which are attractive to RAA. The second highest RAA densities were recorded in Cortland. Very low numbers of natural enemies were found. Timely monitoring and pre-bloom application of aphicide, if needed, are IPM tactics that ought to be implemented in 2022.

Acknowledgments

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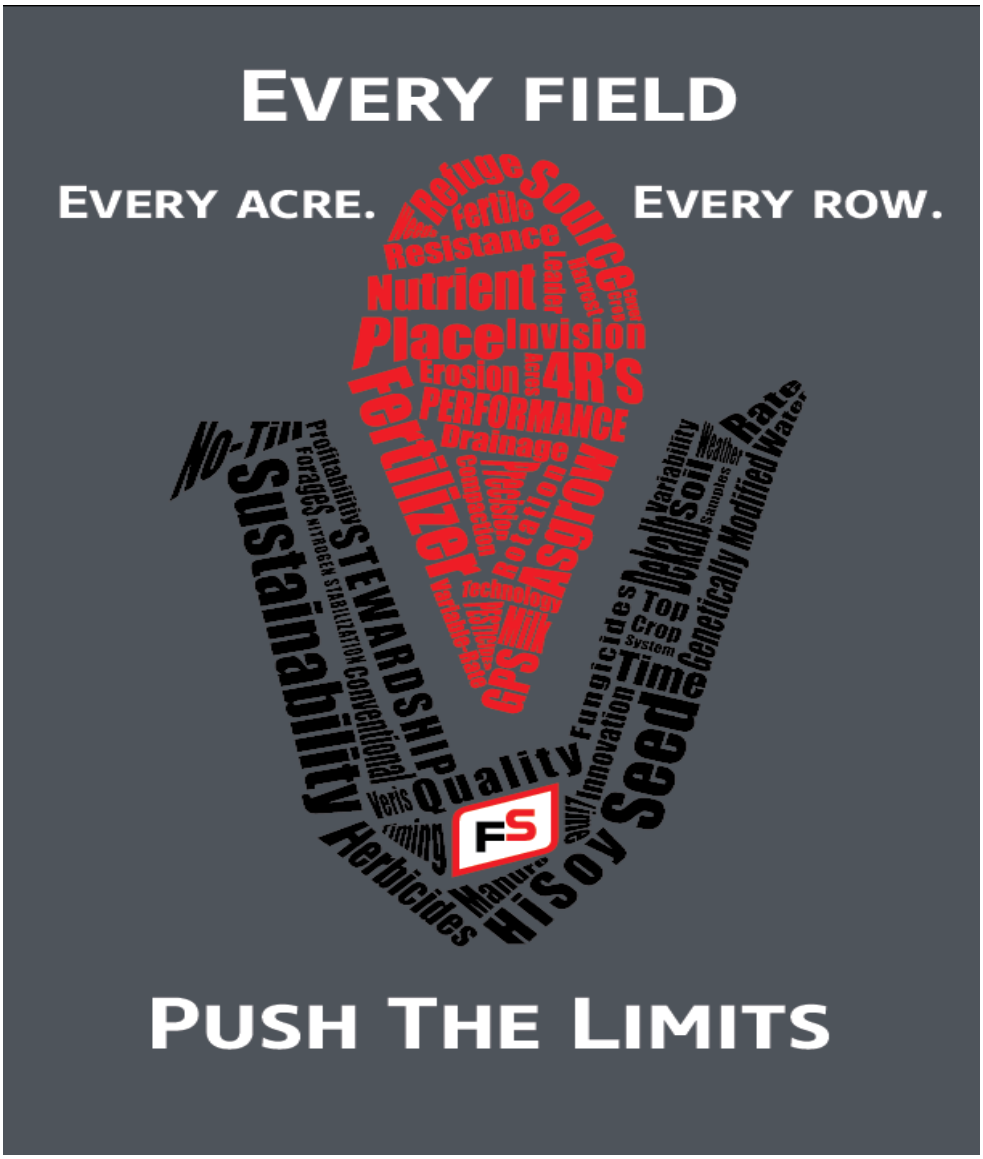

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