Is More Than One Trap Tree Required on Perimeter Rows to Monitor the Course of Plum Curculio Injury to Fruit?

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The concept of a trap tree as a practical approach to determine need and timing of insecticide applications against overwintered plum curculios (PCs), based on the occurrence of fresh egglaying injury, was put forward by Ron Prokopy in the 2002 Winter Issue of *Fruit Notes*. Based on research conducted during 2003, the following guidelines were proposed: (1) use of four vials dispensing benzaldehyde (BEN), the attractive host plant odor at a rate of ~40 mg/day (= 4 BEN), in association with one dispenser releasing the attractive PC pheromone grandisoic acid (GA) at a rate of ~1 mg/day (= 1 GA); (2) use of a threshold of one fruit showing fresh PC injury out of 25 fruit sampled on a trap tree; and (3) use of a single perimeter-row odor-baited tree located mid-way of a perimeter row encompassing 60-70 yards.

Because in our 2003 evaluations the greatest distance tested on a perimeter row was 30 yards to either side of a trap tree, it was not possible to determine whether trap trees would be attractive to PCs over distances longer than 30 yards. Whether or not the amount of attractive odor being emitted by a trap tree could draw PCs into an orchard from a distance greater than they would normally travel to find an orchard, which could potentially result in a greater-than-normal amount of PC injury to fruit on perimeter-row trees having trap trees, was another question that came out from the 2003 evaluations.

Here, our objectives were to determine (1) the maximum distance over which the combination of 4 BEN + 1 GA is able to congregate PCs and (2) whether an increase in the number of odor-baited trees on a perimeter row is associated with increasing amount of damage to perimeter-row fruit.

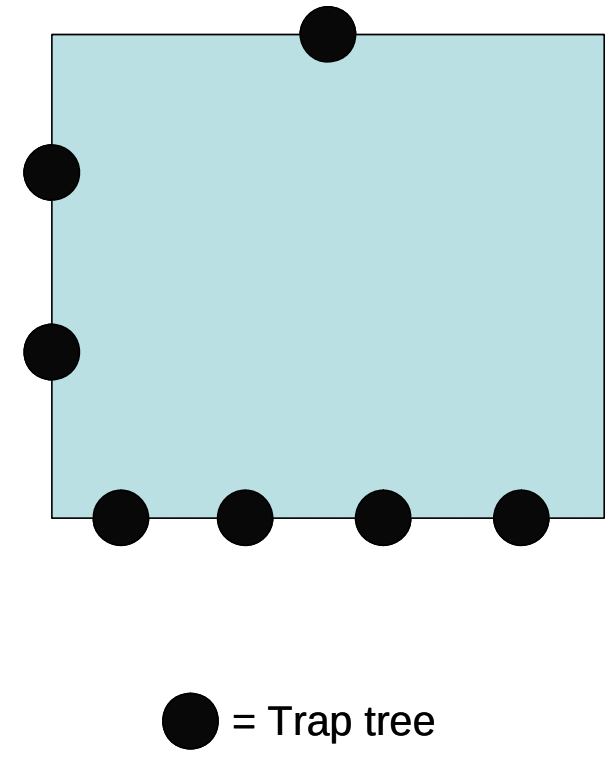

Figure 1. Representation of an apple orchard block having on each of its four sides either 0, 1, 2, or 4 trap trees spaced equidistantly. Each trap tree was baited with 4 BEN and 1 GA. Each of the four sides of the blocks used for this study comprised at least 120 yards.

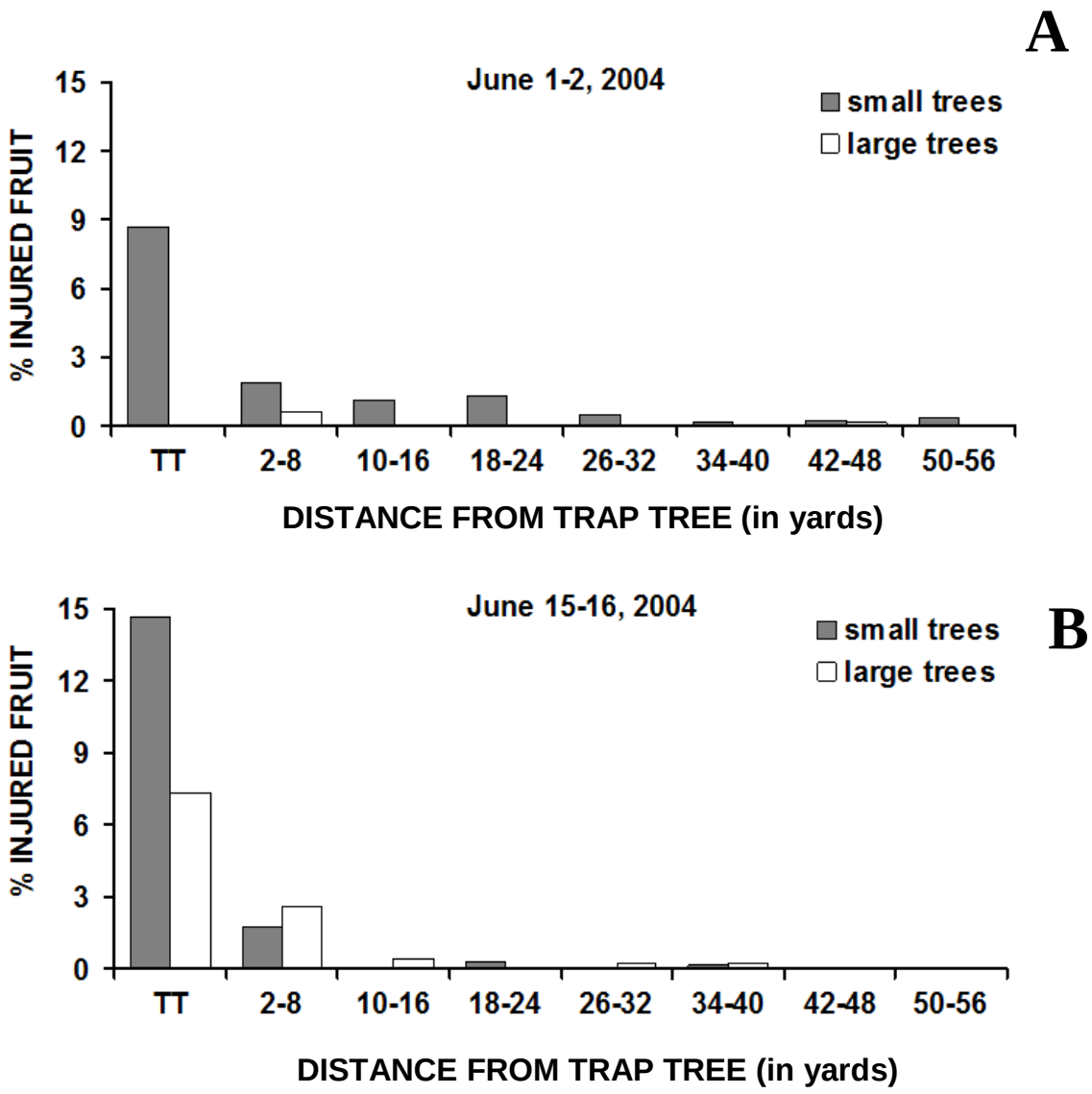

Figure 2. For the side of orchard blocks having only one trap tree located at the center of the perimeter row, amount of injury to perimeter-row fruit by PC on either (A) the first sampling date or (B) the second sampling date, as a function of distance from a trap tree. Trap trees were baited with 4 BEN and 1 GA on May 25-26, 2004.

Materials & Methods

This evaluation was conducted during May and June, 2004, in 12 sprayed sections of eight commercial orchards located in Massachusetts. Six of the orchard blocks used had small (M.9 rootstock) trees, whereas the remaining six blocks had large (M.7 rootstock) trees. Each block was composed of one or more of the cultivars McIntosh, Gala, Delicious, Cortland, and Empire, among others. Each of the four sides of the blocks used for this study was at least 120 yards long. All trees within a block were sprayed with insecticide against PC in a similar fashion.

On May 25-26 (i.e., about 10 days after petal fall), either, 1, 2, or 4 perimeter-row trap trees, each baited with 4 BEN and 1 GA, were set up on each side of a block; the remaining side of a each block had no trap trees (Figure 1). The sides of the blocks to which a

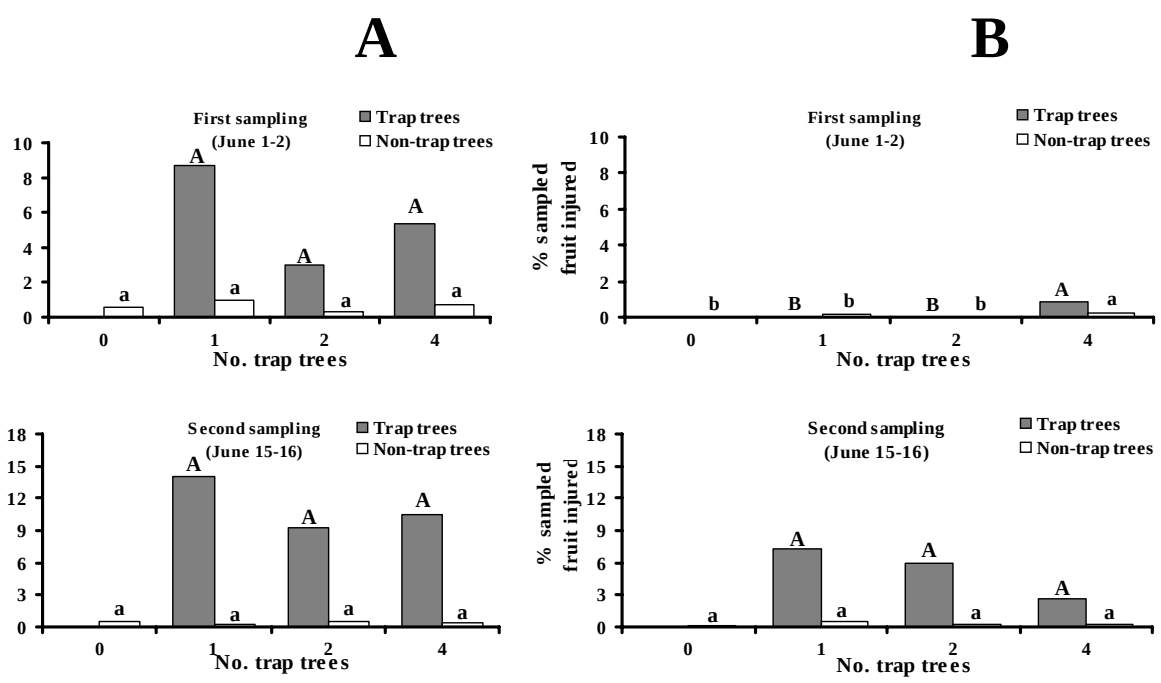

Figure 3. For each of the four sides of orchard blocks composed of either (A) small or (B) large trees, amount of injury by PC that occurred on trap trees or on other perimeter-row trees (= non-trap trees), according to the number of trap trees deployed.

particular treatment were assigned (i.e., 0, 1, 2, or 4 trap trees) were randomized to minimize variation in results due to the nature of habitat (woods, hedgerow, orchard trees) bordering the different sides of a block.

We addressed the first question by sampling 25 fruit per tree on the side of blocks having only one trap tree. This showed incidence of PC injury on perimeter-row trees located up to 60 yards on either side of the trap tree. The second question was addressed by comparing PC injury occurring on trap trees, as well as on perimeter-row non-trap trees, on each of the four sides of each block. This showed what effect trap trees exerted on total amount of injury by PC to fruit in perimeter-row trees. Amount of injury by PC to fruit was quantified twice: on June 1-2 (i.e., one week after odor-baiting) and on June 15-16 (i.e., three weeks after odor-baiting). For blocks having large trees, all perimeter-row trees were sampled for PC injury (25 fruit per tree). For blocks having small trees, either every other tree or every-two trees were sampled for PC injury (including all trap trees) because of the tree density in these blocks was much higher than in blocks having large trees.

Results

Combining both sampling dates, almost 63,000 fruit were sampled on the 12 orchard blocks used for this study.

For the first objective, Figure 2 reveals that one week after deploying 4 BEN and 1 GA (i.e., on June 1-2), the maximum distance over which PCs were congregated to a trap tree was 50-56 yards for blocks having small trees, and 42-48 yards for blocks having large trees. Three weeks after deploying the synthetic lures (June 15-16), the maximum distance over which PCs were congregated to a trap tree was 34-40 yards, regardless of tree size.

For the second objective, Figure 3A shows that, for both sampling dates and for blocks having small trees, amount of injury to fruit by PC on the trap trees was similar in the sides of blocks having either 1, 2, or 4 trap trees. Importantly, for both sampling dates, an almost identical amount of injury to fruit by PC occurred on non-trap trees in each of the four sides regardless of the number of trap trees deployed. Figure 3B reveals that, for large trees, initial amount of injury

to fruit by PC (i.e., first sampling) was greater in the sides of blocks having 4 trap trees than either 1 or 2 trap trees. The same result was found for amount of injury by PC in non-trap trees. For the second sampling, the amount of injury produced by PC to fruit on the trap trees was similar on the different sides of blocks, regardless of the number of trap trees deployed. The amount of injury by PC in non-trap trees was very low in general and was not associated with the number of trap trees deployed on the different sides of a block.

Overall, three weeks after deploying 4 BEN and 1 GA (i.e., by June 15-16) trap trees were, on average, 28 times more likely to reflect injury by PC than all perimeter-row non-trap trees sampled in blocks having small trees, and were 15 times more likely to reflect injury by PC than all perimeter-row non-trap trees sampled in blocks having large trees.

Conclusions

From the first study, we learned that the effective distance over which trap trees seemed to aggregate PC injury was at least 50-56 yards for the first sampling date and 34-40 yards for the second sampling date. We also determined that trap trees were less able to concentrate injury by PC by the first sampling than by the second sampling, in particular if blocks had large trees. We believe this result is largely due to the cool and rainy weather that prevailed from the moment in which we baited the trap trees (on May 25-26) until the first sampling (on June 1-2). Because during that period of time the release rates of the synthetic lures were presumably low, it is conceivable that PCs may have not been strongly attracted to trap trees and, as a consequence, injury to fruit by PC was more spread from the trap tree for the first sampling date than for the second sampling date. After three weeks, most injury by PC occurred on the trap trees and on the most adjacent trees.

Our results from the second study show that, except for blocks having large trees in the first sampling date, the amount of injury by PC to trap trees was similar on perimeter rows having 1, 2, or 4 trap trees, regardless of the size of trees in a block. This finding indicates that a single trap tree deployed mid-way of a perimeter row of about 120 yards will be sufficient to monitor accurately the seasonal course of injury by PC to fruit. Remarkably, the amount of injury by PC to perimeter-row fruit located in the side of blocks having no trap trees was as low as the amount of injury that occurred in all perimeter-row fruit when we excluded injury on the trap trees. Thus, we should not expect greater-than-normal amounts of injury by PC to perimeter-row fruit by having odor-baited trap trees (regardless of the number).

Whether the attractiveness of a trap tree could be enhanced by adding other types of stimuli so as to increase its ability to congregate PCs is a question that remains to be investigated. Finding a way of enhancing the attractiveness of trap trees could be very valuable, for instance, in the context of potential direct control of PC by confining insecticide sprays to trap trees only (after a whole-block spray). In the context of monitoring of PC injury, an enhanced trap tree might decrease the extent to which PCs penetrate into orchard blocks (especially in blocks having small trees) by holding PCs on perimeter-row trees, thereby making perimeter-row sprays more efficient.

Acknowledgments

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