Performance of Various Trap Types for Monitoring Populations of Cherry Fruit Fly (Diptera: Tephritidae) Species

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ABSTRACT The eastern cherry fruit fly, *Rhagoletis cingulata* (Loew), and black cherry fruit fly, *R. fausta* (Osten Sacken), are the most important insect pests of cherries *Prunus* spp. in the eastern and midwestern United States. In 1998, we studied the responses of cherry fruit fly species using the recommended V-shaped Pherocon AM board. Significantly more *R. cingulata* flies were caught on boards with aqueous solutions of ammonium baits compared with boards that had solid ammonium baits mixed into the Tangle-Trap. Captures of *R. fausta* flies were low in 1998 and the weekly trapping data never exceeded a total of five adults. In 1999, several commercial traps were evaluated including the unbaited, three-dimensional Rebell trap and different types of ammonium baited spheres and boards including a 9-cm-diameter red sphere, a modified version of the Ladd trap (L & S trap), and the Pherocon AM yellow board in the vertical and V-shaped orientations. There were significantly more *R. fausta* flies caught on unbaited Rebell traps compared with any other commercial traps studied. Red sphere treatments (regardless of baiting system) consistently captured significantly fewer *R. fausta* flies than any other treatment evaluated. For *R. cingulata,* total captures on unbaited Rebell traps were not significantly different from other commercial traps including the 9-cm-diameter red spheres baited with ammonium acetate mixed into the Tangle-Trap, L & S traps, and the baited Pherocon AM yellow boards deployed in a vertical orientation. The study demonstrated that the unbaited Rebell trap was the most effective and selective device evaluated for monitoring *R. fausta* and *R. cingulata* flies. In addition, red sphere (9-cm-diameter) traps were found ineffective for use in *R. fausta* monitoring programs.

KEY WORDS *Rhagoletis cingulata, Rhagoletis fausta,* flies, traps

MICHIGAN PRODUCES 75% of the nations sour cherries, *Prunus cerasus* L., and ≈12% of sweet cherries, *P. avium* (L.). The 1998 gross receipts from sour and sweet cherries exceeded $50 million (Michigan Agricultural Statistics 1998). Economically, the eastern cherry fruit fly, *Rhagoletis cingulata* (Loew), and the black cherry fruit fly, *R. fausta* (Osten Sacken), are the two most important pests of cultivated cherries in the eastern and midwestern United States (Frick et al. 1954). *R. cingulata* is the most abundant among the two species and can be distinguished from the black cherry fruit fly by the presence of white horizontal bands across the abdomen (Howitt 1993).

Bush (1966) noted that *R. cingulata* and *R. fausta* were morphologically distinct and geographically separated. In southwestern Michigan, both species readily infest cultivated cherries. *R. cingulata* is the dominant species and emerges from overwintering sites ≈3 wk later than *R. fausta.* Although both species readily infests cultivated cherries (Glasgow 1933), there are clear-cut differences in native host preferences. The native host of *R. cingulata* is the wild black cherry, *P. serotina* Ehrh., whereas *R. fausta* is confined to pin cherry, *P. pennsylvanica* L. (Glasgow 1933).

Although the time spent on leaves versus fruit is a function of time of day and weather, in cultivated cherries, Smith (1984) found that *R. cingulata* spends more time foraging on host fruit compared with leaves, whereas Prokopy (1976) found *R. fausta* spends more time on the leaves compared with the fruit of host plants. In addition, *R. cingulata* oviposits into cherries in the "yellow" stage (just before becoming ripe), whereas *R. fausta* oviposits into the "full" green fruit. The behavioral and ecological differences that exist among the species may have implications for the development of individual management tactics for *R. cingulata* and *R. fausta.*

For almost three decades, cherry fruit fly integrated pest management (IPM) programs in Michigan have relied on visual and olfactory traps to make control decisions. The standard strategy adopted by most growers involved the deployment of baited Pherocon AM yellow sticky boards in cherry orchards (Prokopy 1975; Reissig 1976). The detection of one fly on a trap was usually followed by ground and aerial applications of insecticides, primarily organophosphates.

In an attempt to develop a reliable trap for monitoring *R. cingulata,* Prokopy (1975) found that sticky yellow rectangle traps, hung in the standard vertical orientation, were just as effective in capturing *R. cingulata* flies as any other traps and orientations evalu-

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ated. However, when sticky yellow cone traps were hung in a 45-degree angle, with the apex-down, they were significantly more selective in captuing *R. cingulata* flies than other trap orientations tested. In a later study, Reissig (1976) also showed that yellow panels folded into a 45-degree angle with the adhesive outside were as effective and more selective in capturing *R. cingulata* flies than standard vertical rectangle yellow sticky boards. In his study, spheres baited with 50% ammonium acetate solution attracted significantly more *R. cingulata* than *R. fausta* flies.

In studies with the related European cherry fruit fly, *Rhagoletis cerasi* L., Russ et al. (1973) compared responses of *R. cerasi* to two and three-dimensional traps in replicated field studies. He found that the response of *R. cerasi* to three-dimensional traps was superior compared with the two-dimensional sticky rectangular boards. Further investigations indicated that daylight fluorescent yellow was highly attractive to *R. cerasi* and that a medium or large yellow surface (15 by 20 cm) captured significantly more flies than a small, dark colored sphere mimicking the host fruit (Boller 1969; Prokopy 1969; Prokopy and Boller 1971a, 1971b).

With another closely related species, the western cherry fruit fly, *R. indifferens* Curran, AliNiazee (1978) evaluated several types of traps including Pherocon ICPY-MAGO, Pherocon AM yellow boards and Saturn yellow spheres and found no significant differences in the response of *R. indifferens* to traps deployed in replicated field experiments.

To date, management strategies for *R. cingulata* and *R. fausta* have been combined, despite significant differences in their behavioral response, host species used for larval development, geographical location, and variation in emergence patterns. Our hypothesis was that management strategies for *R. cingulata* and *R. fausta* should differ based on the individual behavioral patterns within the two species. Our objectives were to study the current monitoring techniques for both species and then to develop appropriate trapping systems based on species-specific responses to visual and olfactory stimuli.

Materials and Methods

Research on the cherry fruit fly was conducted at Hood's Orchard in southwest Michigan and at the Michigan State University Northwest Horticultural Research Station in Traverse City, MI. Hood's orchard was selected as the study site because it has resident populations of *R. cingulata* and *R. fausta* and a 10-ha block of tart cherries, *P. avium.* The site at the Northwest Research Station (Traverse City) consisted of a 5-ha block of sweet cherries with two cultivars, 'Napoleon' and 'Hedelfingen'. *R. cingulata* is the dominant species at the Northwest Research Station but small numbers of *R. fausta* are caught occasionally on monitoring traps.

Experimental designs were completely randomized blocks (blocked by sweet cherry cultivars at the Northwest Station) with four replicates. Traps were hung within cherry canopies on the south side (exposed to sunrays) ≈0.3 m from fruit and foliage. The foliage immediately surrounding the traps was cleared to prevent any interference between hung traps and the tree canopy (Drummond et al. 1984). Traps were spaced 20 m apart, with ≈30 m between blocks. Traps were replaced (with new traps) after each trapping period of ≈3 wk in 1998. In 1999, traps were changed at ≈4 wk intervals in the first half of the season and 3-wk intervals in the second half. All traps were rotated on a weekly basis.

1998. Only the Hood's orchard site was used for our studies in 1998. Research was designed to assess the visual and olfactory response of *R. cingulata and R. fausta* to the recommended V trap with various ammonium bait formulations (Prokopy 1975, Reissig 1976). Unbaited Pherocon AM yellow sticky boards obtained from Great Lakes IPM (Vestaburg, MI) were hung in V-shaped orientation (folded into a 45-degree angle with apex downward and sticky surface outward) because Prokopy (1975) and Reissig (1976) found this orientation to be highly selective in capturing *R. cingulata* flies.

Five treatments (baits) were evaluated by either placing baits into attached vials or incorporating bait formulations into the 13 g of Tangle-Trap on initially unbaited Pherocon AM yellow sticky boards. Treatments consisted of 2.0 g of ammonium acetate and 0.5 g protein hydrolysate (Aldrich, Milwaukee, WI), 2.0 g of ammonium acetate without protein hydrolysate, aqueous ammonium acetate solution containing 2.0 g of ammonium acetate and 0.5 g of protein hydrolysate dissolved in 4 ml of water, aqueous ammonium acetate solution containing 2.0 g of ammonium acetate without protein hydrolysate. The fifth treatment (control) consisted of a Pherocon AM yellow board without bait.

Treatments that included solid ammonium baits were thoroughly mixed into the Tangle-Trap on a yellow sticky board just before field deployment. Treatments consisting of aqueous ammonium solutions were placed into scintillation vials (National Diagnostics, Atlanta, GA) and plugged with cotton wool (Liburd et al. 1999). Vials were then securely fastened in the upper corner of the trap with masking tape and reinforced with staples.

1999. In addition to comparing responses of *R. cingulata* and *R. fausta* to the recommended Pherocon AM yellow board in the V-orientation, we also wanted to evaluate other commercially available traps used for monitoring key *Rhagoletis* species. Both sites (Hood Orchard and the Northwest Horticultural Research Station) were used in our 1999 field studies.

1999 Hood Orchard Study. Two treatments were selected from our 1998 study for further investigation in 1999. These treatments were the recommended Pherocon AM yellow sticky board (V-shaped orientation) baited with aqueous ammonium acetate solution as previously described, and a Pherocon AM yellow sticky board (V-shaped orientation) baited with 2.0 g of ammonium acetate and 0.5 g protein hydrolysate mixed within Tangle-Trap. Four new treatments (totaling six) were evaluated at this site. These were an unbaited three-dimensional cross-shaped Rebell trap (Swiss Federal Research Station, Wadswill, Switzerland) used extensively in Europe for monitoring the European cherry fruit fly (Boller 1969, Russ et al. 1973), a 9-cm-diameter red sphere (Great Lakes IPM, Vestaburg, MI) baited with 2.0 g of ammonium acetate and 0.5 g protein hydrolysate mixed into 13 g of Tangle-Trap (Liburd et al. 1998), a 9-cm-diameter red sphere baited with aqueous ammonium solution containing 2.0 g of ammonium acetate in 4 ml of water, a modified version of the Ladd trap (L & S trap) consisting of yellow background with a 9-cm-red hemisphere (the L & S trap was baited with 2.0 g of ammonium acetate and 0.5 g protein hydrolysate mixed into 16 g of Tangle-Trap).

1999 Northwest Horticultural Research Station. The same experiment described above for the Hood's Orchard site in 1999 was replicated at the Northwest Horticultural Station in Traverse City. However, an additional treatment was included in the Northwest study. This seventh treatment consisted of a baited Pherocon AM yellow sticky board deployed in a vertical orientation. The additional treatment was included because we observed that the majority of commercial cherry growers in Michigan were using yellow boards deployed in a vertical orientation for monitoring instead of the recommended V-orientation.

Sampling. *R. cingulata* and *R. fausta* flies caught on traps were counted by sex and removed from traps twice per week. Unwanted insects were left on traps in the the field. In 1999, traps were visually inspected in the field at least once per wk for selectivity in capturing *R. cingulata* and *R. fausta* flies.

Statistical Analysis. Data from all three experiments were square-root transformed ($x + 0.5$) and then subjected to an analysis of variance. Least significant difference (LSD) tests were used to show treatment mean differences ($P = 0.05$) (SAS Institute 1989). The untransformed means and standard errors are presented in tables and figures. Data on trap selectivity were recorded as the percentage of *R. cingulata* or *R. fausta* in relation to other insects captured on the trap.

Results

1998. Response of *R. cingulata* to Visual and Olfactory Stimuli. Our 1998 experiments showed that during the first part of the season (25 June–14 July) significantly ($F = 4.3$; df = 4, 12; $P = 0.02$) more *R. cingulata* flies were caught on traps baited with an aqueous solution of dissolved ammonium acetate with or without protein hydrolysate than on traps baited with ammonium crystals mixed into the Tangle-Trap (Table 1). On an average, traps baited with aqueous solutions of dissolved ammonium acetate captured more than three times as many flies as any other baited or unbaited traps during this period (Table 1).

The responses of *R. cingulata* during the second trapping period (21 July–9 August) were similar to those observed during the first trapping period. Significantly ($F = 2.2$; df = 4, 12; $P = 0.05$) more flies were captured on Pherocon AM V-traps baited with aqueous ammonium acetate compared with traps baited with solid ammonium acetate or ammonium acetate and protein hydrolysate mixed into the Tangle-Trap (Table 1). Overall, traps baited with aqueous ammonium baits captured more than six times as many flies as traps baited with solid ammonium baits mixed into the Tangle-Trap (Table 1). *R. cingulata* fly captures on unbaited Pherocon AM traps did not differ significantly from captures on traps baited with any form (solid or aqueous) of ammonium baits (Table 1).

Table 1. Attraction of *R. cingulata* flies to Pherocon AM V-traps, Hood's Orchard, Paw Paw, MI (1998)

Trap design/orientation/lure	Mean ± SEM no. flies per trap	
Pherocon AM/V-trap	25 June–14 July	21 July–9 August
2 g ammonium acetate	3.0 ± 1.3b	1.8 ± 0.8b
2 g ammonium acetate + 0.5 g protein hydrolysate	3.3 ± 0.5b	1.3 ± 0.5b
2 g ammonium acetate + 0.5 g protein hydrolysate/4 ml water	11.8 ± 3.3a	14.3 ± 7.2a
2 g ammonium acetate/4 ml water	10.8 ± 3.0a	12.0 ± 7.3ab
No bait	2.5 ± 0.9b	6.8 ± 2.9ab

Means in the same column followed by the same letter are not significantly different, ($P = 0.05$, LSD test).

Overall, there were no significant differences in the performance of Pherocon AM boards baited with aqueous solutions containing dissolved ammonium acetate bait (2 g) or aqueous solutions of ammonium acetate plus protein hydrolysate (Table 1). In addition, there were no significant differences among traps baited with solid ammonium acetate and traps baited with ammonium acetate and protein hydrolysate (Table 1). Over the entire season, significantly ($F = 83$; df = 1, 2; $P < 0.01$) more *R. cingulata* females than males were caught on traps baited with an aqueous solution of dissolved ammonium baits. The population of *R. fausta* was extremely low and weekly trapping data never exceeded a total of five adult flies.

1999. Response of *R. fausta* to Commercial Traps. Unlike in 1998, high populations of *R. fausta* adult flies were present during our 1999 field study in southwestern Michigan and highly significant differences were observed among the traps evaluated (Table 2). Significantly ($F = 54$; df = 5, 15; $P < 0.01$) more *R. fausta* flies were caught on Rebell traps compared with other commercial traps evaluated during the first trapping period (Table 2). Overall, the Rebell trap caught twice as many flies as any other trap evaluated during the trapping period 6 June–2 July (Table 2). There were no significant differences in captures on baited Pherocon AM yellow boards or the L & S trap baited with ammonium acetate (Table 2). Baited 9-cm-diameter red spheres consistently captured significantly fewer *R. fausta* flies than any other treatment evaluated during the trapping period 6 June–2 July (Table 2). In fact, at least 30 times more flies were captured on baited Pherocon AM boards compared with red spheres during the first trapping period (Table 2).

Table 2. Attraction of *R. fausta* flies to traps of various designs, baits and orientations, Hood's Orchard, Paw Paw, MI (1999)

Trap design/orientation/lure	Mean ± SEM no. flies per trap	
	6 June–2 July	5 July–16 July
Pherocon AM/V-trap/2 g ammonium acetate + 0.5 g protein hydrolysate	45.3 ± 9.2b	9.8 ± 3.3ab
Pherocon AM/V-trap/vial 2 g ammonium acetate in 4 ml water	49.0 ± 10.7b	15.5 ± 1.3a
Rebell	101.3 ± 23.5a	20.5 ± 8.0a
Red sphere (9 cm diam)/2 g ammonium acetate + 0.5 g protein hydrolysate	1.5 ± 0.3c	0.0 ± 0.0c
Red sphere (9 cm diam)/vial 2 g ammonium acetate in 4 ml water	1.5 ± 1.2c	0.0 ± 0.0c
L & S (modified Ladd trap)/2 g ammonium acetate	33.8 ± 1.8b	9.3 ± 5.6b

Means in the same column followed by the same letter are not significantly different, (P = 0.05, LSD test).

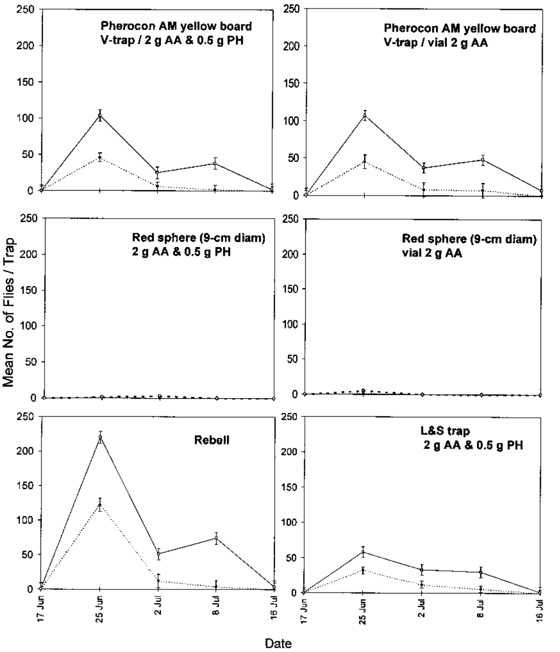

Fig. 1. Response of adult *R. fausta* to traps of various designs, baits and orientations, Southwest MI (1999) [· · ·Male; —Female]

Moreover, the highly attractive unbaited Rebell trap caught 67 times more *R. fausta* flies than either of the red sphere treatments (Table 2).

Responses of *R. fausta* flies during the second trapping period, 21 July–9 August, followed the same pattern as those observed during the first trapping period. The unbaited Rebell trap and Pherocon AM yellow board baited with a vial containing aqueous ammonium acetate captured significantly (F = 15.6; df = 5, 15; P < 0.01) more *R. fausta* flies than the L & S trap. However, captures of *R. fausta* on Pherocon AM V-traps baited with 2 g of ammonium acetate mixed into the Tangle-Trap did not differ significantly from captures on the experimental L & S trap. Both the Rebell trap and Pherocon AM board captured significantly (P < 0.05) more *R. fausta* than either of the red sphere treatments. In fact, we did not catch any *R. fausta* flies on red spheres during this trapping period (Table 2).

Throughout the entire trapping period, significantly (F = 49; df = 1, 2; P < 0.01) more *R. fausta* females than males were captured on the unbaited Rebell trap and the baited Pherocon AM boards, whereas such a difference was not recorded with other traps evaluated (Fig. 1). There were no significant differences among male and female captures for baited red spheres and L & S traps (Fig. 1). Throughout the trapping periods, the unbaited Rebell trap was the most selective device capturing >75% of *R. fausta,* compared with ammonium baited red spheres (mixed into the Tangle-Trap) and Pherocon AM boards in V-orientation (with vial), which captured 10 and 43%, respectively, of *R. fausta* flies. In 1999, captures of *R. cingualta* remained very low at the Hood's Orchard research site and weekly counts never exceeded four flies.

1999. Response of *R. cingulata* to Commercial Traps. Responses of *R. cingulata* to commercial traps at the Northwest Horticultural Research Station during the first trapping period were different from those observed for *R. fausta* exposed to the same stimuli at Hood's Orchard. The Rebell trap, which captured significantly more *R. fausta* than any other trap at the Hood's Orchard research site did not catch significantly more *R. cingulata* than red spheres (9 cm diameter) baited with 2 g of ammonium acetate and 0.5 g of protein hydrolysate mixed into the Tangle-Trap (Table 3). Furthermore, captures of *R. cingulata* on Rebell traps did not differ significantly from captures on the L & S trap (Table 3).

The experimental Pherocon AM boards in the vertical orientation (commonly used by growers) baited

Table 3. Attraction of *R. cingulata* flies to traps of various designs, baits and orientations, Northwest Horticultural Research Station, Traverse City, MI (1999)

Trap design/orientation/lure	Mean ± SEM no. flies per trap	
	1 July–26 July	30 July–17 August
Pherocon AM/V-trap/2 g ammonium acetate + 0.5 g protein hydrolysate	35.5 ± 13.9bc	6.8 ± 3.2b
Pherocon AM/V-trap/vial 2 g ammonium acetate in 4 ml water	53.3 ± 17.6bc	17.8 ± 8.1ab
Pherocon AM/vertical (standard)/2 g ammonium acetate + 0.5 g protein hydrolysate	85.8 ± 26.6ab	23.8 ± 13.3ab
Rebell	98.8 ± 34.4a	49.0 ± 22.8a
Red sphere (9 cm diam)/2 g ammonium acetate + 0.5 g protein hydrolysate	84.5 ± 29.3ab	17.3 ± 5.3ab
Red sphere (9 cm diam)/vial 2 g ammonium acetate in 4 ml water	17.0 ± 7.6c	6.3 ± 3.0b
L & S (modified Ladd trap)/vial 2 g ammonium acetate	67.0 ± 18.8ab	17.8 ± 5.7ab

Means in the same column followed by the same letter are not significantly different, (P = 0.05, LSD test).

with 2 g of ammonium acetate and 0.5 g of protein hydrolysate captured statistically as many flies as the Rebell, red spheres (without vial) and the L & S trap (Table 3). However, *R. cingulata* captures on Pherocon AM yellow boards deployed in a V-orientation were significantly ($F = 3.0$; df $= 6, 18$; $P = 0.03$) lower than those on Rebell traps regardless of the baiting system used (Table 3). During the first trapping period, Pherocon AM yellow boards in the V-orientation captured 1.9 times fewer flies when baited with a vial containing aqueous ammonium acetate solution, and 2.8 times fewer flies, when baited with 2.0 g of ammonium acetate and 0.5 g of protein hydrolysate mixed into the Tangle-Trap relative to captures on the Rebell trap (Table 3). During that same period, *R. cingulata* captures on these yellow boards did not differ significantly from captures on red spheres baited with a vial containing aqueous ammonium acetate solution or the L & S trap (Table 3). During the second trapping period the Rebell trap did not capture statistically more *R. cingulata* flies than the other treatments evaluated.

Throughout both trapping periods, there were no significant differences in male and female captures on different trap types for *R. cingulata* flies. The unbaited Rebell trap was the most selective device evaluated, capturing >70% of *R. cingulata* flies, compared with the ammonium baited red spheres (mixed into the Tangle-Trap) and Pherocom AM boards in V-orientation, which only captured ≈55 and 46%, respectively, of *R. cingulata* flies.

Discussion

Our study demonstrated that the three-dimensional, unbaited Rebell trap was the most effective and selective device evaluated for capturing *R. fausta* flies. During the first trapping period, the unbaited Rebell trap caught considerably more *R. fausta* flies than any other traps examined. In addition, the Rebell trap caught the first *R. fausta* fly 4 d earlier than the other traps studied at the Hoods Orchard research site. In Michigan, early detection of *R. fausta* flies is critical for successful management of cherry fruit flies. *R. fausta* flies begin to lay eggs ≈7–9 d after emergence, and >10% of the entire population is likely to emerge within 1–2 wk of the first fly emergence (Liburd and Stelinski 1999). Therefore, growers must detect flies early to select the most appropriate management tactics for meeting the stringent zero tolerance (for cherry maggot) policy regulated by Federal laws. In Europe, the three-dimensional Rebell trap has been the most effective device used for detecting early populations of the European cherry fruit fly for more than two decades (Russ et al. 1973).

During the second trapping period, *R. fausta* responses to baited Pherocon AM boards were not statistically different from those observed for the Rebell traps, irrespective of the baiting system used. We do not know the reasons for the shift in response of *R. fausta* to these commercial traps during the second trapping period. During the first trapping period, traps were out in the orchard for about a week before the majority of flies were caught. Perhaps, during that time, the Pherocon AM boards may have lost the bulk of their odor power. Replacement Pherocon AM boards on 5 July (second trapping period) may have been initially powerful, and lost power toward the end of the season when fewer flies were caught. Other factors that may have contributed to the shift in response of *R. fausta* flies include the ripening of cherries, fly maturation, and fluctuations among immigrant and residential fly populations.

Another crucial observation from a management standpoint was that during both trapping periods there was very little attraction of *R. fausta* flies to 9-cm-diameter red spheres. This observation has particular relevance for management programs in Michigan as some growers in the state rely on red spheres (9 cm diameter) for monitoring both species of cherry fruit fly. Our results indicate that the practice of using red spheres (9 cm diameter) for monitoring *R. cingulata* may be a viable tactic but a completely futile approach for *R. fausta* management. It is possible that the 9-cm-diameter spheres were too large, and thus beyond the range of supernormal stimulus effective for attracting *R. fausta* flies.

In 1998, the tart cherries at the Hood Orchard research site became infested with brown rot *Monilinia fructicola* (G. Wint.) disease in mid-July. The diseased cherries rotted and wilted before peak oviposition of *R. cingulata* flies, but after *R. fausta* larvae had already exited the fruit. This was the primary reason for the low captures of *R. cingulata* flies in 1999.

The response of *R. cingulata* to the unbaited Rebell trap was not as dramatic (compared with other traps) as that of *R. fausta.* Although the majority of *R. cingulata* flies were found on Rebell traps during both trapping periods, these counts were not statistically different from those recorded for the 9-cm-diameter red spheres or the baited Pherocon AM board in the vertical orientation. However, the Rebell trap (nonbaited) was the most selective device tested, capturing >70% of *R. cingulata* flies, compared with baited red spheres (mixed into the Tangle-Trap) and vial baited Pherocom AM boards in V-orientation, which only captured ≈55 and 46%, respectively, of *R. cingulata* flies. This high degree of selectivity may be owing to the fact that the Rebell trap is unbaited, and therefore large numbers of other Dipteran insects that are usually attracted to the ammonia of baited yellow boards and red spheres were avoided.

The overall superiority of the unbaited Rebell trap stems from its visual attractiveness to both *R. fausta* and *R. cingulata* flies. The trap is comprised of two thin (approximately 2 mm thick) plastic panels that snugly fit into each other, creating a three-dimensional, cross-shaped structure. This configuration appears to provide a greater field of visual stimulus (regardless of fly approach) to *R. fausta* flies, which spend the bulk of their time foraging on host leaves. The three dimensional plastic Rebell trap is pigmented with daylight fluorescent yellow color, the brilliance of which is maintained throughout the course of the season. Alternatively, the cardboard Pherocon AM yellow traps have a greater tendency to decay, becoming tarnished and losing their yellow color during a typical Michigan summer (because of heavy rain and sun exposure).

Our 1998 findings supported the earlier work of Prokopy (1975) and Reissig (1976) that Pherocon AM yellow board in the V-orientation appeared to be fairly selective to *R. cingulata.* However, the degree of selectivity of the V-orientation was lesser when compared with the Rebell trap. Our 1998 results demonstrated that traps baited with aqueous solutions containing dissolved ammonium acetate crystals were three to six times as attractive as traps baited with ammonium acetate crystals embedded in the Tangle-Trap. These results were similar to those observed by Reissig (1976) who also found that baiting yellow boards in the V-orientation with ammonium acetate solution increases the attractiveness to *R. cingulata* flies compared with other ammonium baits mixed into the Tangle-Trap.

The low counts of *R. fausta* flies during the 1998 field season were probably due to the late establishment of the experiment (25 June). We subsequently learned that this was after peak emergence of *R. fausta* in southern Michigan. Populations of *R. fausta* usually emerge ≈3 wk earlier than *R. cingulata.* This situation was corrected in 1999 by starting the experiment ≈3 wk earlier.

We observed differences based on sex in the response of *R.cingulata* and *R. fausta* to the yellow, foliage-mimicking traps with or without ammonia. A higher percentage of *R. fausta* females compared with males were attracted to the unbaited Rebell trap and the Pherocon AM yellow boards. In contrast, both male and female *R. cingulata* responded with near equal frequency to these commercial traps. This difference in species response was observed throughout both trapping periods and did not appear to change as flies matured. We conclude that yellow foliage-mimicking colors and ammonium volatiles serve as stimuli for both sexes of *R. cingulata.* However, these same stimuli appear to be significantly more important to *R. fausta* females than males for host or mate finding and recognition. Perhaps the response *R. fausta* males is guided by different stimuli while foraging.

Our research demonstrates that the Rebell trap is the single most effective and selective device that is commercially available for monitoring both *R. fausta* and *R. cingulata.* The study also showed that red spheres (9 cm diameter) are ineffective for monitoring *R. fausta.* However, spheres can be used in management programs for *R. cingulata.* This difference in attraction to spherical traps between the species has future implications in control programs using the recently developed insecticide-treated sphere technology (Hu et al. 1998, Liburd et al. 1999). The potential use of red or black insecticide-treated spheres may be a viable future strategy for the management of *R. cingulata* but not *R. fausta.* A possible future research direction for the control of *R. fausta* is the development of a yellow, three-dimensional, nonsticky, insecticide-treated device.

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