Comparison of Two Yellow Sticky Traps for Capture of Western Cherry Fruit Fly (*Rhagoletis indifferens*) in Tart Cherry in Northern Utah
2015

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Objective:
To compare the efficacy of two types of yellow sticky traps for attraction and capture of western cherry fruit fly (*Rhagoletis indifferens*) adults in tart cherry in northern Utah. The standard yellow sticky trap for monitoring cherry fruit fly is the Pherocon AM Baited Trap (Trece Inc., Adair, OK). It is a folded cardboard trap with a food attractant incorporated into the soft and sticky adhesive. It is opaque; no light passes through. This standard trap was compared with the Alpha Scents, Inc. (West Linn, OR) Yellow Sticky Card. The Alpha Scents trap is made from a thin cardstock with a hot-melt adhesive on both sides that is tacky, but dry. This Alpha Scents trap is semi-transparent; some light passes through. Additional ammonium carbonate bait was used with both trap types.

Pherocon AM Baited Trap

Alpha Scents Yellow Sticky Card

(Ammonium carbonate bait boxes were hung from the bottom of traps)

Methods:
Experimental Design
The study was conducted in a 2.6-acre 'Montmorency' tart cherry orchard planted in 2003 at the Utah State University (USU) Horticulture Research Farm in Kaysville, UT. Tree and row spacing was 3.4 × 6.1 m (11 × 20 ft), respectively. Trees were approx. 4.5-6 m (15-20 ft) tall, and the canopy had filled its space within the row. An insecticide efficacy trial with four treatments was established in the orchard, and the traps were compared by placing one of each type in each plot. Plot size was 18 trees (three rows by six trees within a row) surrounded by one row of untreated buffer trees, and replicated four times in a randomized complete block design. Three insecticide treatments were compared to an untreated control (see treatments below) and applied three times with an airblast sprayer (100 gpa; 100 psi) at a 7- or 9-day interval on June 3, 12, and 19. Other pesticides applied to the plots included fungicides for powdery mildew control, but no insecticides other than those included in the study treatments were applied.

Treatments:
1. Untreated control
2. Altacor (Chlorantraniliprole) WG 3.0 oz per acre (label rate is 3.0 to 4.5 oz per acre)
3. Cyclaniliprole 16.4 oz/acre
4. Cyclaniliprole 22 oz/acre

Cherry Fruit Fly Trapping
Traps were placed on May 26 and serviced approximately weekly through June 30 (five weeks). One Pherocon AM Baited Trap (PH) (23 × 14 cm; 9.1 × 5.5 in) and one Alpha Scents Yellow Sticky Card (AS) (18 × 14 cm; 8 × 5.5 in) were hung from a limb at a height of 1.8 m (6 ft) on the southwest side of two different center tree in each plot. An additional ammonium carbonate (AC) bait box was hung from the bottom of each trap, and refilled weekly. On each trap service visit, adult western cherry fruit fly (WCFF) were removed from PH traps with a metal scooper and placed into labeled vials with histoclear, a concentrated citrus oil solvent (Great Lakes IPM, Vestaburg, MI), to dissolve the adhesive. After several weeks in histoclear, flies were transferred to 70% ethyl alcohol for storage. The tacky surface of the AS traps prevented easy removal of adult flies, so on each service visit, AS traps were removed from the limb, covered with clear plastic wrap, and the trap replaced. AS traps were stored in a refrigerator to await processing. Flies were examined under a dissecting microscope (10-30 × magnification) to determine their sex, and female abdomens were dissected to determine reproductive maturity (fully developed eggs present, or not). Numbers of captured adults across sampling dates, and cumulative numbers of adults captured during the five-week period, were compared among trap types with analysis of variance (SAS Institute Ver. 9.3; Proc Mixed). The frequency of capture of male vs female adults, and immature vs mature females, was compared among trap types with a chi-square test (SAS; Proc Freq).

Results:
Trap capture increased from late May to mid-June, and then plateaued (AS) or decreased (PH) in late June (Fig. 1). Adult capture did not significantly differ between the two trap types ($p = 0.08$); however, there was a significant interaction between trap type and date ($p < 0.0001$) and capture differed among dates ($p < 0.0001$). The interaction was caused by the difference in adult capture patterns across time for the two trap types. AS traps continued to catch higher numbers of WCFF adults into late June while capture rates declined on PH traps (Fig. 1). Adult counts were higher on June 15 and 23 than on all other dates.

There was also not a significant effect of trap type on cumulative capture of adults for the five week period ($p = 0.11$); but there were significantly more reproductively immature females caught on AS than PH traps ($p = 0.01$) (Fig. 2). In addition, there was a significant interaction between insecticide treatments and trap type in capture of reproductively mature females only ($p = 0.05$) (Fig. 3). More mature females were caught on AS traps in the untreated control, whereas more mature females were caught on PH traps in the three insecticide treatments.

Comparison of the frequency of capture of male vs female adults did not vary among trap types ($p = 0.90$); for both traps, more males than females were caught (Fig. 4). Likewise, the frequency of female adults with immature vs mature ovaries did not vary with trap type ($p = 0.27$); more immature than mature females were captured on both types of traps (Fig. 5).

Conclusions:

Population pressure of western cherry fruit fly was high in this study. Mean weekly capture rates ranged from 22 to 52 adults per trap, much higher than is typical in commercially managed tart cherry orchards in the region. WCFF population size was more than adequate to assess efficacy of the two trap types for attractiveness and capture success of adults.

Capture rates of total numbers of WCFF adults were similar between AS and PH traps; however, AS traps were more efficient in attracting and/or capturing adults during the last two weeks of the study in late June when populations were high. While capture rates dropped for the PH trap, capture remained steady for AS traps (Fig. 1). Interestingly, more reproductively immature female WCFF were captured on AS than PH traps (Fig. 2). The bright yellow color of the two traps is similar, but the semi-transparency of AS traps allows for the yellow color to be visible to adult flies inside the canopy of the tree, whereas the solid PH traps prevent light transmission and appear dark from inside the tree canopy. Immature females may be searching for males to mate or ripe cherry fruits as they wait for their ovaries to mature. The transparent yellow color of the traps may be more attractive to immature females, or the hot-melt adhesive of the AS traps may be more efficient in capturing WCFF. Males were the most common sex of WCFF present in the trees (Fig. 4), but immature females were more abundant than mature females (Fig. 5).

It isn't apparent why more reproductively mature females were caught on AS traps in the untreated control plots while the trend was the opposite for the three insecticide treatments (Fig. 3). WCFF trap capture was greater overall in the untreated control ($p = 0.0004$); therefore, the AS traps may have been more effective in attracting and/or capturing mature females where total adult densities were higher.

In conclusion, although the AS trap was not found to capture more total numbers of WCFF adults than the standard PH trap during the entire five-week study period, it did capture more adults during late June when WCFF populations were high. AS traps also captured more reproductively immature females and mature females in the untreated plots where WCFF densities were greatest. AS traps may be more efficient in retaining flies that alight on the trap surface. Across the entire five-week period, AS and PH traps caught a similar ratio of male vs female and immature vs mature female WCFF adults. The Alpha Scents catalog claims that based on a USDA study, 1.5 to 2.2 more target pests are caught on the Yellow Sticky Card than other brands. Although this same finding was not reproduced in this study, the AS traps did perform slightly better than the PH traps in capturing WCFF.

An advantage of AS traps is that the cost was slightly less; $1.20 vs $1.78 each when purchased in a case of 100 traps. The AS trap dimensions are slightly smaller than the PH trap (18 × 14 cm vs 23 × 14 cm); thus, the smaller size could reduce WCFF capture rates. The ease of use of the two traps is similar. The type of trap adhesive didn't influence the efficiency of adult sexing and female dissection. Adult flies could be equally sexed and female abdomens dissected to determine maturity status whether they were in the dry adhesive of the AS trap, or removed from the soft adhesive of the PH trap. Removal of flies into histoclear, and then transfer to ethyl alcohol added extra steps for processing flies on PH traps. The semi-transparency of the AS traps may increase their visual yellow cues to WCFF adults, although this effect was not consistent during the entire study period in this tart cherry trial.

Fig. 1. Effect of trap type on adult WCFF trap capture from May 26 to June 30, 2015, Kaysville, UT.

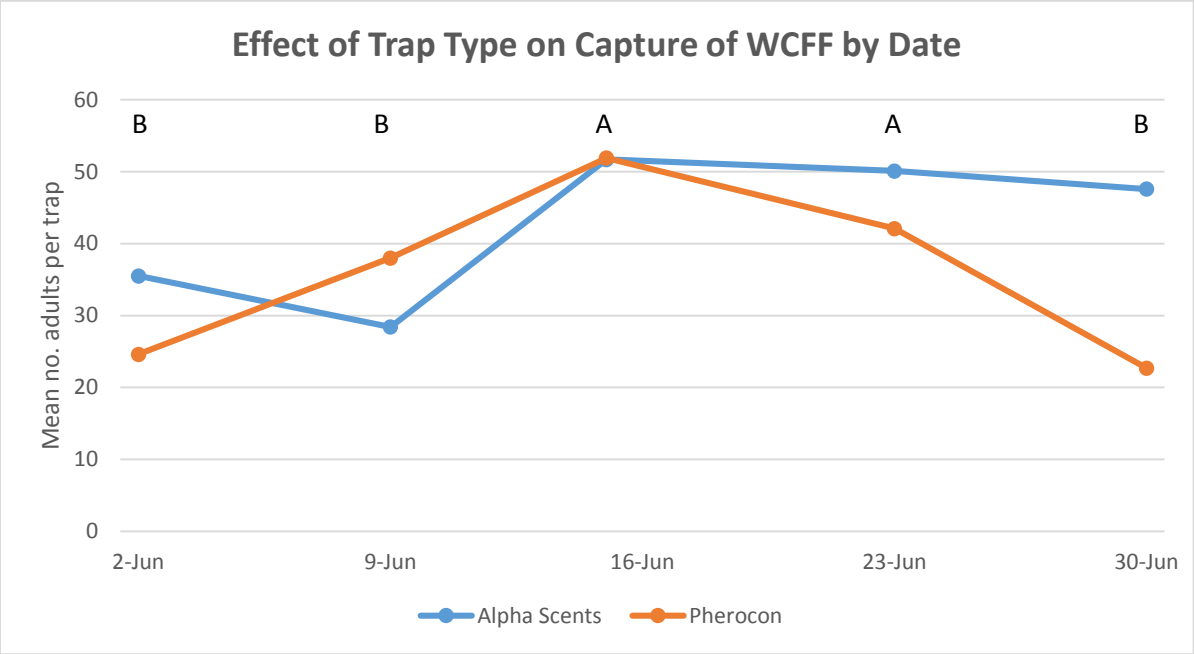

Fig. 2. Effect of trap type on cumulative capture of reproductively immature WCFF females from May 23 to June 30, 2015, Kaysville, UT.

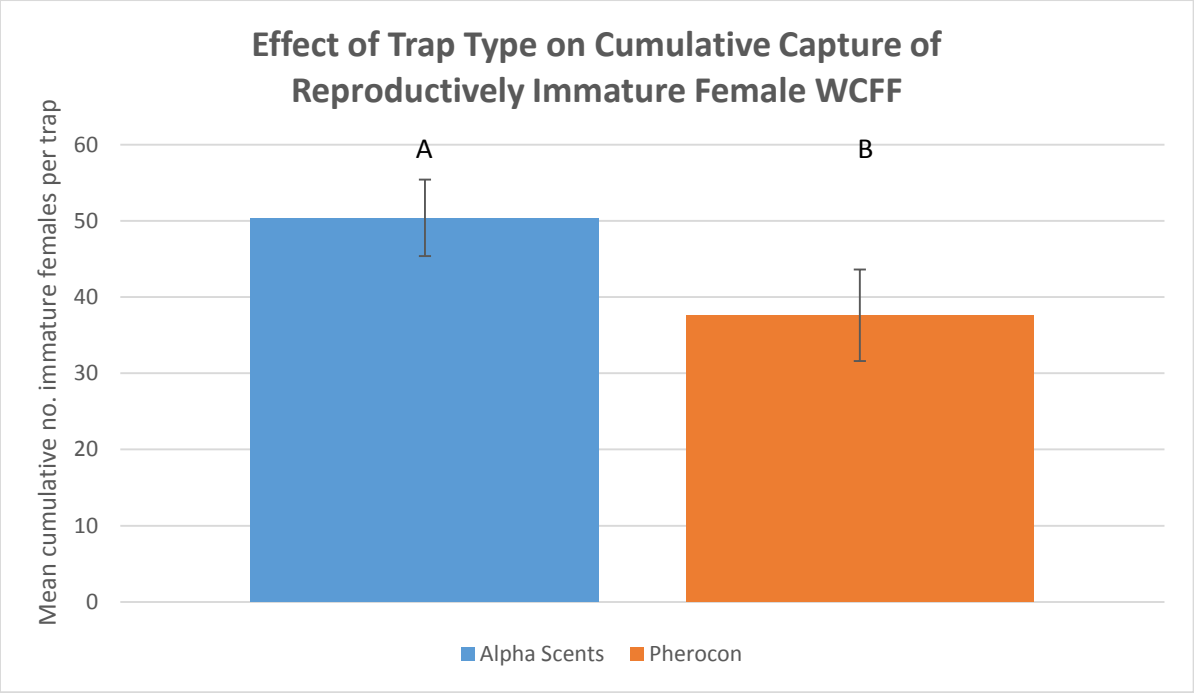

Fig. 3. Interaction between insecticide treatment and trap type on capture of reproductively mature females (contain mature eggs).

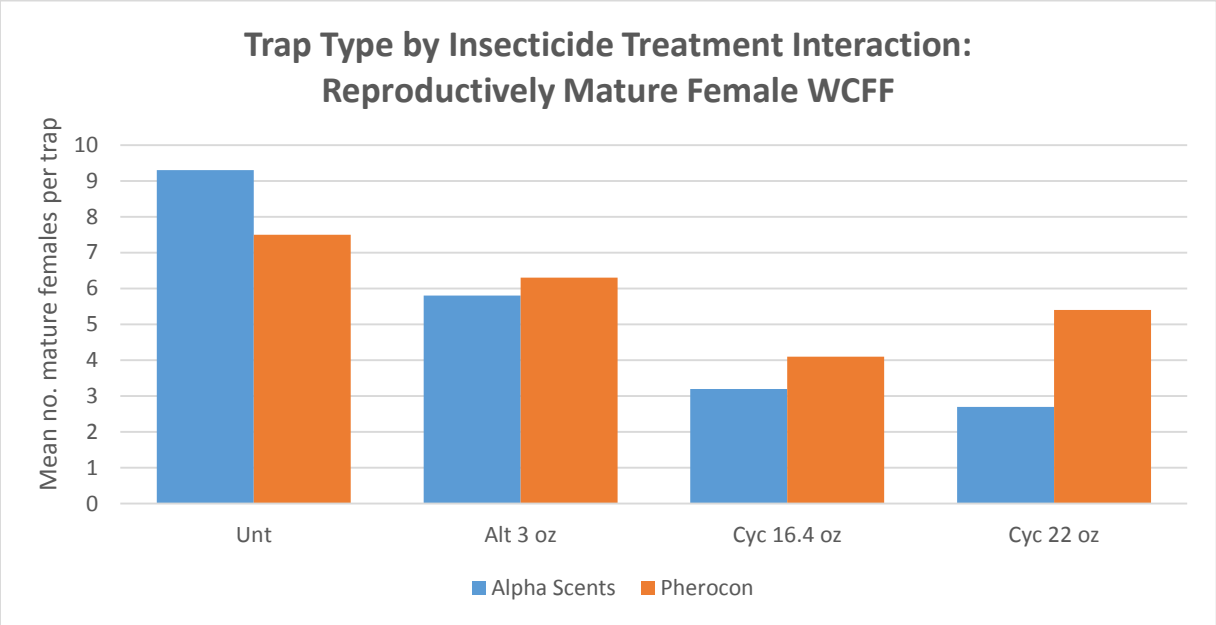

Fig. 4. Cumulative capture of WCFF male vs female for the two trap types.

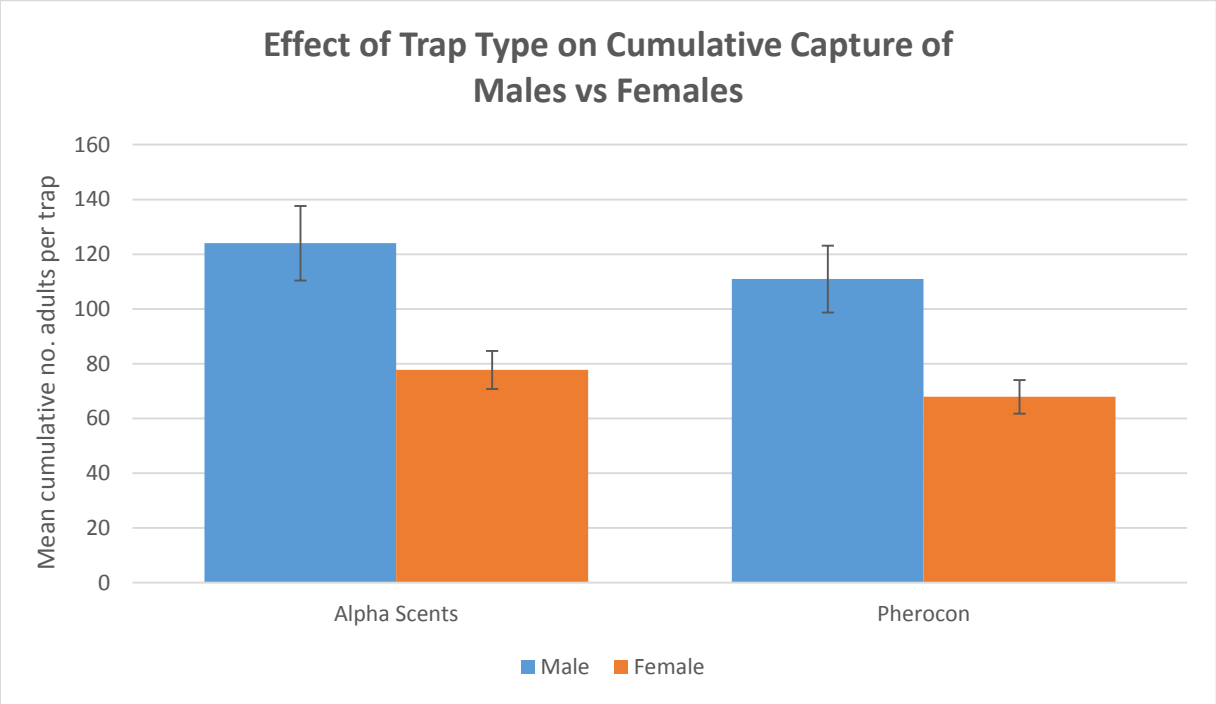

Fig. 5. Cumulative capture of WCFF immature vs mature females based on ovary status for the two trap types.