Evaluation of New Codling Moth Lures and Traps in Mating Disrupted Orchards

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Introduction

Recent developments in monitoring codling moths in pheromone treated orchards have included pheromone lures with higher emission rates and increased longevity. Therefore, selection of trap lures will need to consider potential differences in lure capture rates, cost per individual lure, and the longevity of each lure. Similarly, different trap types have also been developed that vary in size, construction material and design. Often trap selection is based on similar criteria of cost, longevity, and number of moths captured, but also differences in personal preferences play an important part of the selection. Individuals will need to consider trap servicing costs and ease of use when making these decisions. Given the personal nature of this type of decision, we only report moth counts as one objective component of the larger decision-making process.

Previous research has demonstrated that traps baited with pheromone lures have significantly reduced range of attraction in orchards under pheromone mating disruption. Similarly, there is increasing concern about false negatives in pheromone-disrupted orchards. This occurs when monitoring traps in an orchard fail to detect codling moth but non-acceptable levels of codling moth damage occur. As such, our research is part of a larger effort to improve and increase our ability to capture codling moths in pheromone-disrupted orchards. At this stage, we are trying to increase the numbers of moths caught per trap in disrupted orchards over the course of the growing season so as to increase our ability to detect problem orchards. In conventionally managed orchards, catching adequate numbers of moth is rarely a problem using pheromone traps.

In addition, a new type of lure has been co-developed by Trece and Doug Light, USDA-ARS in Albany, CA. The lure is described as a bi-sexual lure that attracts both males and females and is derived from a plant volatile. Therefore, a second objective was to evaluate the effectiveness of this lure in pear orchards under mating disruption.

Seven different types of lures were compared over the course of the growing season in three different sets of experimental plots in two major growing areas of California. Similarly, three different trap types were evaluated using a standard lure in all trap types. While previous research has shown that different lure types vary considerably in their longevity and emission profiles, the consequence of these differences relative to their performance under varied field conditions in California has not been evaluated.

Materials and Methods

Seven lure types were compared in this study, and we used the Pherocon® 1CP wing traps (Trece, Inc.) for all treatments so as to eliminate a trap effect. Five lure types are baited with the codling moth pheromone (codlemone) and two types (Trece DA) utilize a plant volatile as the attractant. Lures were changed following the manufacturer's recommendation. Lure types tested are listed below with the manufacturer's change schedule in parentheses.

1. Trece CM 10X - red septa (2-3 weeks)
2. Trece Megalure (10-12 weeks)
3. Consep Biolure (4 weeks)
4. PheroTech Bubblecap (8 weeks)
5. Scenturion Experimental Lure (6-8 weeks)
6. Trece DA lure (8693) (10-12 weeks)
7. Trece DA lure (8694) (10-12 weeks)

In addition, we compared three trap types using the CM 10X red septa lure (Trece, Inc.) as the standard bait. Trap bottoms, or inserts, or traps were changed at six-week intervals or more often if needed. Trap types were as follows:

1. Scenturion delta trap
2. Pherocon® 1CP wing trap
3. Pherocon® IIC delta trap

Note that the Pherocon® 1CP trap with the CM 10X lure is common to both datasets, giving a total of nine treatments.

All treatments were represented in each of twelve sites. In each site, all traps were hung in the upper 1/3 of the canopy, and traps were spaced a minimum distance of 200 ft. from adjacent traps and away from an orchard edge. The twelve sites were located in pheromone treated pear orchards located in the Sacramento delta and Mendocino regions. All sites were treated similarly, except for five orchards in Sacramento in which traps were rotated periodically within the plots. Similarly, two new orchards were selected mid-season that had higher codling moth pressures, but were still located in the same general area.

The number of codling moth in each trap was recorded and the moths removed on a weekly schedule. The gender of moths trapped by the DA lures was identified and recorded when possible. However, the low trap counts precluded useful analyses of these patterns.

Results and Discussion

The data were analyzed as totals for all 12 sites rather than for individual regions. High inter-trap variability between orchards and dates made differentiation between lures or trap types difficult. The seasonal trends in codling moth across the 12 orchards are shown in Figure 1. As observed in the past, pheromone baited traps in pheromone mating disruption plots had low overall counts on average with peak counts of slightly less than 10 moths in a week. Consistent counts in this range typically would trigger some type of supplemental management tactic, e.g., insecticide application.

The results for each lure type are shown in Figure 2. Four of the lures (Biolure, Trece 10X, Scenturion experimental, and the bubblecap) were not statistically significant from each other, using a conservative mean separation test. The four lure types that caught the most were the Biolure, Trece 10X, Scenturion, and Bubblecap lures, respectively. Capture rate of the Biolure by Consep was statistically higher than the Megalure (Trece). No statistical differences were found between the Scenturion, Trece 10x, Bubblecap, and Megalure ($P > 0.05$). Trap captures were highly variable between sites and regions as suggested by the trap totals divided for each investigator (Figure 3).

Caution must be used when interpreting these counts in terms of lure purchase, given that lure capture rates are only one component of the decision making process. For example, the red 1mg septum yielded high counts of codling moth, but these lures were changed almost every 2 weeks because of the instable release rates after ca. 2 weeks. Thus, the desire for higher trap counts needs to be balanced against the greater maintenance requirements.

The lowest counts were from traps baited with an experimental lure developed from a plant volatile by Trece and Doug Light (8693 and 8694). While the lure was able to detect both sexes, the relative number of adults per trap was considerably lower than all other lures (ca. 10% of highest totals). The hope had been that the lures would provide a means to detect codling moth in pheromone-disrupted orchards. However, these data should only be viewed as preliminary given the early experimental stage of development for this product. Given that this type of lure is not expected to be directly affected by the presence of the pheromone, we feel that these lures may still have the potential to resolve our limited abilities to detect codling moth in pheromone treated orchards.

No significant differences were observed between the three trap types used in all three investigator's plots (Figure 4). Similar to the lure study, the trap results were highly variable between investigators as well as within the plots of each investigator (Figure 5). As such, trap selection appears to hinge on grower preference and cost rather than differences in their trapping ability.

While differences between lures exist, it remains important that growers or advisors be able to interpret their trap counts. Thus, consistency between weeks, months, and even years is imperative. For example, if the types of lures are changed sporadically during the growing season, then counts throughout the year become extremely difficult, if not impossible, to understand. As has been stressed in many publications, one of the keys to using codling moth traps is to select a trap and lure combination that provides good trap capture, then to maintain consistency in trap placement within a tree, within the orchard, and in location to the nearest pheromone dispenser for mating disruption.

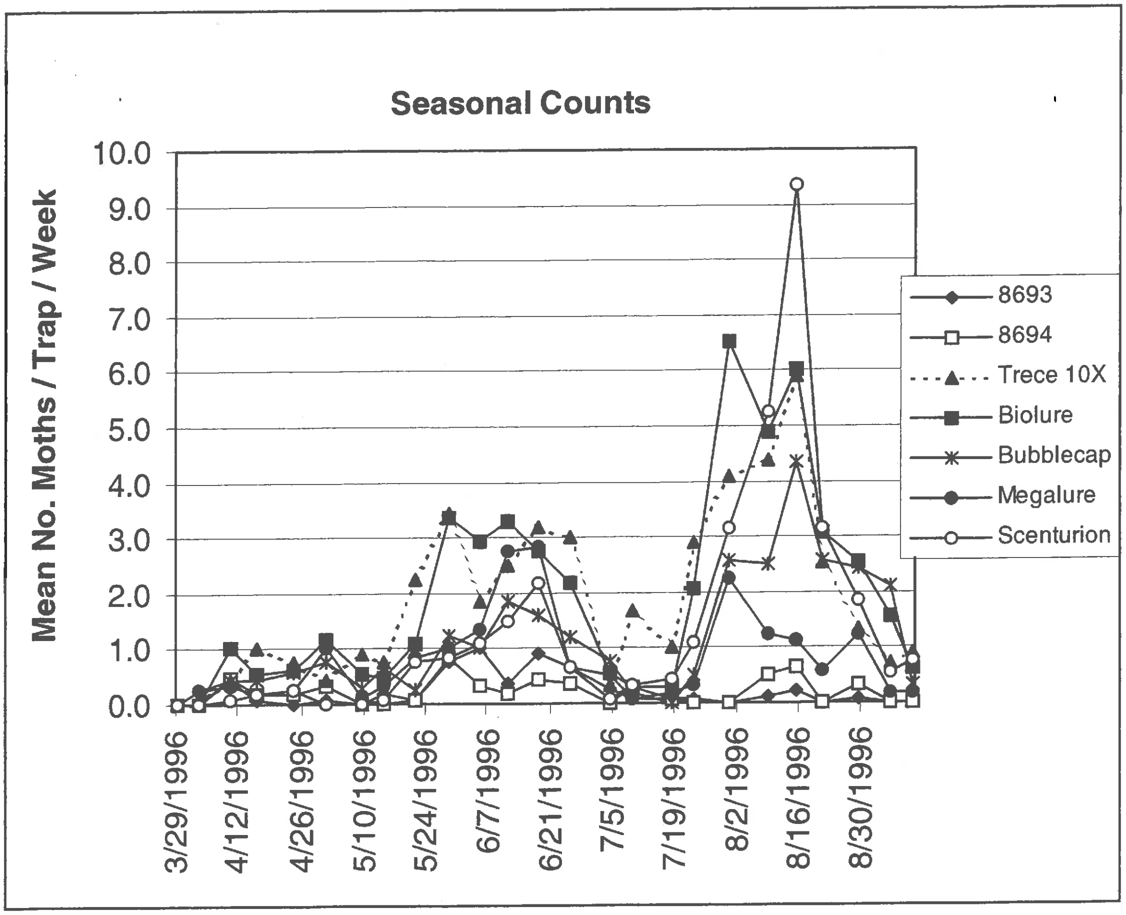

Figure 1. Seasonal trends in average weekly codling moth counts for the 12 orchards.

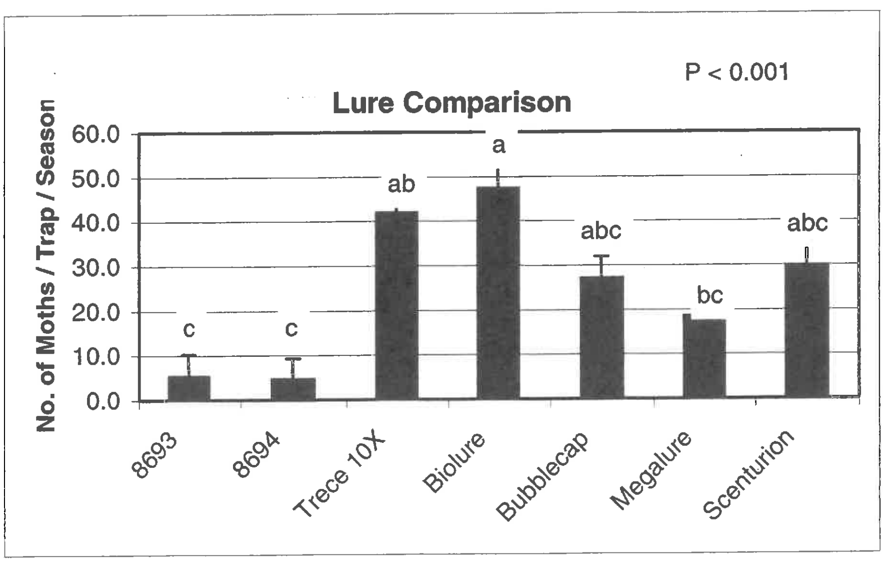

Figure 2. Seasonal average total codling moth counts per lure type for 12 orchards. Columns with the same letters are not significant different from each other at P <0.05 using Tukey's HSD test.

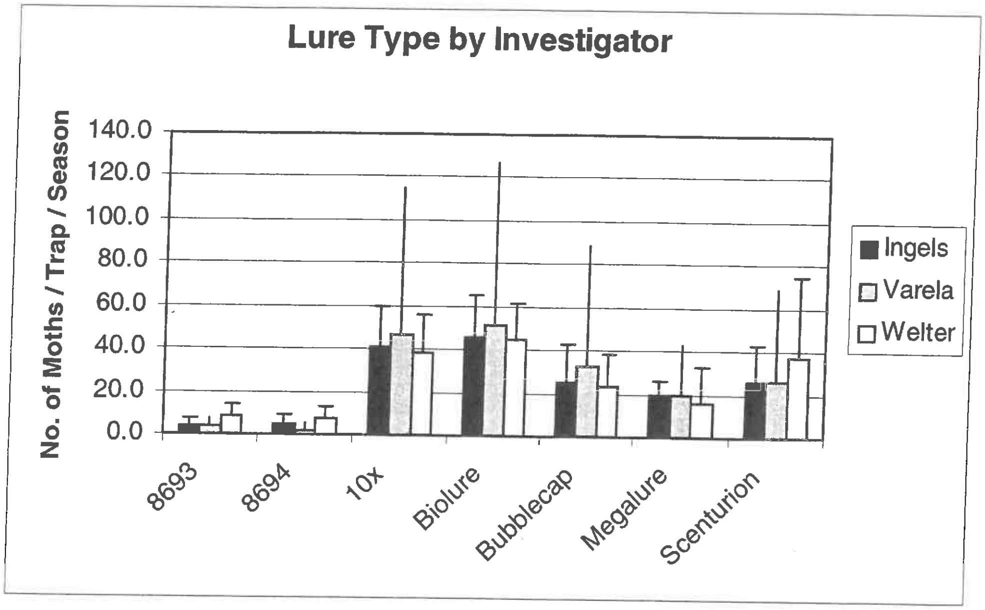

Figure 3. Seasonal average totals for codling moth for each lure type for 3 principal investigators. Columns with the same letters are not significant different from each other at P <0.05 using Tukey's HSD test.

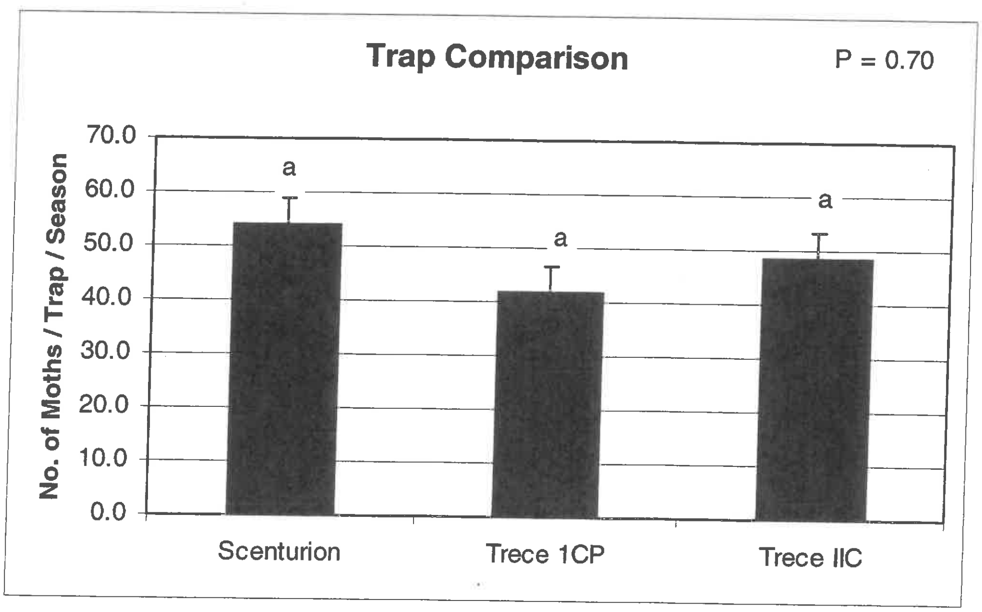

Figure 4. Average total codling moths for each trap type. Columns with the same letters are not significant different from each other at P <0.05 using Tukey's HSD test.

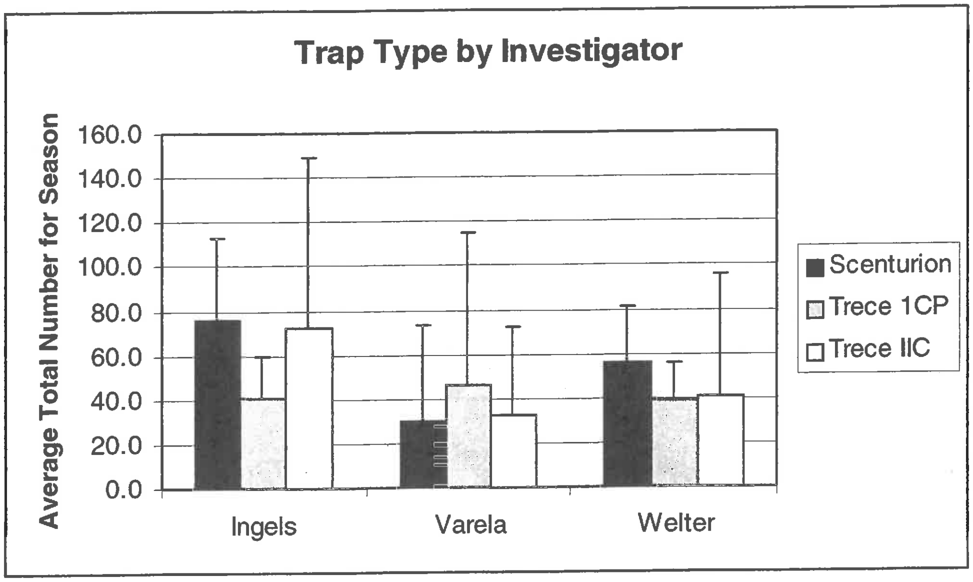

Figure 5. Average total codling moth for each trap type for each principal investigator.