Title: Evaluation of BioControl and Consep Codling Moth Pheromone Dispensers

Principal Investigator:
Lucia G. Varela, North Coast IPM Advisor
University of California Cooperative Extension &
Statewide IPM Project, Santa Rosa, CA 95403

Project Collaborator:
Greg Balog, Senior Agricultural Program Assistant
University of California Cooperative Extension
Santa Rosa, CA 95403

Abstract:
Two hand-applied dispensers of codling moth pheromone are commercially available: BioContol's Isomate-C and Consep's Checkmate in California. To compare these two products we measured trap suppression in side by side plots by releasing sterile codling moth males, assessing trap catches in each plot. The release of sterile males gives a greater population with which to measure trap shutdown than that of the natural population. Two plots of ten acres each were set up, one with Isomate-C and the other with Checkmate and replicated in three orchards. Sterile codling moths obtained from Canada were released at a rate of 800 moths per acre in each plot. Traps were set at the top of the trees in a grid pattern in each of the 10 acre plots. Traps were checked every other day for 10 days following release. Four releases were done at approximately 650, 1400, 1600 and 1800 degree-days. The release times were chosen to coincide with codling moth flights to estimate how the dispensers were performing during those periods. There was a statistically significant difference among treatments ($p<.01$) and release dates ($p<.01$). We also measured dispenser longevity through periodic laboratory analysis and by following weight loss for the BioControl dispensers.

Introduction:

Codling moth mating disruption is being implemented on an increasing number of pear acres. Two hand-applied dispensers are commercially available: BioContol's Isomate-C and Consep's Checkmate. Since the beginning of the areawide mating disruption project in Randall Island the dispenser used has been Isomate-C+. In the Northwest areawide mating disruption projects the product most commonly used is also Isomate-C+. Thus the majority of the knowledge and expertise that researchers and PCA's have acquired has been with Isomate-C+. In the Mendocino project Isomate-C+ was used for the first three years with a shift in the fourth year to 30% of the acreage under Isomate-C+ and the remaining 70% under Checkmate. Consep's Checkmate product is being modified every year and again this coming year a new product that lasts the entire season was introduced.

BioControl's Isomate is being used in a late hanging strategy in Lake County because it is unknown if this product will last the entire season in this location. In warm

years where we may have a third flight, it is important to know if the dispensers last beyond harvest, thus reducing infestation of the fruit remaining on the tree. It is also important to determine when is the earliest that we can deploy either product to be able to protect the fruit through harvest and to avoid increasing populations in the fruit that remains in the tree post harvest. Yet, we need to know how late in the season hangings can be made so we have protection until the end of September without wasting product in October and November when codling moth is already in diapause. October and November are warm months in our region; therefore pheromone continues to be released when it is not needed.

We evaluated the longevity of these two dispensers and compared codling moth trap suppression.

Objectives: To evaluate the longevity and efficacy of the two codling moth pheromone dispensers: BioControl's Isomate –C and Consep's Checkmate.

Plans and Procedures:

Dispenser longevity

Field hung BioControl Isomate-C+ and Isomate C++ dispensers were weighed weekly to determine weight loss. Consep checkmate was removed from the field on a bi-weekly basis and analyzed by Consep. BioControl Isomate C+, Isomate C++ and Consep Checkmate dispensers were sent for chemical analysis to Scenturion Inc. on June 15, July 18 and August 29 at 888, 1527 and 2374 degree-days receptively. These times were chosen to coincide with the end of the first codling moth generation, during the second codling moth generation just before harvest and the beginning of the third flight.

Trap Suppression

To evaluate trap suppression efficacy of both dispensers, we released sterile codling moths and evaluated how many male moths were caught in traps in each plot. The release of sterile males gives a greater population with which to measure trap shutdown than the natural population. Two plots of ten acres each were set up; one with BioControl Isomate-C++ at 200 dispensers/acre and the other with Consep Checkmate also at 200 dispensers/acre. These two treatments were replicated in three different orchards. Sterile codling moths obtained from Canada were released at five release points situated in the center 5 acres of each plot (total of 10 release points per orchard). At each release point 1600 moths were released. A pair of traps was set at the top of the trees at each side of every release point 40 feet away. One trap was loaded with 1mg pheromone lure and the other was loaded with 10mg pheromone lure. Traps were checked every other day for 10 days following release. Four sterile moth releases were done at 675, 1400, 1670 and 1835 degree-days. The release times were chosen to coincide with codling moth flights to estimate how the dispensers are performing during those periods. Data was analyzed using ANOVA

Mating evaluation

To evaluate mating at both plots, females were trapped and the ovaries dissected to determine if mating occurred. Females were trapped in both Isomate-C++ and Checkmate 10-acres plots (prior to sterile moth releases) and in each of three orchards under Isomate-C+ and Checkmate in the Mendocino Areawide Project. Female attractants lures by Trece were used to trap the females. Trapping was done during the "A" and "B" peak of the first generation and during the second generation.

Fruit damage

Fruit damage was evaluated at harvest in the two10-acres plots in the three orchards. Three thousand fruit per plot were inspected for codling moth damage.

Results:

Dispenser longevity

Weight for BioControl dispensers Isomate C+ and C++ as measured by weighing the dispenser every week is presented in figure 1. Isomate C++ is a new unregistered dispenser by BioControl that is composed of two tubes of the Isomate C+ dispenser. Thus, Isomate C++ has double the amount of pheromone as Isomate C+ and is placed at 200 dispensers/acre. The weight loss for the Isomate C+ dispenser ranged from 0.3 to 1.9 mg/day, and for C++ from 0.5 to 3.4 mg/day. Since Isomate C++ is composed of two tubes the average weight loss per day should be double the weight loss per day of Isomate C+. After day 37 the weight loss for Isomate C++ was approximately double of Isomate C+, however early in the spring when temperatures are cool Isomate C++ did not loose double the weight as Isomate C+.

Codling moth pheromone is composed of three components with codlemone being the primary component. Both BioControl dispensers, Isomate C+ and C++, are loaded with the three components of the pheromone. The chemical analysis gives the weight of each individual pheromone component. If to the total weight of the three components we add the weight due to inert components we get the total weight of the liquid inside the dispensers. Therefore, we can compare the chemical analysis results to the weight loss as measured by weighing the dispensers. The total weight from the chemical analysis measured on three different dates and the cumulative weekly weight loss as measured by weighing is presented in figure 2 for Isomate C+ and figure 3 for Isomate C++. The chemical analysis coincides with the weight measurements at day 66 for both dispensers C+ and C++ (see figures 2 and 3). At day 99 and 141 the weighing measurements give approximately double the weight of that measured with the chemical analysis (figure 2 and 3). We do not know why the chemical analysis differs from the weight measurements. The chemical analysis is a more precise measurement, but to obtain a more accurate representation of the seasonal loss the chemical analysis should have been performed at shorter intervals.

The Consep dispensers are only loaded with codlemone, the main component of codling moth pheromone and not with a blend of the three components. The weights of codlemone for the BioControl and Consep dispensers are shown in Table 1.

Isomate C+ are loaded with half the amount of codlemone as both Isomate C++ and Checkmate, but the application rate for Isomate C+ is 400/acre while for Isomate C++ and Checkmate is 200/acre. Therefore, all three dispensers are similar in the amount of codlemone on a per acre basis. Because the chemical analysis was done at large intervals the average weight loss is a very gross estimate of the loss per day (Table 2). In the first period (day 0 to 66) the weight loss for Isomate C+ is 0.66 mg/day. If we multiply this rate by two (1.32 mg/day) to account for double the application rate, it is slightly higher than the weight loss for both Isomate C++ and Checkmate of 0.92 and 1.05 mg/day, respectively. During the second period (66-99 days) the daily weight loss is similar among the three dispensers (3.58 to 4.66 mg/day) but double that of the first period. The daily weight loss for the third period (99 to 141 days) for the BioControl dispensers Isomate C+ and C++ was only 0.15mg codlemone/day. By day 141 both BioControl dispensers still had codlemone left in the dispensers. At day 141 Consep dispenser had only an average of 4.8mg codlemone. Since we cannot determine when after day 99 the codlemone was exhausted in the Consep dispensers, the daily weight loss for the last period (99-141 days) cannot be calculated.

Trap Suppression

Over the four release dates, in traps loaded with 10mg lures we recaptured an average of 7.55 ± 0.94 and 2.26 ± 0.95 sterile moths per trap on the Checkmate and Isomate C++ treatments, respectively. Over all dates, trap suppression was significantly greater in the BioControl plots by a factor of 3X. Data for the individual releases is presented in Figure 4. In all four release dates trap suppression was greater in the BioControl plots by factors of 4, 3, 10, and 2X in releases 1,2,3 and 4 respectively. Traps loaded with 1mg lures caught too few moths to be able to do a statistical analysis.

Mating evaluation

To evaluate mating female attractant lures were used. The female attractant lures are an experimental lure that contains plant volatiles attractive to both female and males. Too few moths were collected in all plots to be able to conduct a statistical analysis of mating in the Isomate C++ plots versus those caught in the Checkmate plot.

Fruit Damage

Fruit damage was evaluated mid-season and at harvest from the two treatments (Isomate C++ and Checkmate) in the three orchards. There was no significant difference in damage between treatments (Table 3); damage was very low in both treatments. We chose three orchards with low codling moth populations to conduct the experiment to avoid having to put a cover spray that might cloud the results of the comparison of the two treatments.

Conclusions

There was a significant difference in trap suppression between treatments. Over four release dates trap suppression was three times greater in the plots under BioControl Isomate C++ dispensers than plots under Consep Checkmate dispensers. The difference in trap suppression cannot be explained by differences in the dispensers release rates of codlemone. The release rates up to day 99 were similar for both Isomate C++ and Consep Checkmate. Chemical analysis of the dispensers needs to be conducted at shorter intervals to get a more accurate representation of the release rates throughout the season. Since both dispensers were applied at 200 dispensers per acre, the number of point sources for both product was the same.

Other explanations need to be investigated that might account for the difference in trap suppression between the two products. The dispensers differ in several respects. The shapes are different, thus the plume emitted by either dispenser might be different. One dispenser is loaded with a single pheromone component while the other is loaded with a blend of three components. The level of polymerization of the pheromone might vary between dispensers. These differences need to be further investigated.

Table 1. Weight of codlemone present in Isomate C+, Isomate C++ and Checkmate dispensers at 0, 66, 99 and 141 days old

	mg of codlemone		
Day	Isomate C+	Isomate C++	Checkmate
0	130.5	261.0	270.0
66	87.0	200.1	200.9
99	27.9	75.0	47.0
141	21.8	68.5	4.8

Table 2 – Average codlemone weights loss/day for three dispensers Isomate C+, Isomate C++ and checkmate during three periods through the season

	Average codlemone (mg/day)		
Period	Isomate C+	Isomate C++	Checkmate
0 - 66	0.66	0.92	1.05
66 - 99	1.79	3.79	4.66

Table 3 – Codling moth fruit damage at harvest in plots under Isomate C++ and Consep checkmate dispensers in three replicated orchards

	Fruit damage (%)	
	Consep Checkmate	BioControl Isomate C++
Orchard 1	0.03	0.00
Orchard 2	0.00	0.03
Orchard 3	0.06	0.00