

<b><i>DESCRIPTION:</i></b>	Evaluation of BioControl and Consep Codling Moth Pheromone Dispensers
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## **Title: Evaluation of BioControl and Consep Codling Moth Pheromone Dispensers**

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### **Abstract:**

Two hand-applied dispensers of codling moth pheromone are commercially available in California: BioControl's Isomate C+ and Consep's Checkmate. Bio-Control is testing a new product Isomate Ctt. To compare these three products we measured trap suppression in side-by-side plots by releasing sterile codling moth males at different times during the season and assessing trap catches in each plot. The release of sterile males gives a greater population with which to measure trap shutdown than measuring native populations. The dispensers Isomate C+, Isomate Ctt and Checkmate CMWS were each applied to ten acres plots and replicated in four 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 surrounding the released points in each of the 10-acre plots. Traps were checked every other day for 10 days following release. Six releases were done at approximately 150, 600, 1000, 1400, 2000 and 2400 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 the majority of pear acres. Two hand-applied dispensers are commercially available: BioControl's Isomate C+ and Consep's Checkmate. BioControl has developed a new product Isomate Ctt containing two releasing chambers, doubling the amount of pheromone per dispensers, thus allowing to be placed at 1/2 the rate per acre than Isomate C+. 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 and fifth years to 30% of the acreage under Isomate-C+ and the remaining 70% under Checkmate.

Consep's Checkmate product is being modified every year. In 2000 the season long product Checkmate XL1000, was introduced. In 2001 the growers in the project returned to the previous product Checkmate CMWS that lasts 60 to 90 days and is applied twice per season.

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 measured the longevity of these three dispensers through weight loss and chemical analysis and evaluated their efficacy by measuring codling moth trap suppression.

**Objectives:** To evaluate the longevity and efficacy of the three codling moth pheromone dispensers: Consep's Checkmate CMWS and BioControl's Isomate C+ and Ctt.

### **Plans and Procedures:**

#### **Dispenser longevity**

Field hung BioControl Isomate-C+ and Isomate Ctt dispensers were weighed weekly to determine weight loss. In addition, Isomate C+, Isomate Ctt and Consep's Checkmate CMWS dispensers were sent for chemical analysis to Scenturion Inc. every two to three weeks. Checkmate CMWS dispensers were analyzed after 40, 68, 82 and 96 days in the field. Isomate C+ and Ctt were analyzed after 54, 68, 82, 96, 110, 124 and 138 days in the field. Analyzes of Checkmate dispensers were stopped after 96 days since the manufacture considers it a 90-day product.

#### **Trap Suppression**

To evaluate trap suppression efficacy of the 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. Three plots of ten acres each were set up; 1) Isomate C+ dispensers applied at 400 dispensers/acre, 2) Isomate Ctt dispensers applied at 200 dispensers/acre and 3) Checkmate CMWS dispensers applied at 160 dispensers/acre. The BioControl products were applied once during the season at codling moth biofix. Consep product was applied twice: at biofix and approximately 90 days later on the last week of June. These two treatments were replicated in four different orchards. Sterile codling moths obtained from Canada were released at a rate of 800 moths in each of five release points situated in the center 5 acres of each plot (total of 15 release points per orchard). For each release site a pair of traps was set 40 feet upwind from the moth release point. Within each pair, which was separated from each other by 80 feet, one trap was loaded with a 10-mg lure and placed at the top of the tree. The other was loaded with a 1-mg lure and placed at eye

level. Traps were checked every other day for 10 days following release. Six sterile moth releases were done at approximately 150, 600, 1000, 1400, 2000 and 2400 degree-days on May 1, May 23, June 20, July 11, August 8 and August 29, respectively. The release times were chosen to coincide with the A and B peak of the overwintering flight, the beginning and the B peak of the second flight, during harvest and post-harvest, respectively. This would allow us to estimate dispensers performance during those periods. Data was analyzed using ANOVA

### **Fruit damage**

Fruit damage was evaluated at harvest in the three 10-acre plots in the four orchards. Three thousand fruit per plot were inspected for codling moth damage.

## **Results:**

### **Dispenser longevity**

Weight for BioControl dispensers Isomate C+ and Ctt as measured by weighing the dispenser every week is presented in figure 1. Isomate Ctt is composed of two tubes of the Isomate C+ dispenser. Thus, Isomate Ctt has double the amount of pheromone as Isomate C+ and therefore is placed at 1/2 the rate of Isomate C+ dispensers/acre. The weight loss for the Isomate C+ dispenser ranged from 0.4 to 2.2 mg/day and for Ctt from 0.7 to 4.4 mg/day. This results are very similar to last years (please see 2000 report). Since Isomate Ctt is composed of two tubes the average weight loss per day should be double the weight loss per day of Isomate C+. After day 21 the weight loss for Isomate Ctt was approximately double of Isomate C+, however early in the first three weeks of spring, when temperatures are cool, Isomate Ctt released approximately 80% above the Isomate C+ release rate.

Codling moth pheromone is composed of three components with codlemone being the primary component. Both BioControl dispensers 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 ingredients 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 seven different dates and the cumulative weekly weight loss as measured by weighing the dispensers is presented in figure 2 for Isomate C+ and figure 3 for Isomate Ctt. In both Isomate C+ and Ctt, the chemical analysis consistently showed less amounts than by weighing the dispensers (see figures 2 and 3). For Isomate C+ the amount determined through chemical analysis was approximately 85% of the amounts obtained by weighing at day 54 and 68, but 50% for day 82, 96, 110, 124 and 138 (figure 2). For Isomate Ctt the amounts determined through chemical analysis were closer. For the first three dates they were approximately 80 to 95%, and for the last 4 dates approximately 60%. (Figure 3). We do not know why the chemical analysis differs from the weight measurements. The

chemical analysis is a more precise measurement thus after day 60 a chemical analysis should be used to determine the amount of pheromone left.

Of the three codling moth pheromone components, the Consep dispensers were loaded with only two: codlemone (the main component of codling moth pheromone) and the 12 alcohol. It did not contain the 14 alcohol. 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 of both Isomate Ctt and Checkmate CMWS, but the application rate for Isomate C+ is 400/acre while for Isomate Ctt is 200/acre and Checkmate is 160/acre. Therefore, all three dispensers should be 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). Release rate per day ranged from 0.4 to 1.1 mg during the first 80 for Isomate C+ and approximately double to triple that for Isomate Ctt (from 1.8 to 2.4 mg). Release rate increased substantially for both BioControl dispensers between day 82 to 96 to then decrease after day 96. By day 138 both BioControl dispensers had approximately 10% of the original codlemone left in the dispensers. When only 10% of the codlemone is left in the tubes, the release rate is very low. Thus both BioControl dispensers lasted approximately 135 days in the field in Mendocino County. The Concept dispenser released approximately 1.4 mg per day until day 68 and then released between 4 to 5 mg per day until day 96 when the analysis was stopped.

### **Trap Suppression**

Over the six release dates, in traps loaded with 10-mg lures we recaptured an average of  $66 \pm 15$ ,  $31 \pm 10$  and  $23 \pm 7$  sterile moths per trap on the Checkmate CMCS, Isomate C+ and Isomate Ctt treatments, respectively. Trap suppression was significantly greater with the BioControl dispensers during 4 of the 6 release dates (Figure 4). Trap catches were greater in the Concept plots than the Isomate C+ plots by factors of 0.7, 6, 2 and 3X in releases 1, 3, 5 and 6, respectively. Also, in releases 3, 5 and 6 we caught between double and triple the amounts of moths in the plots with Checkmate CMCS dispensers than in the plots with Isomate Ctt dispensers. Release # 4 happened one week after the second application of Checkmate CmWs was placed in the field. Plots under BioControl dispensers did not receive a second application. This may account why on the 4<sup>th</sup> release date there was no significant difference between treatments. But, one month later, on the 5<sup>th</sup> and 6<sup>th</sup> release dates, we once again caught substantially more moths in the plots under Checkmate CmWs dispensers than the other two treatments. Traps loaded with 1-mg lures caught too few moths to be able to do a statistical analysis (Figure 5).

### **Fruit Damage**

Fruit damage was evaluated mid-season and at harvest at the 3 treatments plots in the four orchards. There was no significant difference in damage between treatments (Table 3); damage was very low in all treatments. We chose 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 greater in the plots under BioControl Isomate C+ and Ctt dispensers than the plots under Consep Checkmate CMWS dispensers. The difference in trap suppression cannot be explained by differences in the dispensers release rates of codlemone. The release rates up to day 68 were similar for all three dispensers if we take into account the number of dispensers deployed per acre for each product. After day 68 Checkmate dispenser appear to be releasing at very high rates, still in those plots we continue to catch the most moths.

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 two-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 Ctt and Checkmate dispensers at 0, 66, 99 and 141 days old

Day	mg of codlemone		
	Isomate C+	Isomate Ctt	Checkmate CmWs
0	147	290	287
41			234
54	85	194	
68	79	167	190
82	69	134	134
96	30	80	64
110	29	72	
124	20	46	
138	12	39	

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

Period	Average codlemone (mg/day)		
	Isomate C+	Isomate Ctt	Checkmate CmWs
0-41			1.3
0-54	1.1	1.8	
41-68			1.5
54-68	0.4	1.9	
68-82	0.7	2.4	4.0
82-96	2.8	3.9	5.0
96-110	0.1	0.6	
110-124	0.6	1.9	
124-138	0.6	0.5	

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

	Fruit damage (%)	
	Consep Checkmate	BioControl Isomate Ctt
Orchard 1	0.03	0.01
Orchard 2	0.02	0.03
Orchard 3	0.01	0.03
Orchard 4	0.06	0.02



**Figure 1 - Isomate C+ and C<sup>TT</sup> Dispenser Weekly Weight Loss and Average Weekly Temperature in Ukiah, Ca 2001**

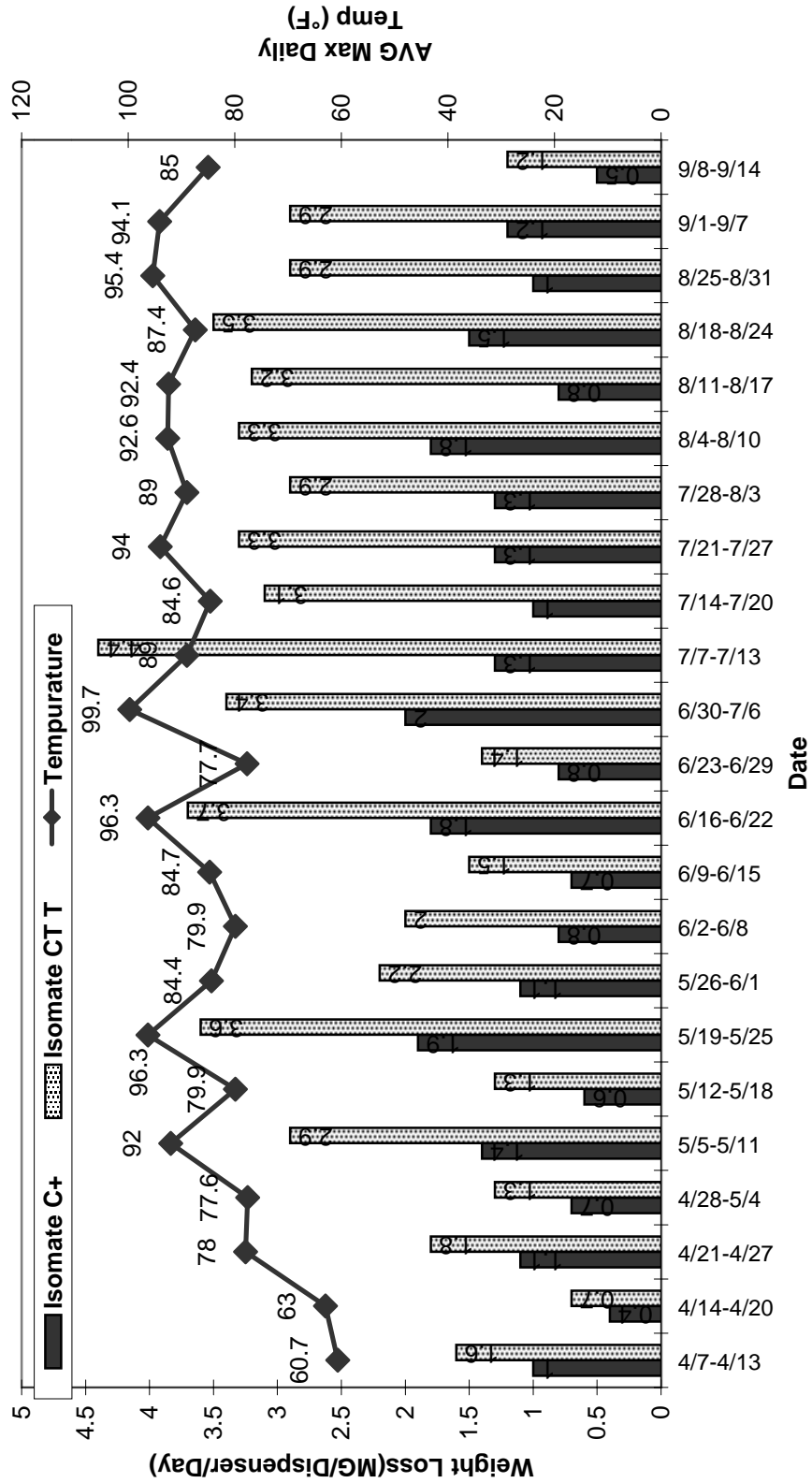
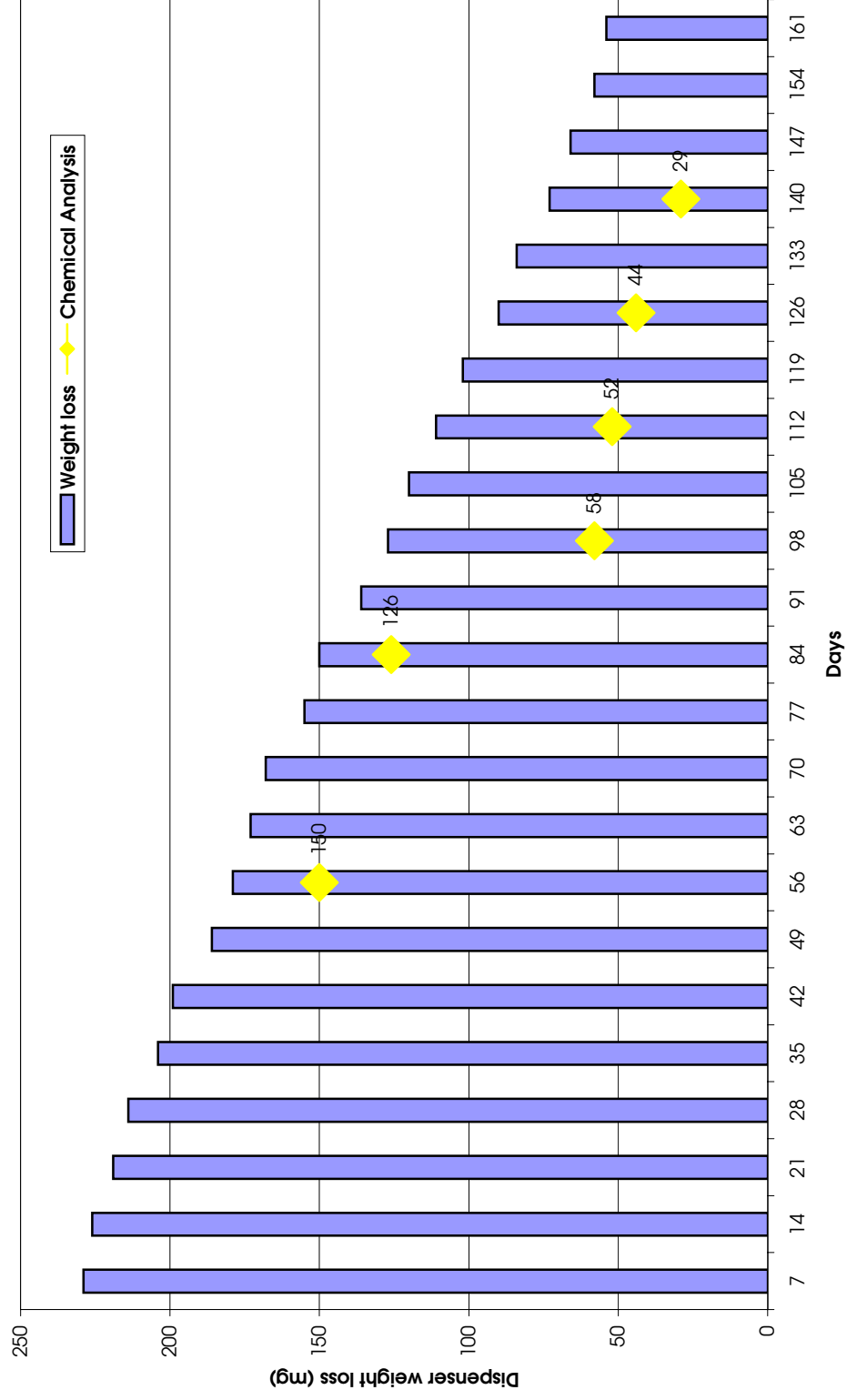
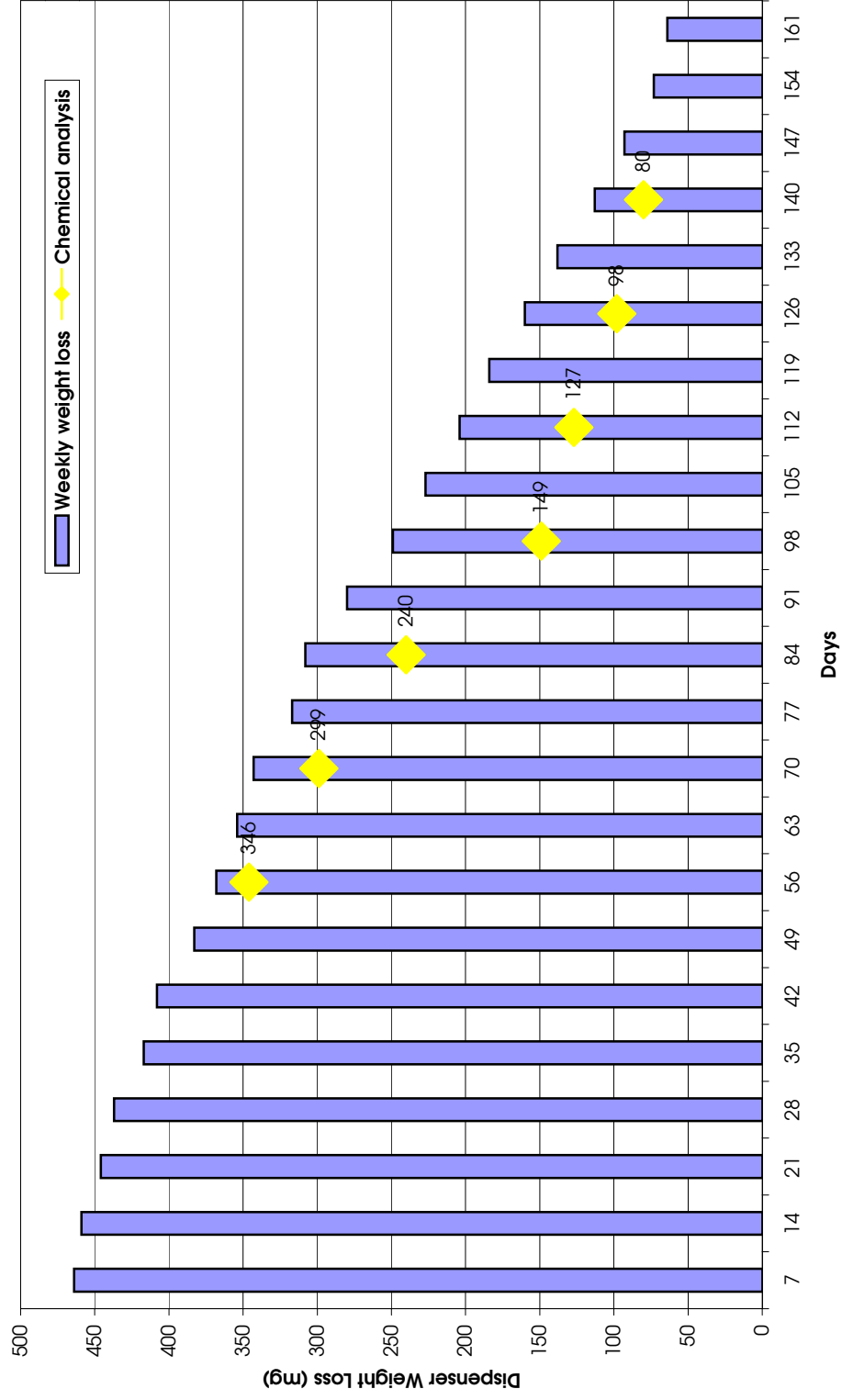


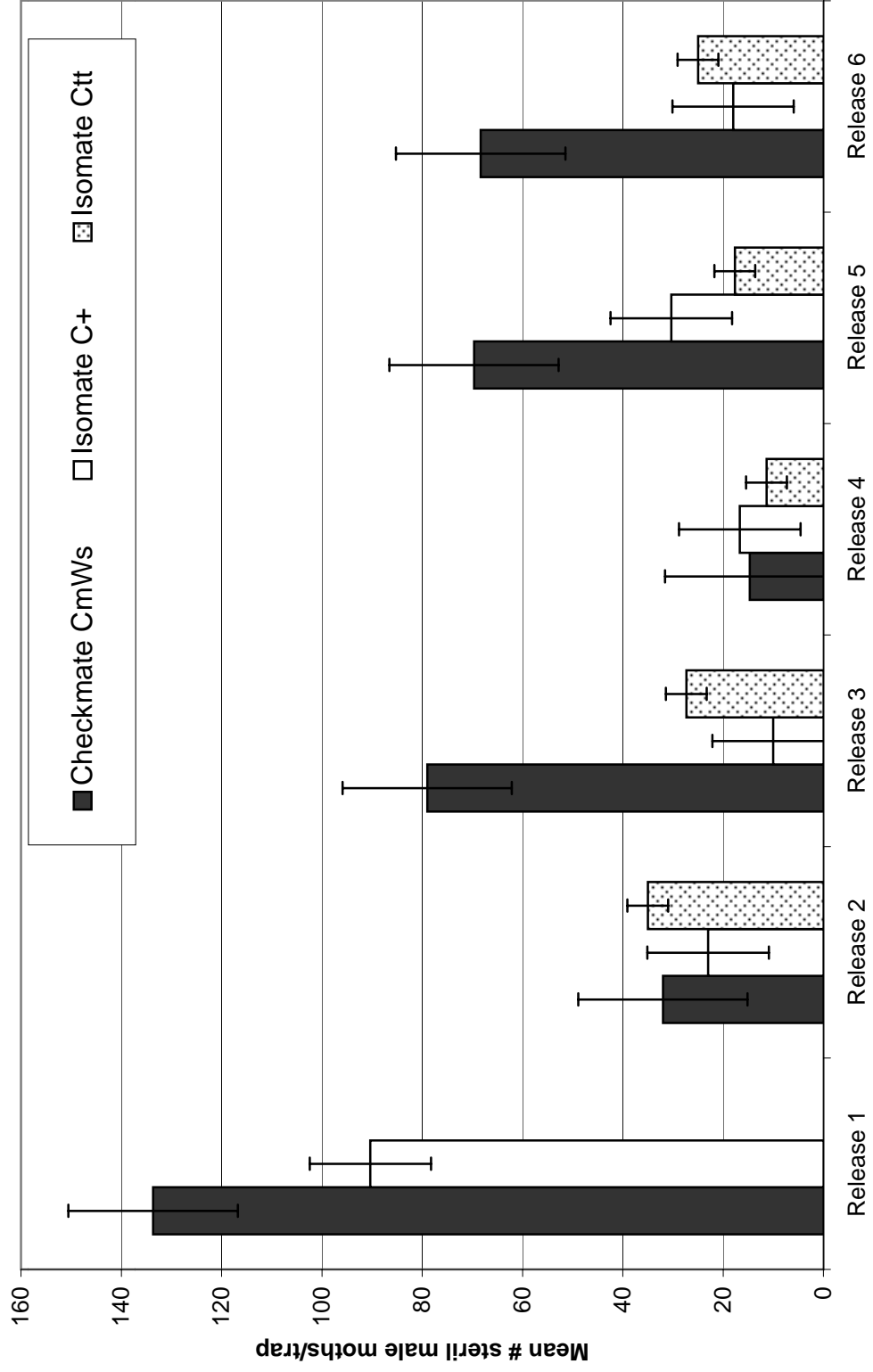
Figure 2 - BioControl Isomate C+ dispenser weight loss measured by: weekly weighing of dispensers and chemical analysis of all pheromone components and inert ingredients at 54, 68, 82, 96, 110, 124 and 138 days.



**Figure 3 - BioControl Isomate Ctt dispenser weight loss measured by: 1) weekly weighing of dispensers and 2) chemical analysis of all pheromone components and inert ingredients at 54, 68, 82, 96, 110, 124 and 138 days**



**Figure 4 - Mean Number of Sterile Male Moths Captured per 10X Trap in plots under Concep Checkmate CMWS, BioControl Isomate C+, and Isomate Ctt at six release dates (May 1, May 23, June 20, July 11, August 8 and August 29).**



**Table 5 - Mean Number of Sterile Male Moths Captured per 1x Trap in plots under Consep Checkmate CMWS, BioControl Isomate C+, and BioControl Ctt dispensers at six release dates (May 1, May 23, June 20, July 11, August 8 and August 29)**

