

## The Efficacy of Mating Disruption against Codling Moth [*Cydia pomonella* (L.) Lep.: Tortricidae] under Isparta Conditions

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### Abstract

The study was carried out for control of codling moth in the apple orchards of the Fruit Research Institute in 2008 and 2009. The orchards were comprised of Golden Delicious and Starking Delicious cultivars grafted on the seedling rootstock. There were two different treatments; mating disruption (MD) plot (1.5 ha in size), and control (C) plot (1 da in size). Isomate-C- Plus type of dispensers, containing 190 mg of active ingredient (E,E-8,10-Dodecadien-1-ol), were used as 1.000 pieces per hectare for all trees in the MD plot. In both MD and C plots, the insecticides were used Spirodiclofen, propargite (for mites), and imidacloprid (for aphids). Insecticides were not used for codling moth in both plots. In the study, fruits were collected from 30 trees in the MD plot while 10 trees were sampled in the C plot. The infected fruits were counted and the rate of infected calculated in percent. In the MD plot, the percentage of infected fruits was 2.38% in 2008 and 13.50% in 2009. In the C plot, the percentage of infected fruits was 72.07% and 64.05% in 2008 and 2009, respectively.

**Keywords:** Apple, *Cydia pomonella*, codling moth, mating disruption, population fluctuation

### Isparta Koşullarında Elma İçkurdu [*Cydia pomonella* (L.) Lep.: Tortricidae]'na Karşı Çiftleşmeyi Engelleme Yönteminin Etkinliğinin Belirlenmesi

### Özet

Bu çalışma, Meyvecilik Araştırma Enstitüsü elma bahçelerinde elma içkurdu ile mücadele amacıyla 2008-2009 yıllarında yürütülmüştür. Bahçeler, çoğür anacı üzerine açılı olan Golden Delicious ve Starking Delicious elma çeşitlerinden oluşmuşlardır. İki farklı uygulama bulunmakta olup bunlar çiftleşmeyi engelleme yöntemi parseli (ÇEY) (1.5 ha) ve kontrol (K) parselidir (1 da). ÇEY uygulanan parseldeki tüm ağaçlarda, hektara 1.000 adet, 190 mg aktif madde içeren (E,E-8,10-Dodecadien-1-ol) Isomate-C- Plus yayıcılar kullanılmıştır. ÇEY ve K parselinde insektisit olarak kırmızı örümcekler için spirodiclofen, propargite; yaprakbitleri için imidacloprid kullanılmıştır. Elma içkurdu için her iki parselde de insektisit kullanılmamıştır. Çalışmada, ÇEY parselinde meyveler 30 ağaçtan toplanırken, K parselinde ise 10 ağaçtan meyve örnekleme yapılmıştır. Kurtlu meyveler sayılarak kurtlanma oranı % olarak hesaplanmıştır. Yapılan çalışmada, ÇEY uygulanan parselde kurtlanma oranı 2008 yılında %2.38, 2009 yılında ise %13.50 olmuştur. K parselinde kurtlanma oranı ise 2008 ve 2009 yılında sırasıyla %72.07 ve %64.05 olarak gerçekleşmiştir.

**Anahtar Kelimeler:** Elma, *Cydia pomonella*, elma içkurdu, çiftleşmeyi engelleme yöntemi, popülasyonu dalgalanması

## 1. Introduction

Turkey acquires the first ranks in the world apple production, and 20% of its production takes place in the province of Isparta. Isparta is located in the Lakes Region of Turkey. The location is the transitional district between the middle of Anatolia and the Mediterranean. Its altitude is about 1000 m. Approximately, precipitation is 650 mm and temperature is 13°C. The apple is cultivated since 1950s in this region.

Diseases and pests are among the most serious problems of apple growing. Codling moth is the

most important pest of apple. Larvae makes holes, tunnels and galleries in fruits by eating their pulp and core (Beers et al., 1993; Beers et al., 2003; Anonymous, 2008; Pedigo, 2009) (Figure 1). Codling moth has high population and generated twice per year in Isparta. There is a need for alternative control methods to control codling moth damage (Kovancı, 2015). Mating disruption is one of the most promising alternative methods. The use of mating disruption encompasses 3% of the apple production areas worldwide and 7-8% of the apple production areas in developed countries (Anonymous,



**Figure 1.** Codling moth larvae (infected fruit)

2006). This study aimed at determining the efficacy of the mating disruption method against the codling moth in our region.

## 2. Material and Methods

The study was carried out for control of codling moth in the apple orchards of the Fruit Research Institute in 2008 and 2009. The orchards were comprised of Golden Delicious and Starking Delicious cultivars grafted on the seedling rootstock. There were two different treatments; mating disruption MD plot (1.5 ha in size), and control C plot (1 da in size). The material of the study was comprised of sexual attractive traps for codling moth (Pherocon type), specific dispensers and insecticides.

Isomate-C- Plus type of dispensers (Shin-Etsu Chemical Co. Ltd.) containing 190 mg of active ingredient (E,E-8,10-Dodecadien-1-ol) were used as 1.000 pieces per hectare for all trees in the research plot. Double-dose pheromone dispensers were applied to the marginal rows on 3 sides of the orchard (Figure 2). The monitoring traps (each plot one piece, the tree height of 1.5 -2 m) (Figure 3) and dispensers were hung on the trees on 25.04.2008 and 04.05.2009. 5 dispensers hung in an orchard were weighed in order to determine the amount of pheromone released in weekly periods in 2008 and 2009.

The insecticides were used Spirodiclofen, propargite (for mites) and imidacloprid (for aphids-one time) in both MD and C plots (Table 1). Insecticides were not used for codling moth in both MD and C plots.



**Figure 2.** Pheromone dispenser



**Figure 3.** Codling moth monitoring trap

**Table 1.** Insecticides were used in experimental (mating disruption and control) plots in 2008-2009

Pests	Active Ingredient	Chemical Control Date
Aphids	Imidacloprid 350 g/l	5.6.2008
		6.6.2009
Red mites	Spirodiclofen 240 g/l	5.6.2008
		6.6.2009
	Propargite 570 g/l	2.7.2008
		10.7.2009

In the study, fruits were collected from 30 trees in the MD plot while 10 trees were sampled in the C plot. The fruits which fell onto the ground were counted in terms of whether they were

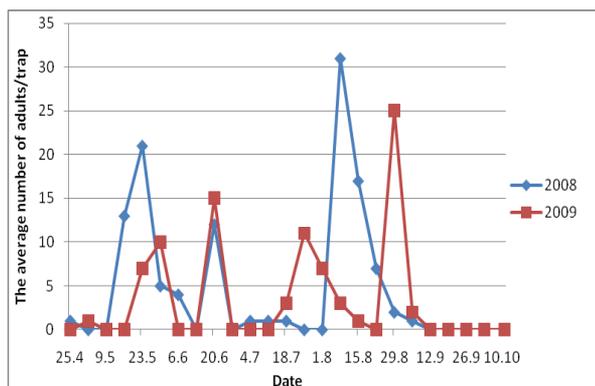
uninfected or infected once in two weeks from the second week of July to the harvest. In the harvest, all of fruits were counted from each tree and the rates of infected fruits among the fruits which fell onto the ground and after they had been collected were calculated.

### 3. Results and Discussion

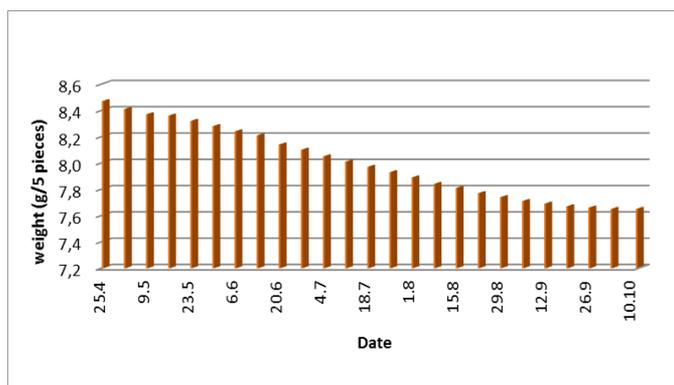
When examining release of the pheromone dispenser it showed that the release of pheromone dispenser decreased day by day and stopped on 3.10.2008 (Figure 4) and 12.10.2009 (Figure 5). This showed that the difference between 2008 and 2009 hanging the tree of the dispenser 9 days later than previous year, had thought to be cause of this result.

In the monitoring traps, an adult was captured in the MD plot on 08.08.2008, but no adult was captured in 2009. A total of

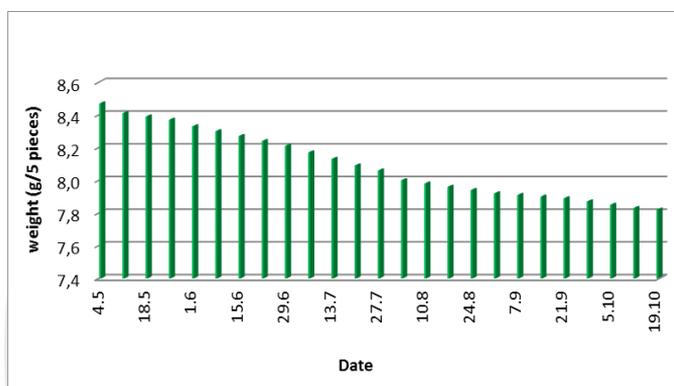
117 adults were captured in C plot trap for 2008. However, only 85 adults were captured in C plot trap for 2009 (Figure 6).



**Figure 6.** Population fluctuation of *Cydia pomonella* L. on traps between 2008 and 2009



**Figure 4.** Weekly variations in the weights of pheromone dispensers in 2008 (g/5 pieces)



**Figure 5.** Weekly variations in the weights of pheromone dispensers in 2009 (g/5 pieces)

In the MD plot, the percentage of infected fruits was 2.38% in 2008 and 13.50% in 2009. The average of two years regarding the rate of infected fruits was determined as 7.94%. In the C plot, the percentage of infected fruits was 72.05% in 2008 and 64.05% in 2009 (Table 2). In this study, the percentage of infestation fruit was  $7.94\% \pm 2.14$  (3.08% - 12.80%) in the MD plot, whereas damage rate was  $68.06\% \pm 2.18$  (63.12% - 73.00%) in the C plot. According to these results, statistically significant difference was found between infestation ratio based on t test analysis ( $P < 0.01$ , CV: 18%).

In the study, the percentage of infected apples was determined 7.94%. The fact that the percentage of apples infected by codling moth was 5-6% in the apple orchard, where mating disruption method was applied, means that it was successful (Anonymous, 2012). The high population and the presence of external infections were likely to explain why the per-

**Table 2.** Percentages of fruit infestation by codling moth larvae in the mating disruption (MD) and control (C) plots in 2008-2009

Year	Plot name	Repeat	Infected Fruit	Uninfected Fruit	Total Fruit	Infected Rate (%)
2008	C	1	1356	465	1821	74.46
	C	2	1254	552	1806	69.43
	C	3	1078	406	1484	72.64
	C	4	1134	576	1710	66.31
	C	5	1341	389	1730	77.51
	Mean					72.07
	MD	1	44	1644	1688	2.60
	MD	2	62	1703	1765	3.51
	MD	3	24	1716	1740	1.37
	MD	4	22	1706	1728	1.27
	MD	5	50	1540	1590	3.14
Mean					2.38	
2009	C	1	1115	502	1617	8.95
	C	2	895	798	1693	52.86
	C	3	958	596	1554	61.64
	C	4	1256	579	1835	68.44
	C	5	1026	475	1501	68.35
	Mean					64.05
	MD	1	135	1253	1388	9.72
	MD	2	275	1207	1482	18.55
	MD	3	82	1124	1206	6.79
	MD	4	331	1573	1904	17.38
	MD	5	265	1497	1762	15.03
Mean					13.50	

centage of apples infected by codling moth reached 7.94%. Aydar et al. (2010) determined that the region, where the study was carried out, had a high codling moth density. In addition, the experimental area was surrounded by apple orchards on three sides and chemical control was implemented. Witzgall et al. (1997) stated that adult males migrating from the untreated orchards can fly over the top of the trees and in the margins of the orchard. The success of this technique depends on the isolation of the plots to be treated as well as to the homogeneous distribution of dispensers (Waldner, 1994; Chamillot, 1995). Likewise, Gut and Brunner (1998) reported that approximately 2/3 of the codling moth damage in 6 apple orchards, where they applied the mating disruption technique in Washington for three years, occurred in the 30-m marginal parts of the orchards (Thomson, 2001).

Mating disruption technique may need to be supported with insecticide applications in places

with a high population (Kovancı et al., 2010). Chamillot (1995) indicated the mating disruption technique and *Cydia pomonella* granulosis virus (CpGV) have been used together in Switzerland and Northern Italy since the 1990s. Chamillot and Pasquier (2003) stated that under the conditions in which the pest population is high, the mating disruption technique and the *Cydia pomonella* granulosis virus (CpGV) preparations might be used together (Kutinkova et al., 2008; Kutinkova et al., 2010). Becid (1997) noted that mating disruption should not be considered as an ordinary pest management because it is a promising method, which requires training to ensure its appropriate use.

#### 4. Conclusion

The ratio of average infestation fruit was determined 7.94% in plot used mating disruption technique and this ratio was slightly above the acceptable rate since the study was applied in small and non-isolated plot. Consequently, the results similar to the chemical management may be achieved when this technique applied in large area even if the codling moth population is high.

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