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## Comparison of Food-Based Synthetic Attractants for Capture of *Ceratitis capitata* (Diptera: Tephritidae) on Persimmon Fruits

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### ABSTRACT

The Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae), is an important pest on persimmon fruits in Turkey. The study was conducted in 2016-2018 to determine comparison of food-based synthetic attractants for capture of *Ceratitis capitata* on persimmon fruits in Dörtyol and Antakya districts of Hatay province. The Decis and Maxitrap traps baited with various attractants impregnated in paper handkerchief dispensers were used. As a result of two years of investigations, efficacy of various attractants varied in each of the sampling year. In 2016, the highest mean of *C. capitata* were observed by the combination of ammonium acetate + ammonium carbonate attractant traps, while the lowest mean of *C. capitata* was observed by a single of ammonium carbonate attractant traps. In 2018, the highest mean of *C. capitata* were observed by a single of ammonium carbonate and ammonium bicarbonate attractant traps, while the lowest mean of *C. capitata* was observed by the combination of ammonium acetate + trimethylamine + putrescine and ammonium acetate + trimethylamine + cadaverine attractant traps.

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## Introduction

Persimmon, *Diospyros* (Ebanaceae: Ebenales), is an important tropical and subtropical tree [1-3], widespread in Turkey where it comprise approximately 59.491 da with a total produce of 97.560 tons of fruit per annum, and Hatay province's share is 2.330 da and 3.458 tons [4]. The Mediterranean fruit fly (Medfly), *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae), is one of the most important fruit pests throughout the world [5-10]. The Medfly is a polyphagous tropical fruit fly, which attacks more than 350 botanical species [11,12]. The females lay eggs below the skin of the host fruits, which are destroyed by larval feeding [5-7,13]. The Medfly caused significant damages on persimmon fruits in Turkey [13,14,17]. The control program of medfly is based on applications of organophosphate insecticides that are mainly used foliage baiting and cover spraying methods [18]. However, the intensity of insecticide treatments for

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medfly has resulted in the development of resistant populations, harmful effects on human health, beneficial insects and non-target organisms [18-21]. Therefore, development of effective control methods as alternative to chemical control contains traps baited with female and male lures [22-23]. Traps baited with trimedlure and attractants are important tools for detection, monitoring and controlling of the *C. capitata* [13,15,17,24-30]. The trimedlure contained in Jackson traps, and McPhail traps baited with hydrolyzed protein were the primary detection tools used in medfly detection programmes [6,14,17,30-34]. Traps baited with lures are also continuously used to monitor and control population size and spread [15-17,24-26,30,35-36]. The purpose of the current study was to determine comparison of food-based synthetic attractants for capture of *Ceratitis capitata* (Diptera: Tephritidae) on persimmon fruits in Hatay province of Türkiye.

## **Material and Methods**

The studies were conducted in 2016-2018 to determine comparison of food-based synthetic attractants for capture of *Ceratitis capitata* (Diptera: Tephritidae) on persimmon fruits in Hatay province of Türkiye. The Decis type traps and the Maxitrap type traps are usually used for the control of *C. capitata* on various fruits in Türkiye. Therefore, two types traps were used in these studies. In the first year, a study was carried out with Decis type traps which has lateral holes and without bottom entry. In the second year, the study was conducted with Maxitrap type traps which has lateral holes as one-way entrances and invaginated hole in the bottom of the trap. A single and the combinations of two and three attractants, ammonium acetate (AA), ammonium carbonate (AC), ammonium bicarbonate (AB), trimethylamine (TMA), diaminoalkane (cadaverine) (C) and 1,4-diaminobutane (putrescine) (P), were used as synthetic food-based lures in the study (Table 1). An attractant or mixed attractants impregnated into paper handkerchiefs were used. Each of the paper handkerchief package (10x7.5 cm) had a 3-mm diameter hole and contained 25 g attractant or mixed of attractants, 2 ml of 10% propylene glycol to decrease water evaporation and 2 ml of 2% dichlorvos. In the first year, the study was conducted on persimmon orchards in Dörtyol district, which contains more persimmon trees than other persimmon orchard located in Antakya district. Therefore, in the first year, the study was conducted as randomized complete block design with 5 treatments and 10 replications. In the second year, the study was

conducted as randomized complete block design with 5 treatments and 5 replications. In both years, the treatment of ratios were also different to comparison of food-based synthetic attractants for capture of *C. capitata* on persimmon fruits. The distance between two traps was 4 m and the traps were placed at 1.5-2m high on southeastern side of the persimmon trees (1 trap per tree) on 29 June 2016 and 27 August 2018. Attractant and propylene glycol and dichlorvos in the traps were replaced with the new ones in every 45 days. After harvesting of persimmon fruits, traps were removed on 10 November 2016 and 25 November 2018. In addition, they brought to the laboratory and captured adults of *C. capitata* were counted. All data were analyzed by analysis of variance (ANOVA) with using the SAS software and means were separated by using the Least Significant Difference (LSD) Multiple Comparison Tests ( $P < 0.05$ ) [37].

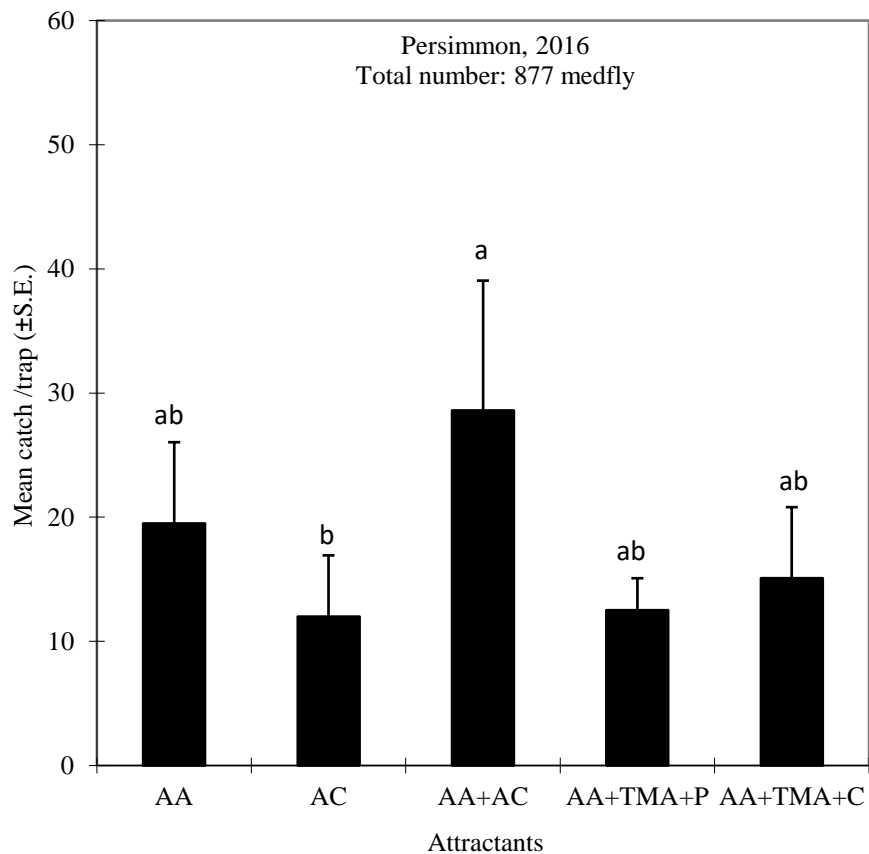
**Table 1** Attractants used at persimmon orchards in Dörtyol and Antakya districts of Hatay province.

Treatments (Lures) <sup>a</sup>	2016	2018
	Lures (gr)/trap <sup>z</sup>	Lures (gr)/trap <sup>z</sup>
Ammonium acetate	0.42	7.5
Ammonium carbonate	0.42	7.5
Ammonium bicarbonate	---	7.5
Ammonium acetate+Ammonium carbonate	0.42+0.42	---
Ammonium acetate +Trimethylamine+Putrescine	0.42+0.13+0.01	7.5+3.16+0.05
Ammonium acetate+Trimethylamine+Cadaverine	0.42+0.13+0.01	7.5+3.16+0.05

<sup>a</sup>Lures abbreviations: Ammonium acetate (AA), Ammonium carbonate (AC), Ammonium bicarbonate (AB), Ammonium acetate+Ammonium carbonate (AA+AC), Ammonium acetate + Trimethylamine + Putrescine (AA+TMA+P), Ammonium acetate+ Trimethylamine +Cadaverine (AA+TMA+C). <sup>z</sup>Putrescine and Cadaverine used as (mg) and rest of the treatments (lures) used as (gr).

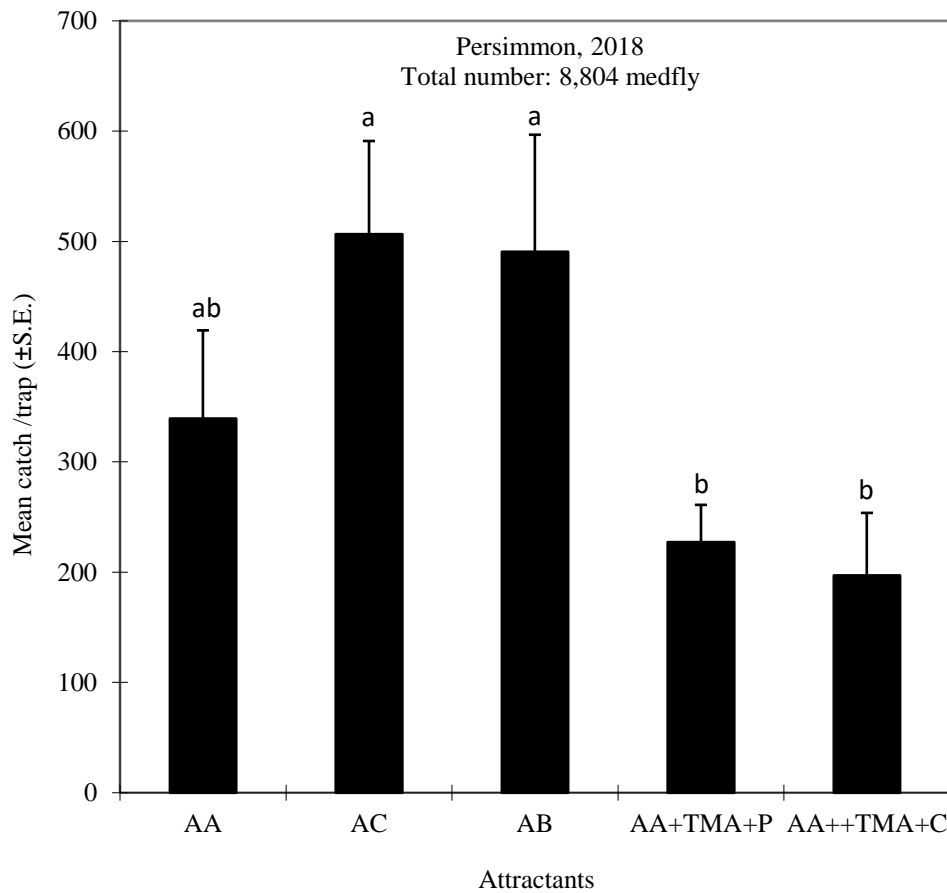
## Results and Discussion

A comparison of food-based synthetic attractants for capture of *C. capitata* on persimmon fruits varied in each of the sampling year. In the first year, a total of 877 *C. capitata* adults were caught by food-based synthetic attractants traps. The highest mean of *C. capitata* were caught by the combination of ammonium acetate + ammonium carbonate attractant traps ( $F=0,98$ ;  $P=0,4864$ ) (Figure 1).



**Fig 1** Mean ( $\pm$ SE) catches of medfly adults traps baited with attractants (29 June-10 November, 2016) at persimmon orchard in Dörtyol district. Different letters above bars indicate significant differences according to Least Significant Difference (LSD) ( $P < 0.05$ ).

The lowest mean of *C. capitata* was caught by a single of ammonium carbonate attractant traps. In the second year, a total of 8,804 *C. capitata* adults were caught by attractant traps. The highest mean of *C. capitata* were caught by a single of ammonium carbonate and ammonium bicarbonate attractant traps ( $F=1.58$ ;  $P=0,2073$ ) (Figure 2). The lowest mean of *C. capitata* was caught by the combination of ammonium acetate + Trimethylamine + putrescine and ammonium acetate + Trimethylamine + Cadaverine attractant traps.



**Fig 2** Mean ( $\pm$ SE) catches of medfly adults traps baited with attractants (27 August-25 November, 2018) at persimmon orchard in Antakya district. Different letters above bars indicate significant differences according to Least Significant Difference (LSD) ( $P < 0.05$ ).

Several studies have been conducted to evaluate efficacy of various attractant such as a single of ammonium carbonate for females [15-17,30,38], a different concentrations of ammonium acetate [15,39,40], the combination of ammonium acetate + putrescine [15-17,30,41], ammonium acetate + trimethylamine + putrescine [15,17,30,36,42-45], ammonium acetate + trimethylamine + cadaverine [15-17,24-30] were used for *C. capitata*. Moreover, the food-based baits of diammonium phosphate caught significant number of *C. capitata* [15-17,30,40-46] and the high number of nontarget insects [25]. Previous studies were conducted by Çalıklı (28) to control *C. capitata* with various attractants on pomegranate fruit. In the first year, a total of 2,789 *C. capitata* adults were caught by attractant traps at the ‘Katırbaşı’ pomegranate orchard. The highest mean of *C. capitata* were caught by the combination of ammonium acetate + ammonium carbonate attractant traps. In the second year, a total of 7,787 *C. capitata*

adults were caught by attractant traps at the ‘Hicaz’ pomegranate orchard. The highest mean of male *C. capitata* was caught by the combination of ammonium acetate + ammonium bicarbonate attractant traps, while the female was caught by the combination of ammonium acetate + ammonium carbonate attractant traps. Moreover, previous studies were conducted by Demirel et al. (15) to evaluate effectiveness of various attractants to *C. capitata* on pomegranate fruits. In the first year, a total of 6,444 medfly adults were caught by attractant traps at the ‘Hicaz’ pomegranate and the highest mean of catches were caught by the combination of ammonium acetate + ammonium bicarbonate attractant traps. The lowest mean of catches were caught by the combination of ammonium bicarbonate + trimethylamine + putrescine, ammonium carbonate + trimethylamine + putrescine and ammonium acetate+ammonium bicarbonate + putrescine, single of ammonium carbonate, ammonium bicarbonate and diammonium phosphate attractant traps. In the second year, a total of 5482 medfly adults were caught by attractant traps at the ‘Katırbaşı’ pomegranate and the highest mean of catches were caught by the combination of ammonium acetate + trimethylamine + diaminoalkane (cadaverine) attractant traps. The lowest mean of catches were caught by the combination of ammonium acetate + trimethylamine + putrescine attractant traps.

## **Conclusion**

The present study was conducted by traps baited with various attractants to determine comparison of food-based synthetic attractants for capture of *C. capitata* on persimmon fruits in Hatay province of Turkey. In the first year, the highest mean of *C. capitata* was observed by the combination of ammonium acetate + ammonium carbonate attractant traps. In the second year, the highest mean of *C. capitata* was observed by a single of ammonium carbonate and ammonium bicarbonate attractant traps.

## **Abbreviations**

Medfly: Mediterranean fruit fly, AA: Ammonium acetate, AC: Ammonium carbonate, AB: Ammonium bicarbonate, AA+AC: Ammonium acetate+Ammonium carbonate, AA+TMA+P: Ammonium acetate + Trimethylamine + Putrescine, AA+TMA+C: Ammonium acetate+ Trimethylamine +Cadaverine

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## **Data Availability statement**

The author confirms that the data supporting this study are cited in the article.

### Compliance with ethical standards

#### Conflict of interest

The authors declare no conflict of interest.

#### Ethical standards

The study is proper with ethical standards.

#### Authors' contributions

In these studies were carried out by myself at at persimmon orchards located in Dörtüol and Antakya district of Hatay. In addition, the article was organized and finalized by myself.

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