Evaluation of mass trapping for control of Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) in Satsuma mandarin in Hatay province of Turkey

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***Abstract*—** *The Mediterranean fruit fly (Medfly), Ceratitis capitata (Wiedemann) (Diptera: Tephritidae), is one of the most important pests of citrus in Turkey. The objective of this study was to evaluate mass trapping for the control of Medfly in Satsuma mandarin in Hatay province of Turkey. The studies were conducted in 2011-2012 using eostrap® invaginada traps baited with % 95 Trimedlure impregnated in a polymeric plug-type dispenser. In the first year, 48 traps per 0.7 ha were placed in an experimental site from 1st August to December. In the second year, 23 traps per 0.7 ha were placed in the same site from 14 August to December. After two years of the study, the population density of medfly varied in each of the sampling year. In the first year, a total of 8968 medfly adults were caught by traps. The largest mean of catches per trap were recorded on 31 October (64.21), followed by 24 October (31.29), 17 October (22.48), 7 November (20.64), 3 October (17.60) and 10 October (16.71). In the second year, a total of 1307 medfly adults were caught by traps. The largest mean of the catches per trap were recorded on 25 September (7.35), followed by 13 November (5.83), 6 November (5.52), 18 September (5.43) and 30 October (4.26), respectively. The percentages of damage rates of medfly observed in both years. The damage rates of Medfly were 10.91 and 8.56 % in 2011 and 2012, respectively. In conclusion, the population density of medfly on satsuma mandarin increased in September and October due to high temperature. The mass trapping was not enough to control medfly on satsuma mandarin. Therefore, the mass trapping should be used with pesticides to decrease the population density of medfly during September and October in Hatay province of Turkey.*

Keywords*— *Medfly, trimedlure, traps, satsuma mandarin, Turkey.

I. INTRODUCTION

Satsuma mandarin, *Citrus unshiu* Marc., (Rutaceae: Sapindales) is one of the main cultivated *Citrus* variety in Turkey. Satsuma mandarin production is consisting of approximately 23,413.1 ha with a total produce of 795.050 tons of fruit per annum in Turkey, and Hatay province's share is 10,466.1 ha and 402.601 tons [1]. The Mediterranean fruit fly (Medfly), *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) is the most destructive pest among economically important fruit fly species [2,3]. The medfly is a highly adaptive polyphagous tropical fruit fly attacking more than three hundred and fifty plant species [4,5]. The female flies lay eggs below the skin of fruits which are destroyed by larval feeding [6].

Protein bait sprays mixed with malathion or low toxicity insecticides, spinosad, lambda-cyhalothrin are successfully used to control medfly populations [7,8]. Traps baited with trimedlure are important tools for detection, monitoring and controlling of the medfly [2]. The mass trapping has proved to be effective in suppression of the Medfly and advantage of reduced environmental impact when comparing with toxic bait sprays [9,10]. In addition, mass trapping has been developed in several countries using traps baited with trimedlure, hydrolysed proteins or food-based attractants [11,12,13, 14, 15, 16,17]. This method has been conducted on different fruit trees like peach [18], cherimoya [19], citrus [14,20,21], fig [22], persimmon and coffee [7] and apple[23]. The purpose of the current study was to evaluate mass trapping for the control of Medfly in Satsuma mandarin in Hatay province of Turkey.

II. MATERIALS AND METHODS

The study was conducted in 2011-2102 at a satsuma mandarin orchard in Hatay province of Turkey. The study was carried out using the Eostrap® invaginada traps (Sanidad Agricola Econex, Santomera, Murcia, Spain) baited with % 95 Trimedlure, (formulated in a polymeric plug-type dispenser) (Sanidad Agricola Econex, Santomera, Murcia, Spain) and dichlorvos or 2.2- dichlorovinyl dimethyl phosphate (DDVP) tablet (Sanidad Agricola Econex, Santomera, Murcia, Spain).

In the first year, the study was conducted with 48 traps/0.7 ha and placed in the experimental site from 1st August to December. In the second year, the study was carried out with 23 traps/0.7 ha and placed in the same site from 14th August to December. The traps were placed 1.5 m above ground and checked weekly, trapped medfly adults were counted and removed from the traps. The trimedlure and DDVP tablet in traps were replaced with the new ones in every 90 days. The fruit damage assessment was measured by the percentage of medfly punctures during the harvest. For this purpose, all fruits from satsuma mandarin orchard were harvested and checked for medfly punctures and the percentage of the infested fruits were measured as weight at the packaging house.

III. RESULTS

The population density of *C. capitata* varied in each of the sampling year. In the first year, the mass trapping was conducted with 48 traps/0.7 ha in satsuma mandarin orchard and a total of 8968 medfly adults were caught by traps (Figure 1). The first adults were caught by the traps on 8 August, and the population density of this pest was gradually low from 8 August through 12 September, while it increased from 19 September to 31 October. The largest mean of catches per trap were recorded on 31 October (64.21), followed by 24 October (31.29), 17 October (22.48), 7 November (20.64), 3 October (17.60) and 10 October (16.71).

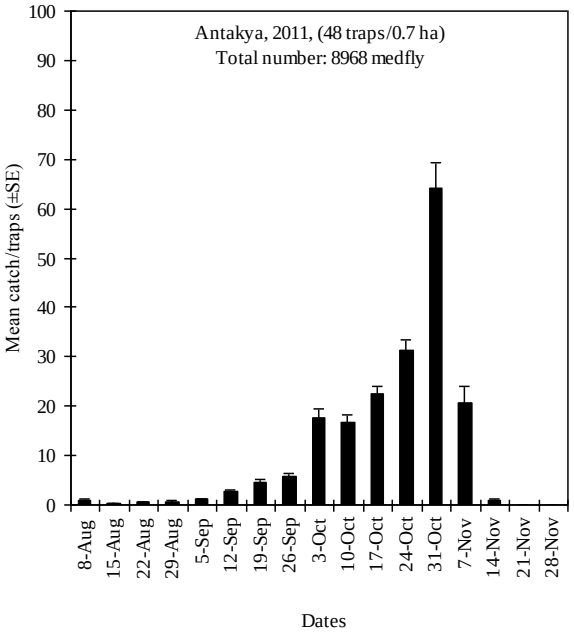

FIGURE 1. MEAN (±SE) CATCHES OF MEDFLY ADULTS IN TRAPS BAITED WITH TRIMEDLURE (1AUGUST–28 NOVEMBER, 2011) AT SATSUMA MANDARIN ORCHARD IN ANTAKYA DISTRICT

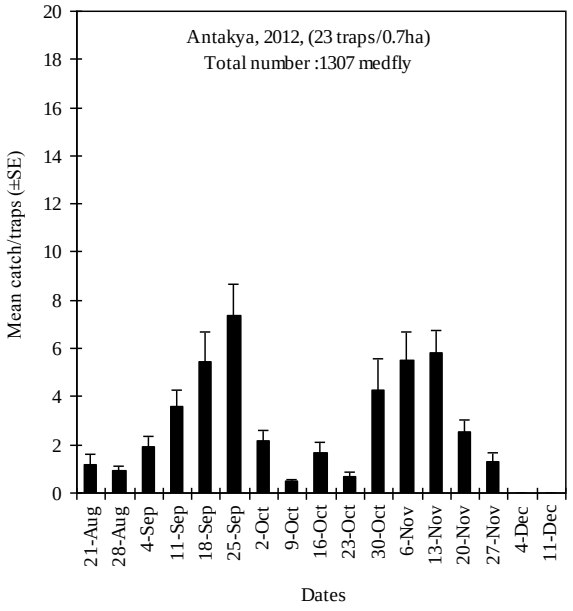

FIGURE 2. MEAN (±SE) CATCHES OF MEDFLY ADULTS IN TRAPS BAITED WITH TRIMEDLURE (15 AUGUST–11 DECEMBER, 2012) AT SATSUMA MANDARIN ORCHARD IN ANTAKYA DISTRICT

In the second year, the mass trapping was conducted with 23 traps/ha at the same orchard and a total of 1307 medfly adults were caught by traps (Figure 2). The population density of medfly was very low comparing with previous year. The first adults were caught by the traps on 21 August, and the population density of this pest was significantly high from 4 September to 25 September and 30 October through 13 November and yet it was significanly low on 2-23 October due to heavy rain in the sampling orchard. The largest mean of catches per traps were recorded on 25 September (7.35), followed by 13 November (5.83), 6 November (5.52), 18 September (5.43) and 30 October (4.26).

The percentage of the total caught over this period varied for each of the sampling month in both years. The distribution of the total caught of this pest according to the months as percentages were 1.17 (August), 6.55 (September), 71.32 (October) and 10.14 (November) in 2011 (Figure 3). These percentages were 3.67 (August), 32.13 (September), 16.37 (October) and 26.70 (December) in 2012 (Figure 4). The percentages of damage rates of medfly observed in both years. The damage ratios of medfly were recorded at 10, 91 percent in 2011, and 8, 56 percent in 2012 (Figure 5).

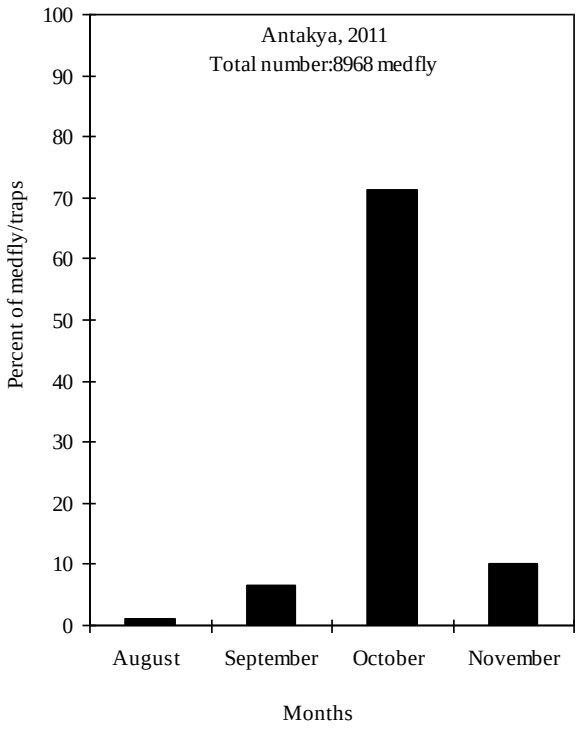

FIGURE 3. PERCENTAGE OF THE TOTAL MEDFLY ADULTS CAUGHT OVER THE SAMPLING PERIOD AT SATSUMA MANDARIN ORCHARD IN ANTAKYA DISTRICT.

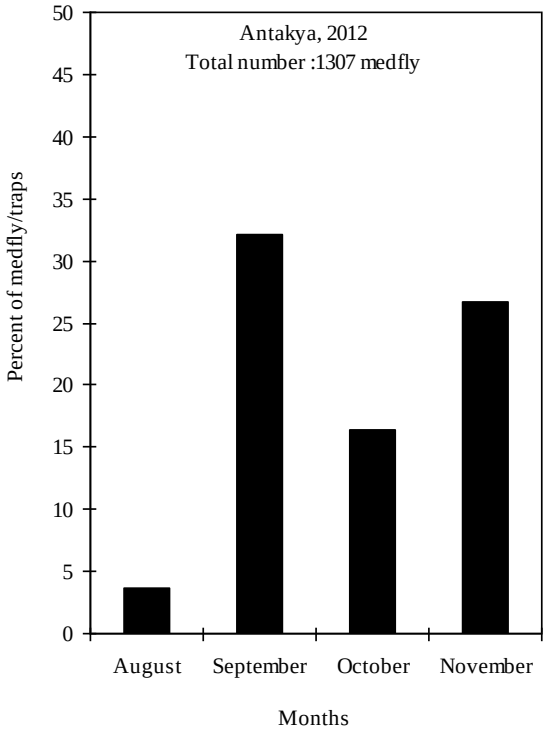

FIGURE 4. PERCENTAGE OF THE TOTAL MEDFLY ADULTS CAUGHT OVER THE SAMPLING PERIOD AT SATSUMA MANDARIN ORCHARD IN ANTAKYA DISTRICT.

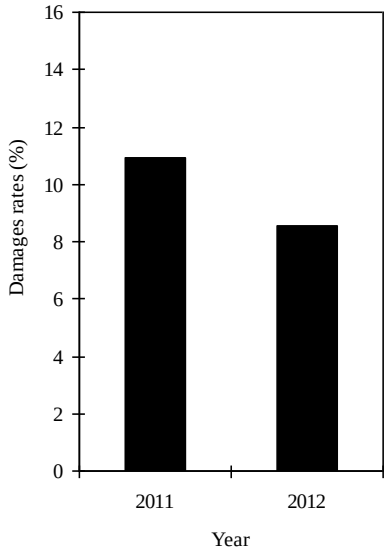

FIGURE 5. PERCENTAGE OF THE DAMAGED FRUITS BY MEDFLY IN SATSUMA MANDARIN ORCHARD IN ANTAKYA DISTRICT

IV. DISCUSSION

The mass trapping has shown significantly effective pest management tool for the Medfly and developed in several countries using traps baited with trimedlure, hydrolysed proteins or food-based attractants [2, 7, 9, 12, 13, 14, 15, 16, 17, 24, 25, 26, 27, 28, 29]. The synthetic food-based attractants, trimethylamine (TMA), ammonium acetate (AA) and putrescine (P) were the more appropriate for mass-trapping of the medfly [9, 11, 14, 15, 30,31, 32].

A various number of traps were used with mass trapping to control medfly on different host plants. Martinez-Ferrer et al. [10] suggested that 25 trap per ha (Maxitrap Model baited with Ferag. CC D TM® attractant) can be a good stand-alone control method against the Medfly in citrus groves in Spain. In addition, IAEA [2] suggested that 20-25 traps per ha density was required by using a mass trapping technique for medfly. Martinez-Ferrer et al. [10] reported that for the Clemenules variety, a 25 traps per ha were enough to capture adults flying within the grove and attract the foraging medflies, as low percentage of fruits were attacked. A number of researchers reported that if the population density of medfly increase, the number of trap per ha will be increased. Therefore, during September-October Medfly population is high, a 50 trap per ha density has been widely accepted as appropriate for citrus orchards [9,32,33,34,35,36,37]. Martinez-Ferrer et al. [10] reported that for the early-season varieties, 50 traps per ha captured as many adults as did 75 and 100 traps per ha, but not enough to diminish the adult medflies foraging in the grove under accepted levels.

Several studies were conducted by many researchers to evaluate the population density of medfly on various host plants. The present results indicated that the population density of medfly was high in September and October in both year. Our results are similar to those of [10,38,39] reported that the population density of medfly was significantly high in September and October due to high temperatures in citrus- producing area.

The percentages damage ratios of medfly varied on different host plants. Martinez-Ferrer *et al.* [37] found that on early-season varieties (Loretina and Marisol), mass trapping at a density of 50 Maxitrap® (Probodelt®) traps/ha baited with Ferag CC D TM® (SEDQ) and chemical treatments with Malafin® (malathion) or SpintorCebo® (spinosad) of the entire groves or the perimeter, can protect well the fruits from the Medfly attack as <2% were damaged in the harvest. However, on the mid-season variety (Clemenules), the adult population decline, and the number of traps could be lowered to only 25/ha and this tactic applied alone was efficient enough to obtain less than 0.5% of punctured fruits. Boulahia- Kheder *et al.* [40] reported that combination of 4 aerial spinosad sprays, sanitation and female mass trapping with Moskisan® + Biolure® Unipack, the damage on Navel oranges reached only 5% at harvest. However, Boulahia-Kheder et al.[41] reported that mass trapping as a single technique it wasn't enough to protect the Navel oranges with more than 30% of damaged fruits at the harvest.

V. CONCLUSION

The present study was conducted by traps baited with trimedlure to evaluate of mass trapping for the control of Medfly in Satsuma mandarin in Hatay province of Turkey. As a result of two-year investigations, the population density of this pest varied in each of the sampling year. In the first year, 48 trap per 0.7 ha were used with mass trapping to control of the medfly. A significant number of medfly were caught by traps and yet the medfly caused significant damages on satsuma mandarin due to high population density in September and October. In the second year, 23 trap per 0.7 ha were used with mass trapping to control of this pest. The population density of medfly was significantly low comparing with that of the previous year. However, the mass trapping was not enough to control this pest because of high population density

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