

MONITORING OF FRUIT FLY PESTS IN COMMERCIAL CITRUS ORCHARDS: TEMPORAL PATTERNS OF MALE AND FEMALE CATCHES

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Efficacy of trapping systems for monitoring of Afrotropical fruit flies]

Abstract

In commercial citrus orchards, both male-biased and female-biased trapping systems are recommended for monitoring of fruit fly (Diptera: Tephritidae) pest populations. A study was conducted on the Mediterranean fruit fly [(Medfly), *Ceratitis capitata* (Wiedemann)], and the Oriental fruit fly, *Bactrocera dorsalis* (Hendel), in citrus orchards in the northern areas of South Africa. This was done to determine the seasonal fluctuations of populations of males of these species depicted by male-lure baited traps, and populations of females of these species depicted by traps baited with food-based attractants, which are female biased. For both species, there were more male than female catches throughout the year; and male catches preceded female catches. Female catches were generally higher during citrus ripening times. These temporal patterns of catches suggest that monitoring data from male biased trapping systems could be early indicators of the levels of fruit fly populations in the area, whilst monitoring data from female biased trapping systems would be indicative of the risk of fruit fly infestation.

Introduction

In commercial citrus orchards, monitoring of males and females of fruit fly (Diptera: Tephritidae) pests, using attractant-based traps, is recommended as part of fruit fly management. Male lures, which are species-specific and are used to track male populations, are also used to track female populations of several fruit fly species (IAEA 2013). Fruit fly monitoring data collected are used to determine whether fruit fly control methods used in orchards are effective. In order to guide growers as to how to measure the efficacy level of fruit fly control being applied in citrus orchards, threshold levels of male and female catches were established for specific trapping systems.

It is well known that catches of males and females of fruit fly pests fluctuate naturally across time in an area. Differences in patterns of catches of males and females of fruit flies have been attributed to

differences in their resource foraging behaviour (PAPADOPOULOS et al. 2003; PAPADOPOULOS et al. 2001). Females in need of oviposition sites might be more attracted to ripening fruit, while males might disperse in an area in search of other resources such as food and mates. An understanding of the dynamics of male and female populations of fruit flies in citrus orchards is useful in understanding trapping data used for decision making.

In this study, we determined the seasonal fluctuations of trap catches of males and females of the Mediterranean fruit fly (Medfly), *Ceratitis capitata* (Wiedemann) and the Oriental fruit fly, *Bactrocera dorsalis* (Hendel), across one year in citrus orchards in the northern areas of South Africa.

Materials and methods

Study sites

Studies were carried out in four selected commercial citrus orchards in two of the northern provinces of South Africa: Limpopo and Mpumalanga. In the commercial orchards, different citrus types were cultivated with the dominant citrus species being sweet orange, *Citrus sinensis* (L.) Osbeck. The study was carried out for one year between September 2014 and October 2015. The hotter and wetter months were between December 2014 and March 2015 in all sites.

Trapping systems

For monitoring of Oriental fruit fly males, the Moroccan bucket traps baited with the male lure, methyl eugenol, were used (Fig. 1A). For monitoring of Medfly males, Sensus bucket traps baited with the male lure - trimedlure were used (Fig. 1B). Chempac Bucket traps baited separately with food-based attractants [3-component Biolure (Fig. 1C) and Questlure] were used to monitor female populations of the two fruit fly species. Each trap contained a Dichlorvos strip for killing attracted flies.

Trapping layout

In each commercial orchard, the four trap/attractant combina-

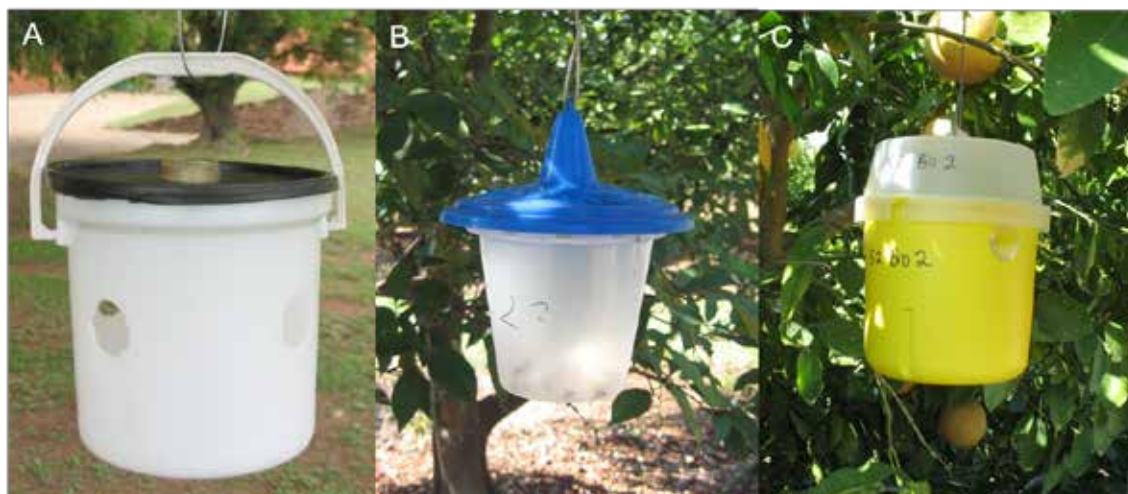


Figure 1. Traps used for studying seasonal phenology of male and with 3-component Biolure for monitoring of females of both species (C).

tions were allocated at random in each of three randomly selected rows within the orchard, which represented three sampling units of each attractant trap combination. Distance between the rows was approximately 35 m (every 5th row), and distance between the traps within the row was approximately 30 m (every 10th tree).

Trap servicing and specimen collections

Traps were checked for fruit flies and emptied on a fortnightly basis until February 2015 and on a monthly basis thereafter. Specimens collected in traps were emptied in labelled vials. Traps were rotated within each row or line after every check. All attractants and Dichlorvos were replaced after four weeks. Flies collected were identified to species and sex at the Citrus Research International (CRI) laboratories in Nelspruit, South Africa.

Data analysis

For each trap/ attractant combination, data for the targeted species and sex were summarised as flies per trap per day for each trapping month. Catches in each trap in each orchard were converted to catches per day by dividing the total catches over the number of exposure days. Catches were then averaged over all traps in all orchards for each trap/ attractant combination.

Results

For both fruit fly species, male catches in male-lure baited traps were higher than catches of females in traps baited with food-based attractant across most of the trapping period (Fig. 2 and Fig. 3).

The peaks of female and male populations of Oriental fruit fly occurred between January and

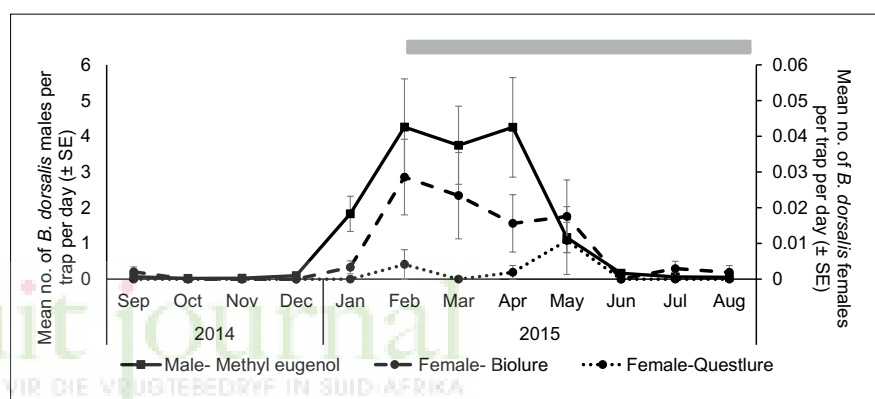


Figure 2. Seasonality of catches of *B. dorsalis* males in methyl eugenol and *B. dorsalis* females in 3-component Biolure and Questlure traps in commercial citrus orchards in Limpopo and Mpumalanga provinces in South Africa, between September 2014 and August 2015. The grey bar on top of the chart represents the general citrus ripening times in study sites.

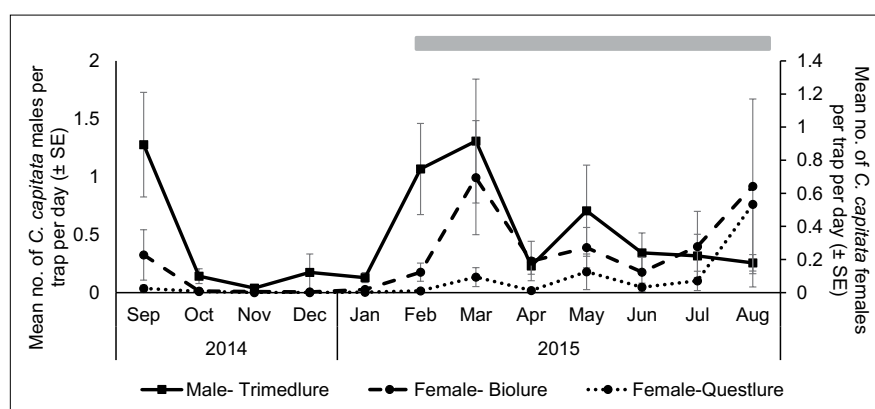


Figure 3. Seasonality of catches of *C. capitata* males in trimedlure baited traps and *C. capitata* females in 3-component Biolure and Questlure baited traps in commercial citrus orchards in Limpopo and Mpumalanga provinces in South Africa between September 2014 and August 2015. The grey bar on top of the chart represents the general citrus ripening times in study sites.

May in commercial citrus orchards (Fig. 2) which coincided with the ripening of citrus in commercial orchards. Catches of males of the Oriental fruit fly in methyl eugenol traps preceded catches of conspecific females in 3-component Biolure and Questlure traps (Fig. 2).

For Medfly in citrus orchards, catches of Medfly females were higher in traps baited with food-based attractants between March and August. Similar to Oriental fruit fly, catches of Medfly males preceded catches of Medfly females. Catches of Medfly males were more or less continuous throughout the year in trimedlure traps in commercial orchards, with distinct peaks in February, March and September (Fig. 3).

Discussion

The higher catches of male fruit flies in male lure-baited traps compared to female fruit flies in traps baited with food-based attractants in the orchards is more likely a function of efficiency of attractants than a reflection of higher abundance of males versus females. In mark-release-recapture trials, where equal numbers of males and females of Medfly were released, recaptures of males in traps baited with capilure (containing trimedlure) were found to be higher than recaptures of females in traps baited with the food-based attractant, Questlure (GROUT et al. 2011). Methyl eugenol is a stronger male lure for Oriental fruit fly males than trimedlure is for Medfly males (MANOUKIS et al. 2015). Higher catches of Oriental fruit fly males in methyl eugenol-baited traps compared to catches of conspecific females in traps baited with food-based attractants are expected as such.

Here we found that for both Medfly and Oriental fruit fly, catches of males in male-lure based traps preceded catches of females in traps containing food-based attractants. This implies that male-lure based traps might be better early warning detection systems for these pests. Different patterns of catches of females and males in traps with food-based attractants and male lures, respectively, were observed for *C. capitata* in mixed deciduous orchards in Greece, where female catches in traps with food-based attractants (3-component Biolure) preceded male catches with trimedlure baited traps (PAPADOPOULOS et al. 2003; PAPADOPOULOS et al. 2001). The authors associated the differences in catches to changes in sex ratio of the fruit fly pest population in line with fruit ripening in these orchards, with females being the first ones captured in the commercial orchards, due to their attraction to ripening fruit. In studies conducted in Greece, *C. capitata* females

were also found to be more clustered around ripening fruit, while *C. capitata* males were more randomly dispersed across the orchards (PAPADOPOULOS et al. 2003). In our study, we also found that catches of female fruit flies in citrus orchards were higher during the citrus ripening period.

In the citrus industry of southern Africa, both male-lure based traps and traps baited with food-attractants are recommended for monitoring of fruit fly pests (MANRAKHAN 2016). The results obtained in this study support the inclusion of both trapping systems in monitoring fruit fly pest levels in orchards as the male-lure based trapping systems would provide an early indication of the population levels of fruit fly pests. The trapping systems using food-based attractants would be more indicative of the potential threat of female fruit fly pests as the fruit ripens.

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