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Novel approaches to gain insights in early detection of low *Ceratitis capitata* populations

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Background: The Mediterranean fruit fly (medfly), *Ceratitis capitata* (Diptera: Tephritidae), threatens the fruit production and trading globally. Despite direct damage in fruit, the presence of medfly in an area may impede fruit trading and impose strict quarantine regulations. Detection of a low-density population of medfly (at early stages of invasion or early in the season in temperate areas) is challenging. In the frameworks of the Horizon 2020 funded project FF-IPM "In-silico boosted, pest prevention and off-season focused IPM against new and emerging fruit flies" we attempted to address the early detection of medfly populations following novel release recapture studies in central Greece, and elaborative trapping efforts in an area that is marginal for the establishment of the pest in northern Greece.

Methods*:* Trapping stations consisted of one plastic McPhail and one Jackson trap baited with food attractant and trimedlure respectively, were established in both experimental approaches. Five trapping stations were deployed in each of four plots (one km^2) that had been established in suburban areas of central Greece. Wildish adults, marked with a fluorescent dye were released from a randomly chosen spot within each plot at two population densities. Recapture efforts lasted at least a month. To detect wild medfly populations in a marginal for its establishment area, the main deciduous fruit production area central Macedonia, Greece, during two growing seasons, the area divided in 50 plots (25 km^2 each) and 25 of them were randomly selected to establish trapping stations. Traps were checked every week during the fruit growing season.

Results: No adults were detected from the low population density (10 males and 10 females per one km2). At the increased density (150 males and 150 females) a proportion of 1.2% adults were recaptured consisting mainly of males (72% of the total captured). Proportion of traps detecting adults was 35%. Recapture rates seems to be independent of the distance between the release and the capture points. The first adults detected at the end of July and at the end of August during 2021 and 2022 respectively, in Macedonia. By the end of both growing seasons 27 out of 37 trapping stations (72%) detected at least one adult. Females were 55% less likely to be detected than males.

Conclusion: Our results reveal that the probability of detecting adult medflies under low population densities is extremely low, even when a dense trapping grid of the best available traps are considered. Low density populations of medfly are scattered in central Macedonia, but the probability of detecting them before August is extremely low.

Keywords: Mediterranean fruit fly, detection efficacy, low- density, release- recapture, trapping, distribution