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Smart-Traps for Fruit Flies: Their Integration into Pest Management and Biosecurity

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Background: Smart-traps for fruit flies (i.e., traps aimed for real-time and remote monitoring of adult fruit flies) are being proposed and developed at a fast rate by many groups, and their applications in fruit fly pest management and surveillance is becoming a reality. Smart-traps are constituted by an electronic and communication system, and detect, count and classify fruit flies with the assistance of electronic sensors, such as optical, electromagnetic and acoustic. In general, most smart-traps proposed and developed for fruit flies utilize optical sensor, either to count flies through photo-interruption, or by obtaining high-resolution images that can be further analysed with image processing techniques. In addition, some currently commercialized smart-trap sense entering fruit flies into the trap with electrical sensors sustained by capacitors. During the last years, some of these smart-trap prototypes have been tested and used in fruit fly pest management research. More recently, some commercial companies are already providing fruit fly management services using smart-traps as a source of information on fruit fly pest levels in space and time for decision-making.

Methods: In our laboratory, we developed two proto-types of optical smart-traps for fruit flies:
(1) A yellow sticky-board e-trap conceived as a "universal" device for three species of fruit flies (*Bactrocera olea*, *Rhagoletis cerasi* and *Dacus ciliatus*), and based on their attraction to colour (yellow board)
(2) A McPhail E-trap that is combined with parapheromone attractants and aimed for surveillance of *Bactrocera* and *Ceratitis* species.
Their performance was, and is being, investigated under two projects: The accomplished *FruitFly Net* project and the ongoing *FF-IPM* (both supported by the EU). Besides testing the reliability of the traps and contrast them to conventional traps used to attract these fruit flies, we also tested their use for decision-making in extensive experiments under field conditions.

Results: The yellow-sticky-board e-trap prototypes provided good monitoring results with the three species of flies and environments, and the information served to implement and test developed Decision Support Systems (DSS) algorithms. In general, DSS provided good control of damage. The McPhail e-trap is currently being implemented and tested as part of a surveillance strategy for invasive and expanding fruit flies. Preliminary results suggest that they provide good early-warning alerts.

Conclusion: Smart-traps are proving to be valuable tools for fruit fly pest management. Their recent commercialization and integration into pest management is a proof of their value. It is expected that more effort and devices will be developed in the future, targeting and complementing other fruit fly management tools, such as SIT.

Keywords: electronic insect traps, *Bactrocera*, *Ceratitis*, Early Warning