IoT in agriculture: Advances on pest monitoring and control of two key-pest flies.

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Abstract

The implementation of any comprehensive treatment program concerning cultivation suffering from an entomological problem requires a set of actions related to the population dynamics of the target key-pest, the decision to be taken for spraying, and finally its application following precise scientific data and guides based on existing legislation in each country. Using conventional practices there are significant delays in the collection and analysis of field data, empirical, and/or intuitive decisions, weaknesses to guide the bayed spraying operators to correctly apply spraying in the cultivation, as well as problematic spraying recording. Nowadays, the frame transition to agriculture 4.0 and 5.0 provides greater attention to innovative approaches such as Artificial Intelligence (AI), Smart Farming (SF), Precision Agriculture (PA), Internet of Things (IoT) in farming, UAVs, and the use of big data. All these technologies are used to provide tools for monitoring operations through the extensive use of sensors in the field to collect information, automating, and analyzing approaches to elaborate them, and provide consultations to end farmers/producers for optimizing cultivation processes.

This contribution illustrates two smart applications for monitoring and controlling *Bactrocera oleae* and *Ceratitis capitata* key-pests. PA is used in the context of pests' e-monitoring, as well as to improve their control leading to more accurate information and a better understanding of their spatiotemporal distribution. The two developments require farm digitization using UAVs, specific DSS for each fruit fly, which create spraying (or risk) maps to make insecticidal treatments precise in time and space. Further, a module is developed, to guide the operator in the field during treatments as well as a web application that returns inputs and outputs to be visualized and managed.

To monitor the two key-pests two IoT devices (e-traps) of specific type have been developed that are based on real-time semi-automatic procedures. These are equipped with a camera that collects images of the insects glued on adhesive panel and sends them to the cloud to identify and count insect pests based on semi-automated procedures. Trials to automated procedures or locally identify the insect pests require processing that leads to excessive energy consumption.

In the agriculture domain, the above innovative technologies into integrated pest management (IPM) practices and systems help farmers to solve complex issues related also to crop production and provide them broad benefits, including a better control of agricultural processes to reduce production inputs, such as chemicals, and labor costs.

Keywords: IoT, agriculture 4.0 and 5.0, tephritids, IPM practices, electronic trap, DSS, spraying,