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SURVEILLANCE STRATEGIES FOR INVASIVE FRUIT FLY SPECIES

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Abstract: The deployment patterns of traps for surveillance and interception of alien fruit flies pests is a critically important factor in plant biosecurity. The optimal spatio-temporal deployment patterns strike a balance between increasing our probabilities of intercepting invading fruit fly pests before they become established and surveillance costs. Over the last 3 years, the ***FF-IPM*** project has been devising, developing and testing surveillance strategies for invading and expanding fruit flies. The strategy includes algorithms and models used for decision-making, and the development of a smart-trap aimed at providing early-warning alerts and tailored to capture *Bactrocera* species responsive to Methyl Eugenol (ME) and *Ceratitis* species attracted to Trimedlure and ME. The strategy also includes deployment tactics based on risk areas and derived from expert opinion.

Surveillance Strategy: 1) The aim of the strategy is to increase our probability of detecting incursions and providing early-warning alerts to initiate containment efforts. This is done by applying a decision-support-system (DSS) that sets activities based on outputs from climatic and population models and from landscape conditions. Activities include, among others, the initiation of surveillance in a region and deployment of smart and/or conventional traps in the landscape. 2) Optimization of the trap locations in space: This is currently being developed and is based on expert opinion on the risk level of landscape features, and on the application of different tactics that manage landscape risk differentially. This aspect is being explored currently, and the generation of deployment options is being automated. 3) Utilization of smart-traps ("electronic traps") to provide early warning alerts on interceptions and to reduce costs and efforts of surveillance in the future. Preliminary Results: 1) Smart-traps were developed and tested using two parapheromones: ME and Trimedlure. Images of the trapped flies were uploaded to an online database and analyzed with an automated feature recognition algorithm. Data were then fed into a web-mapping system and used as biofixes for population dynamic models for forecasting emerging risks. Data obtained can provide an early-warning alert. The "proof of concept" of the ***FF-IPM*** smart-trap and fruit fly classification algorithm is in the process of publication. 2) Optimization of trap deployment: Risk level of landscape objects has been determined using an expert's forum and a pairwise comparison matrix. Risk scores have been used to develop automatic trap deployment schemes in tested landscapes following 3 possible tactic options: (a) risk-driven, (b) effort-driven, and (c) space-driven. These options will be contrasted in several testing landscapes during the next 2 years. 3) The use of smart-traps in the 3 deployment tactics were tested in a preliminary study in South Africa on *Bactrocera dorsalis*. During the Spring and Summer of 2021-22 in the South Africa testing areas, the performance of smart-traps deployed using 3 tactics was compared to the stakeholder's actual deployment scheme in citrus and apple orchards, and in urban settings, using conventional traps. Results suggest that the smart traps in either of the 3 deployment tactics and different environments were able to provide early warning alerts of endemic *B. dorsalis*. More important, the performance of the strategy in "low prevalence" *B. dorsalis* regions was comparable to the stakeholder's surveillance schemes.

Key words: Smart-Trap, Surveillance, Monitoring, Early Warning, Trap-Deployment