Evaluation of Manual and Remote Monitoring Tools for Insect Pests of Agriculture and Forestry Importance

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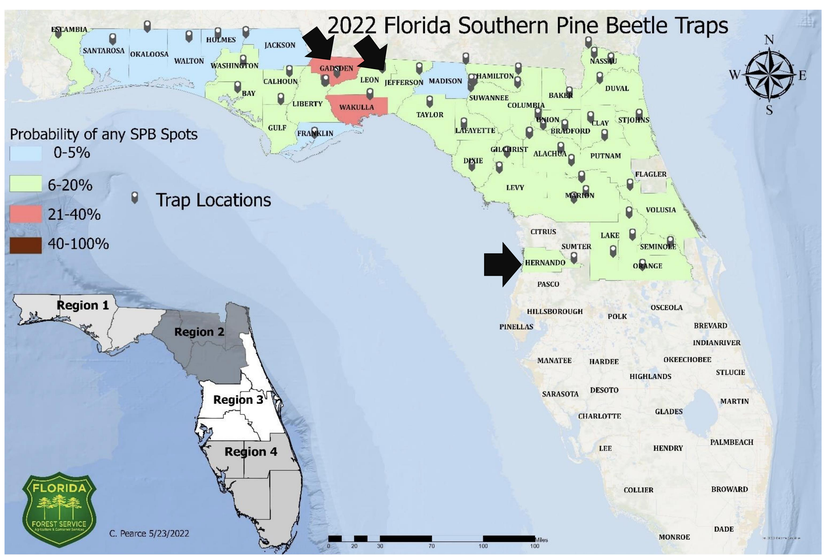
Abstract

Monitoring insect pests is an essential step to improve our knowledge and ability to manage serious insect pests in agriculture and forestry importance. There are numerous insect monitoring tools available, however, some of them work better than others. In recent years, automatic traps have been designed to capture and monitor many insect pests in open fields. In this study, we evaluated the effectiveness of automatic traps for remote monitoring of insect pests. The automatic traps are outfitted with cameras and connected to a specific app that updates data every 24 hours. Our preliminary findings suggest that these traps reduce the labor, time, and cost to monitor insect pests. In contrast, the conventional traps have many limitations; for example, these need service regularly, and data collection occurs at the site. The remote monitoring tools help to determine the level of infestation and facilitate evidence-based pest management decisions remotely. The current study was conducted in Hernando, Leon and Gadsden counties. Several conventual and automatic traps were installed in the field and evaluated for their application in agriculture and forestry.

Introduction

Insect pest monitoring is a critical pest management step in agriculture and forestry to determine the level of pest activity in specific areas. Numerous insect pests pose serious challenges to agriculture and forests. The high susceptibility of crops due to severe pests, timely pest monitoring and management can help minimize agriculture losses (Li et al., 2021). To manage pests, crop growers and foresters have used conventional insect trapping tools to monitor insect pests. Manual pest monitoring using baits, sticky traps, and panel traps for agriculture and forest pests is time-consuming, labor-intensive, and provides poor spatial and temporal resolution achievable by single operators (Preti et al., 2021a). With a more practical Integrated Pest Management approach, we can now monitor pest activity in every corner of the field with precise intelligence, astute reporting, and reliable forecasting remotely (Lima et al., 2020). This saves time, labor, and operational cost of insect monitoring. The major goal of this study was to see if automatic traps can be effectively used for selected pests of agriculture and forestry importance.

Insect monitoring traps are usually deployed in the open fields, natural & urban areas, and landscapes by the small farm growers, foresters, and regulatory pest mangers to detect and monitor serious insect pests.



Southern pine beetle trap locations and the probability of any (>0) SPB spots occurring in 2022 (USDA, FS). The arrows showing the counties surveyed.

Objectives

The following were the specific objectives of the study:

- To survey and monitor major insect pests of agriculture and forestry importance.
- To compare manual and automatic insect monitoring traps.
- To detect insect pests and record their presence or absence.

Materials and Methods

This study was conducted in the Fall of 2022 and Spring 2023 in Brooksville (Hernando County), Tallahassee (Leon County), and Quincy (Gadsden County). Several conventional traps and one type of automatic trap was deployed in the agriculture and pine forest areas in both localities. We used commercial pheromones for the diamondback moth and cucumber moth. For the pine beetles, we used a hand sanitizer (Purell ETOH 70% v/v). The monitoring traps included yellow sticky traps, delta traps, Lindgren funnel traps, and automatic traps (Trapview) with build-in camera, solar panel, and mini weather antenna. All of these traps used either pheromones or lures except the yellow sticky traps.

From the conventional traps the data were collected weekly, and traps were serviced every month. For the automatic traps, data was recorded remotely every 24 hrs. To see the signs and symptoms of infestation in trapping area, observations were made, and images were developed using a regular camera and microscopes. The insects collected were processed in the laboratory.

Pine beetles collected from Hernando County

Pine beetles collected from Leon County

Servicing the Lindgren funnel trap

Observing a pine trunk for beetles' infestation

An automatic trap installed in the field

Results and Discussion

The trap typically consists of two modules, the hardware and software. The hardware usually comprises a high-resolution camera, solar panel, and humidity sensors, a data transmission modem, and a battery. The software consists of an online repository where the captured images are kept and viewed and optional image analysis tools that automatically recognize and tally the captures (Preti et al., 2021b). The trap can exploit data transfer systems through wireless technology that can be managed electronically from a distance, limiting field visits. Adapting of image sensors to monitor insect pests has resulted in several practical advantages for small farm growers, foresters, and regulatory pest mangers.

The following are the advantage of camera-equipped remote monitoring traps:

- Save time, labor, and cost.
- Cover much bigger area/fields accurately for insect monitoring.
- Accurate and reliable recording of insects.
- Provides high-resolution images of insects and data sets.
- Field trip needed only to service the traps.
- Help to identify species accurately.
- Provide site specific weather information.

Signs and Symptoms of Pine Beetles Infestation

Infested pine tree dying due to pine beetles

Beetles reproducing in chamber

Pitch tubes and sawdust on the exterior bark of the tree

Galleries and tunnels of the pine beetle larvae

From left: A. Manual insect monitoring, B & C insect monitoring using conventional traps with yellow and white colors, and D. Automatic insect monitoring trap in open field conditions

Conclusion

The automation of insect pests monitoring has many advantages over conventional monitoring. These are easy to install, save labor, cost, and time. The only limitation these traps will have is that these work perfectly for the insects with pheromones or lures or baits available commercially, for example, cucumber moths, diamondback moths, and pine beetles. These will do better jobs for pest management if aggregation pheromones were available. Our study has demonstrated that automatic traps can be equally useful for trapping and monitoring insect pests in the agriculture and forestry settings. Further research is being conducted on other insect pests in north Florida.

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