AI & DRONE-DRIVEN SOLUTION TO IMPROVE CROP YIELD VIA PRECISE PEST CONTROL

Context / Problem

- Agriculture plays a vital role in food security and economic stability.
- However, pests and diseases pose significant threats to agricultural productivity.
  - Every year up to 40 percent of global crop production is lost due to plant pests and diseases [1].
  - Each year, these losses cost the global economy over USD 220 billion, and invasive insects at least USD 70 billion [1].
- Traditional methods of pest/disease control are often labor-intensive and inefficient leading to increased costs and environmental concerns [2].
- AI, and UAVs offer promising avenues for revolutionizing crop pest/disease control and increase yields. This makes it possible to identify illness symptoms before they manifest and recommend treatment plans [3].

Purpose and study area

1. Purpose

This paper aims to address the challenge of *Thaumatotibia* (Cryptophlebia) *leucotreta* (Meyrick) pest, which affects more than **35 kinds of plants** across **37 African countries** 4 (Figure 1) by leveraging artificial intelligence (AI) and drone technologies. This case study concerns specifically Thaumatotibia leucotreta pest management on mango crops.

AI algorithms can achieve high accuracy in identifying crop diseases from images captured by UAV [5].

> 35 plants

Host plants of Thaumatotibia leucotreta

Avocado	Cotton	Olive
Corn	Pomegranate	Peach
Sugarcane	Sorghum	Arabian coffee
Orange	Marula	Mango
Soursop	Custard apple	Roostetree
Kapoktree	Pineapple	Caper
Bushwillow	Pygmyweed	Diospyros
Sweet thorn	Okra	Rosemallow
Sour	Carambola	Macadamia nut
Khat	Mangosteen	Kola
Eggplant	Castor bean	Tea
Stopper	Guava	Stem fruit

> 37 plants

Global distribution of Thaumatotibia leucotreta

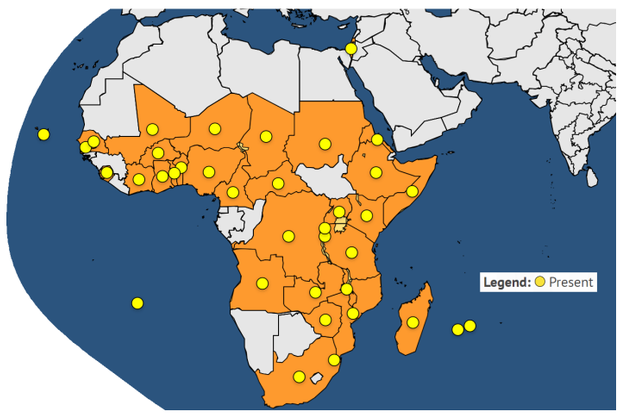

Figure 1: Global distribution and host plants of Thaumatotibia leucotreta

2. Study area

The study was conducted in Gaya city, in Niger (Long: 3.46° and Lat: 11.87) over 5,5 heactares, where GeoMinds Africa (formely known as Drone Service Niger) operates to support local farmers.

- **Climate condition**: Semi-arid climate with average annual rainfall of 600 to 800 mm
- **Crops**: millet, sorghum, maize, oranges, mangoes.

Method

3. Data source and processing

High-resolution images captured by the DJI Mavic 3 Multispectral RTK drone are preprocessed to create orthomosaics on mango crops (with a resolution of 2 cm/pixel over 5.5 hectares).

Figure 2: Agricultural data collection using DJI Mavic 3 DJI Mavic 3 Multispectral RTK

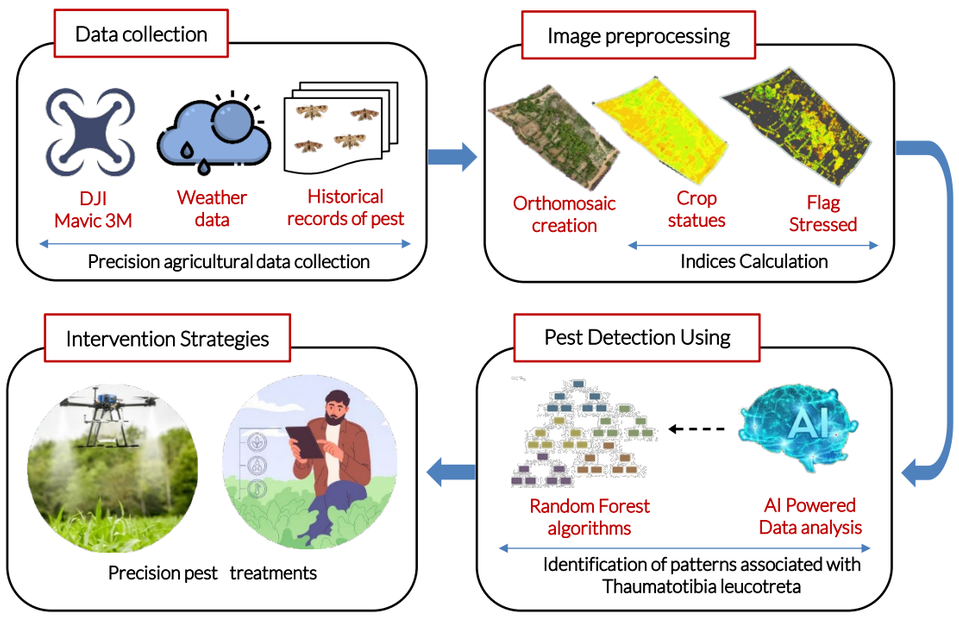

Figure 3: Thaumatotibia leucotreta pest detection process using ML and UAV

Result

The implementation of AI and drone technology in Gaya City yielded significant results in the management of Thaumatotibia leucotreta infestations on mango crops.

- High-resolution drone imagery enabled precise monitoring of crop health.
- Early detection of stressed areas using NDRE.
- Random Forest models demonstrated high accuracy with 85% precision.
- Georeferenced pest infestations allowed targeted interventions.
- Predictive analytics enhanced model capabilities, leading to a 20% reduction in crop losses and a 15% improvement in yields.
- Reduced pesticide usage by 25%, lowering environmental impact and costs.

Early detection and precise localization of pest outbreaks allow for timely interventions, minimizing crop damage and enhancing yield [3].

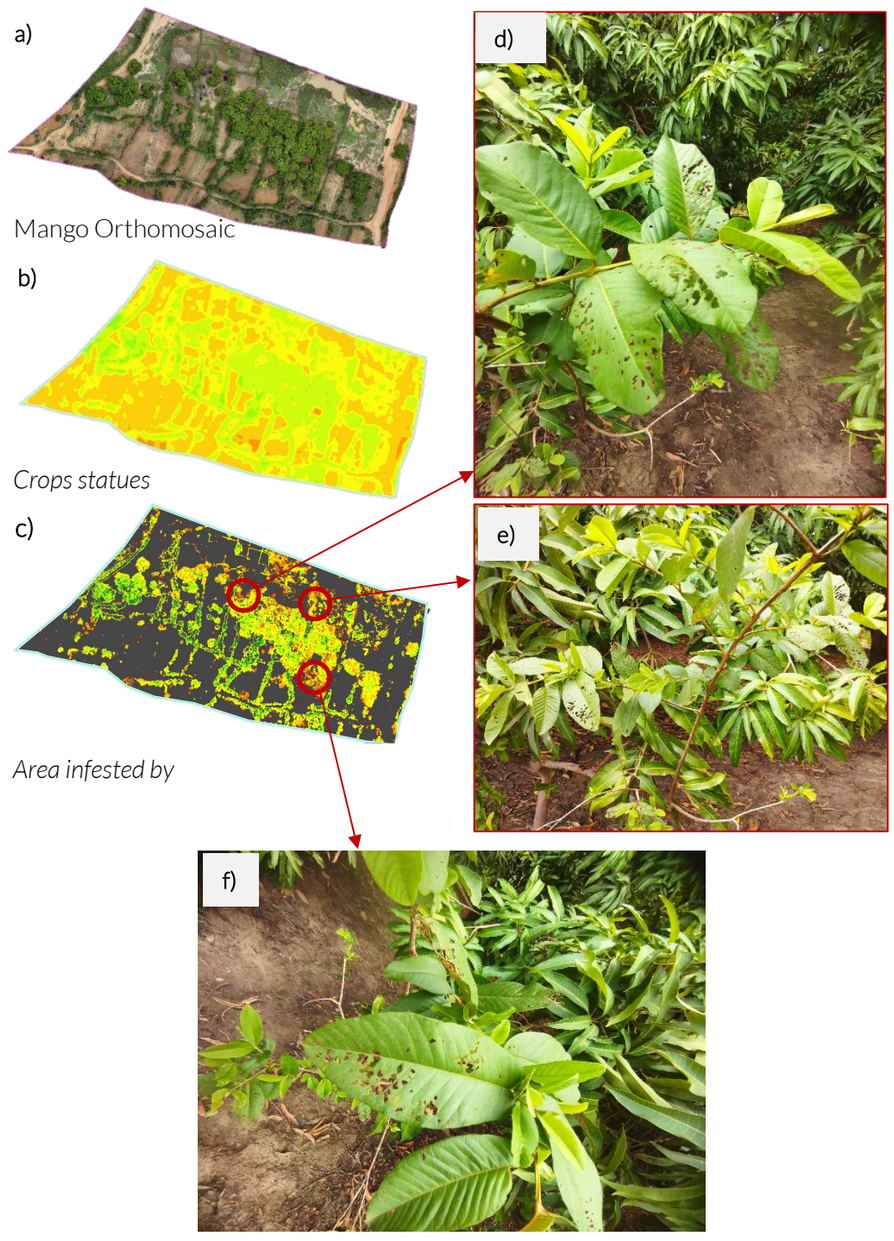

Figure 4: Thaumatotibia leucotreta infestations on mango crops

Discussion

The results highlight the potential of random forest algorithm and drone technologies in transforming of Thaumatotibia leucotreta pest management practices.

- High accuracy of Random Forest models highlights efficacy in agricultural applications.
- Early detection and precise localization of pest outbreaks minimize crop damage and enhance yield.
- Integration of technology fosters resilient farming systems and empowers local farmers.
- Future research should focus on refining technologies and expanding applications to other crops and regions.
- Partnerships between technology providers, agricultural organizations, and governments are essential.

References

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